SAND2007-4363P

Vertical Lifting Fixtures

SE and PE Boxes

March 8, 2007

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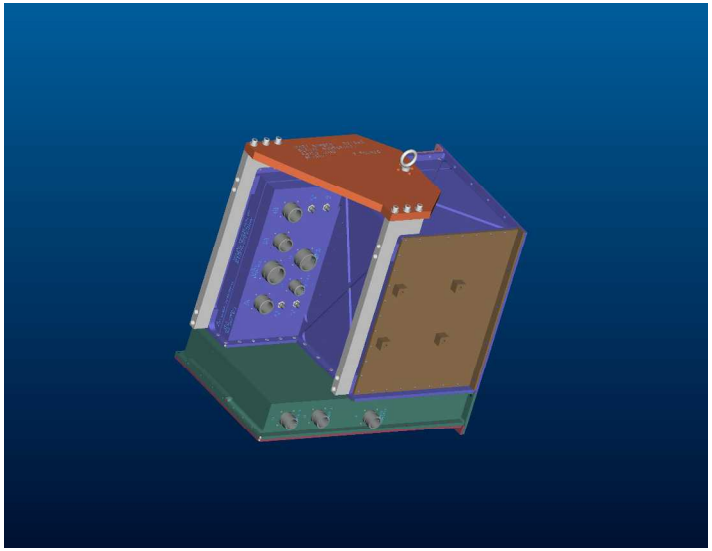
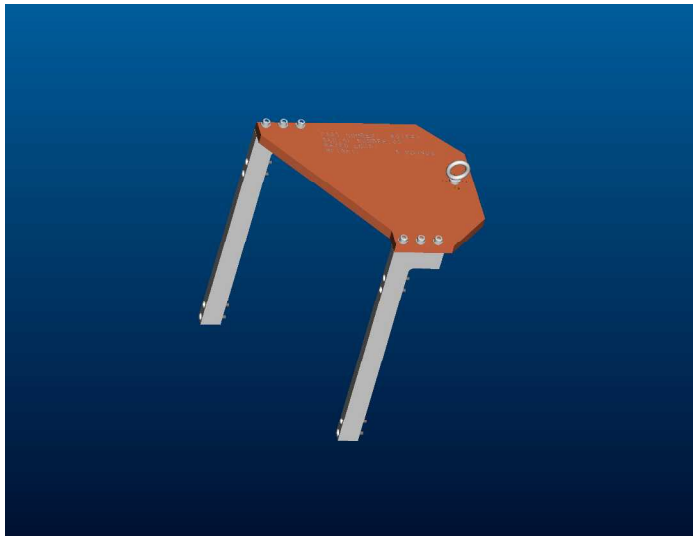
LOCKHEED MARTIN

Sandia National Laboratories

SE Box Lifting Fixture

- Design to Eye Bolt, Host hardware from there.

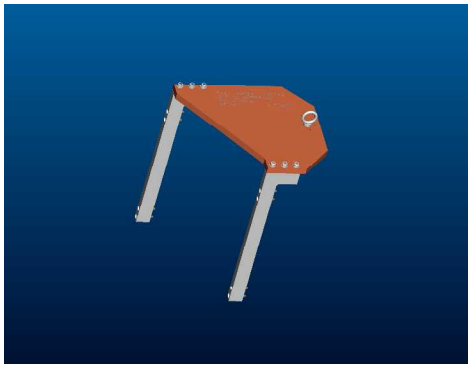


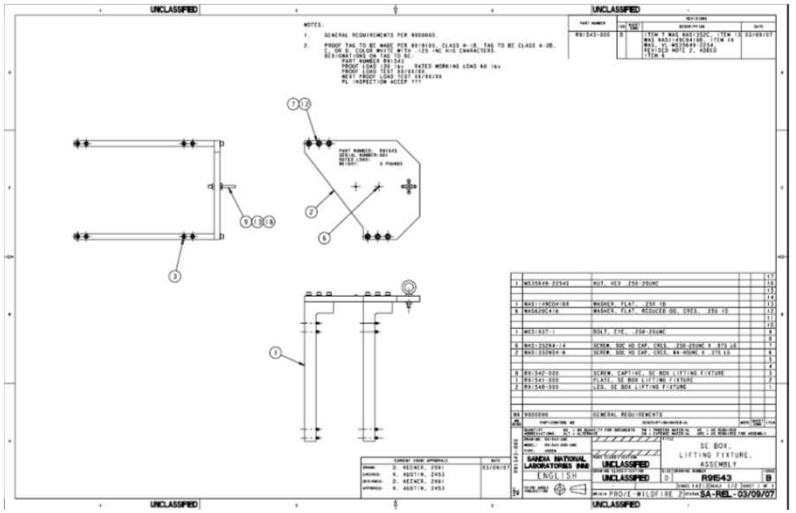


SE Box Lifting Fixture

- **Assembly Drawing R91543**
  - **R91541 Plate**
  - **R91540 Leg**

    Material: Aluminum Alloy 6061-T6 per QQ-A-250/11.





SE Box Lifting Fixture

- **Fasteners**
  - **NAS1352N3-12 Socket Head #10**
  - **NAS1352N4-14 Socket Head .250**

    Material: Heat-Resistant steel per FF-S-86.
- **Hardware**
  - **MS51937-1 Eye Bolt Proof Load 600 pounds**

    Safe Working Load 400 pounds

    Material: Forged steel in accordance with procurement specification

SE Box Lifting Fixture

- Hardware
  - MS35649-2254S, Plain Hexagon Nut

    Material: Steel, Corrosion Resistant series 302 thru 305 and 316.
  - NAS620C416, Flat washer

    Material: Steel, Corrosion Resistant any 300 series.
  - NAS1149C0416R, Flat washer

    Material: Steel, Corrosion Resistant 301 per MIL-S-7952 or 1025.
- All hardware is captive.

SE Box Lifting Fixture

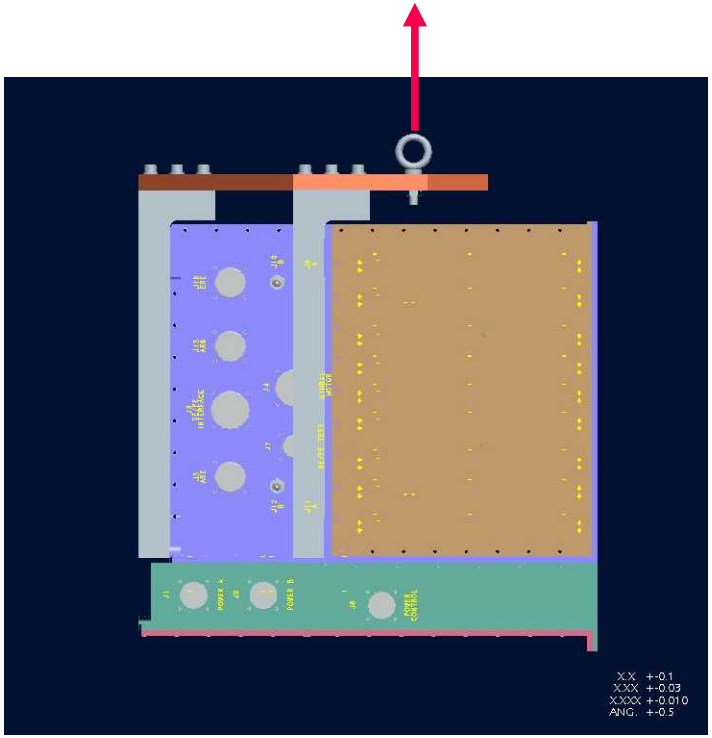
- **Surface Finish**
  - **R91541 and R91540 are Anodize per Mil-A-8625 Type 2, Class 2, color Red.**
  - **Screws, NAS1352 are passivated per QQ-P-35.**
  - **Washers, NAS620 and NAS1149 are passivated per QQ-P-35 or AMS2700.**
  - **Nut, MS35649 is Silver plated per QQ-S-365.**
  - **Eye Bolt, MS51937 is uncoated.**

SE Box Lifting Fixture

- Identification
  - Part Identification will be on R91541 Plate.
    - Part Number: R91543
    - Serial Number: 001
    - Rated Load: 60 pounds
    - Weight: 5 pounds
  - Proof Tag will be attached on R91541
    - Part Number: R91543
    - Proof Load: 120 pounds
    - Rated Working Load: 60 pounds
    - Proof Load Test xx/xx/xx
    - Next Proof Load Test xx/xx/xx
    - PL Inspection Accep.

SE Box Lifting Fixture

- Designed to lift in vertical direction



SE Box Lifting Fixture

- **MAGE Proof Test Option 1**
  - **Test Requirements**

MAGE Specs (lbf)

Live Load (LL)	42
Dead Load (DL)	5.05
BTH= LL + DL	47.05

Factors of Safety

	Static MAGE
Working Load	1
Design Limit Load (DLL)	1.25
Proof Load	1.5
Design Yield	2.5
Design Ultimate	4

Proof Test Options (lbf)

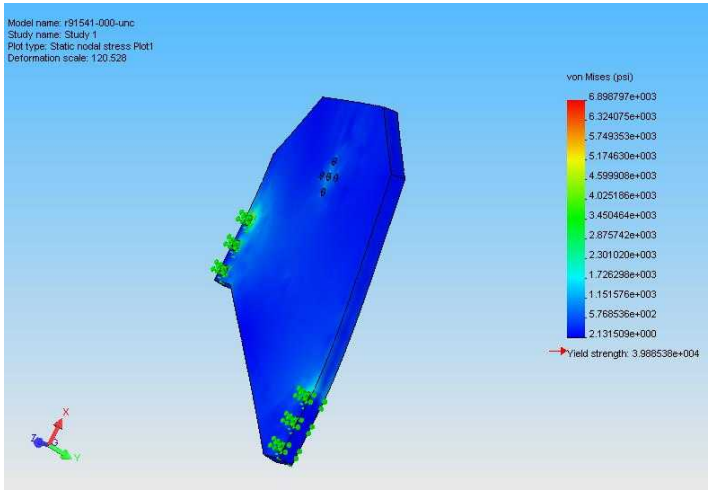
	Option 1
	One static test
Mage Weight	5
Lift Rated Load	42
Sling Rated Load	47
DLL	59
Proof Weight	118
Design Yield Load	176
Design Ultimate Load	294

SE Box Lifting Fixture

- **Preliminary Design Analysis**
  - **Using the DLL of 60lbs the Design Yield Load = 3*DLL results in a force of 180lbf.**

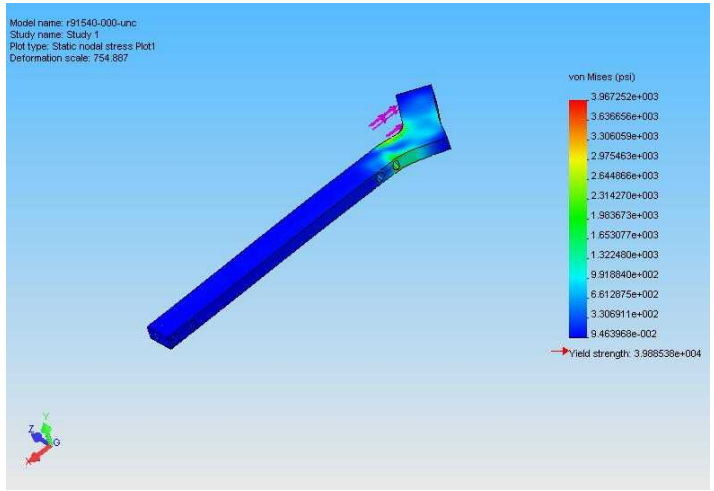
On part R91541

- **Yield Stress FOS of 5.8**
- **Ultimate Stress FOS of 6.5**



On part R91540

Yield Stress FOS of 10
Ultimate Stress FOS of 11.3



SE Box Lifting Fixture

- Preliminary Design Analysis
  - Fasteners
    - Yield Strength and Ultimate Tensile Strength per FF-S-86 are 120 ksi and 160 ksi respectively
    - After .57 Derating they are 68 ksi and 91 ksi
      - NAS1352N3-12 Socket Head #10
        - Yield FOS
          - Tensile = 304
          - Shear = 4.5

        Ultimate FOS
        - Tensile = 406
        - Shear = 6
      - NAS1352N4-14 Socket Head .25
        - Yield FOS
          - Tensile = 23

        Ultimate FOS
        - Tensile = 31

SE Box Lifting Fixture

- Preliminary Design Analysis
- Hardware
  - MS51937-1 Eye Bolt Proof Load 600 lbs
    Safe Working Load 400 lbs
  - After .57 Derating safe working load = 228 lbs
    - Yield FOS
      - Tensile = 1.26

SE Box Lifting Fixture

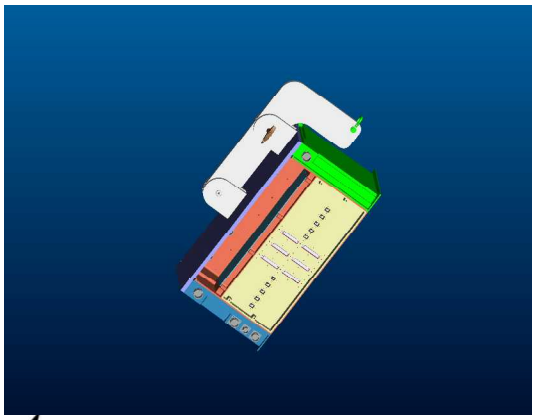
- Test Procedure
  - Proof Load (120 lbf) is applied for a total of three cycles (0-100%-0) and held at 100% for (10) minutes during each cycle.
  - Visual Inspection performed before each critical lift

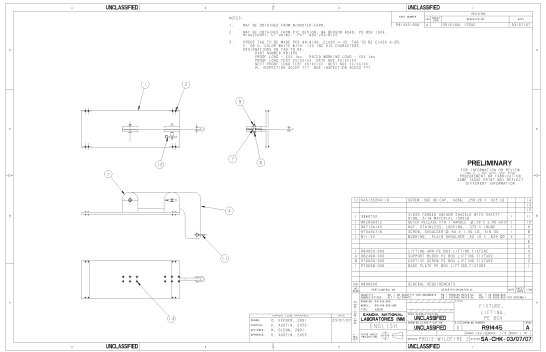
SE Box Lifting Fixture

- **Operational Test**
  - **Uses equivalent weight**
  - **MAGE is traversed vertically using appropriate crane hoist**

PE Box Lifting Fixture

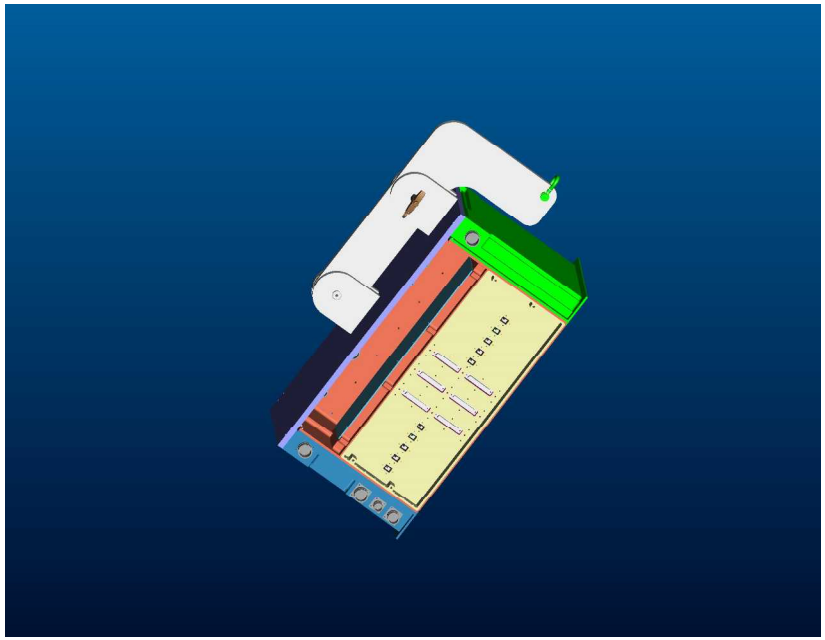
- Assembly Drawing R91400
  - R70008 Base Plate
  - R70009 Captive Screw
  - R82499 Support Block
  - R84000 Lifting Arm
- Material Aluminum Alloy 6061-T6 per QQ-A-250/11.

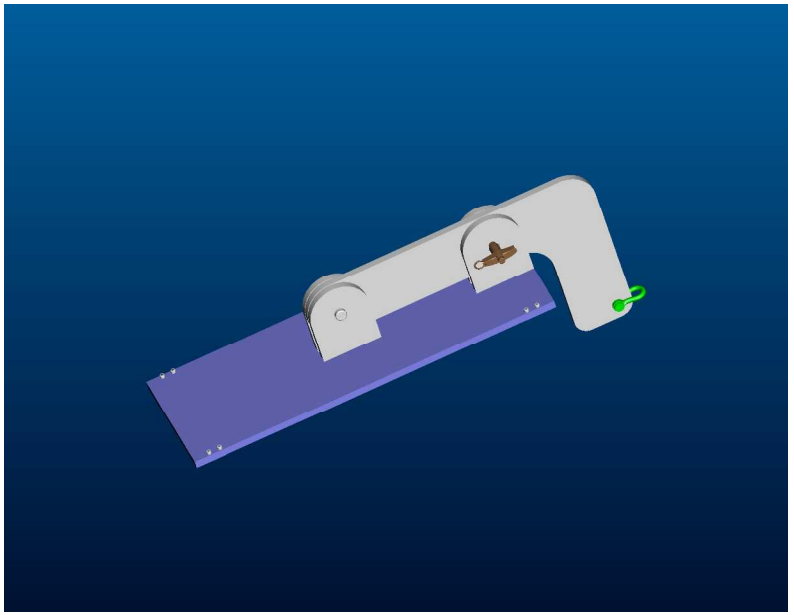




PE Box Lifting Fixture

- Design to shackle, Host hardware after that.





PE Box Lifting Fixture

- **Hardware**
  - **Shackle G-2130 (Crosby)**
    Material: Per Federal Spec. RR-C-27ID, Type IVA, Grade A, Class 3.
  - **Release Pin (Kwik-Lok Pin)**
    Material: CRES 17-4PH/Alloy Steel 4130 Per SAE AMS 5643
  - **Bushing: B11-22 (PIC Design)**
    Material: Bronze per Mil-B-5687
  - **Shoulder Bolt 97345A716 (McMaster-Carr)**
    Material: CRES 316 per XXXXX

PE Box Lifting Fixture

- **Fasteners**
  - **NAS1352N4-10 Socket Head .250**
  - **NAS1352N3-12 Socket Head #10**

    Material: Heat-Resistant steel per FF-S-86.
- **Nut**
  - **Nut 90715A145 (McMaster-Carr)**

    Material: CRES 316 per XXXXX
- **All hardware is captive.**

PE Box Lifting Fixture

- Surface Finish
  - R70008, R70009, R822499, and R84000 are Anodize per Mil-A-8625, Type 2, Class 2, color Red.
  - Screws, NAS1352 are passivated per QQ-P-35.
  - PIN, CRES parts passivate per QQ-P-35, Aluminum parts Anodize per MIL-A-8625 or chemical film per MIL-C-5541.
  - Nut, passivated per xxxxx
  - Shackle,
  - Shoulder Bolt, passivated per xxxxx

PE Box Lifting Fixture

- Identification
  - Part Identification will be on R70008 Base Plate
    - Part Number: R91445
    - Serial Number: 001
    - Rated Load: 130 Pounds
    - Weight: 21 pounds
  - Proof Tag will be attached on R70008
    - Part Number: R91445
    - Proof Load: 260 pounds
    - Rated Working Load: 130 pounds
    - Proof Load Test xx/xx/xx
    - PL Inspection Accep. xxx

PE Box Lifting Fixture

- **MAGE Proof Test Option 1**
  - **Test Requirements**

MAGE Specs (lbf)

Live Load (LL)	83
Dead Load (DL)	21
BTH= LL + DL	104

Factors of Safety

	Static MAGE
Working Load	1
Design Limit Load (DLL)	1.25
Proof Load	1.5
Design Yield	2.5
Design Ultimate	4

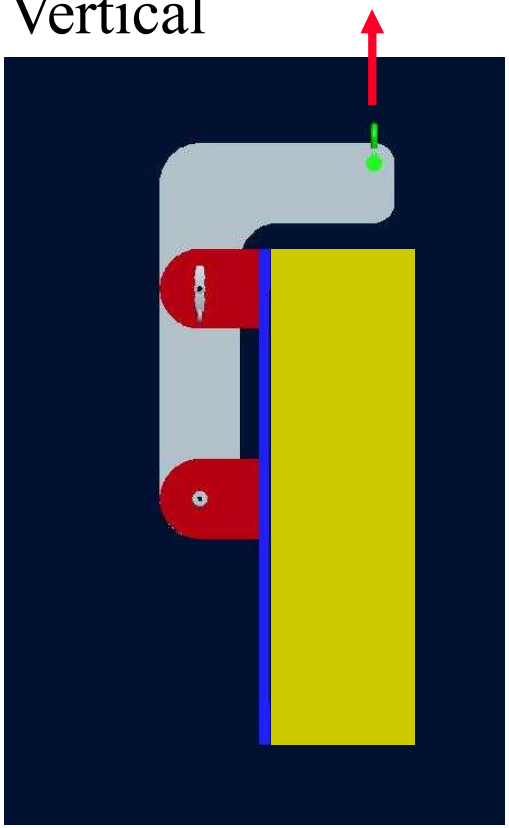
Proof Test Options (lbf)

	Option 1
	One static test
Mage Weight	21
Lift Rated Load	83
Sling Rated Load	104
DLL	130
Proof Weight	260
Design Yield Load	390
Design Ultimate Load	650

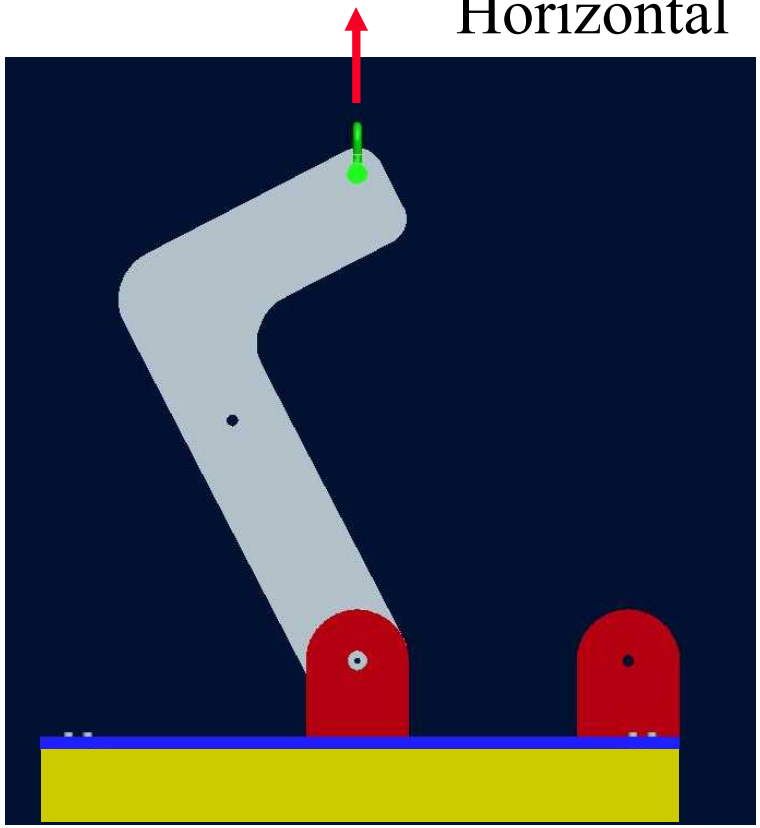
PE Box Lifting Fixture

- **Two Possible Orientations**

Vertical



Horizontal

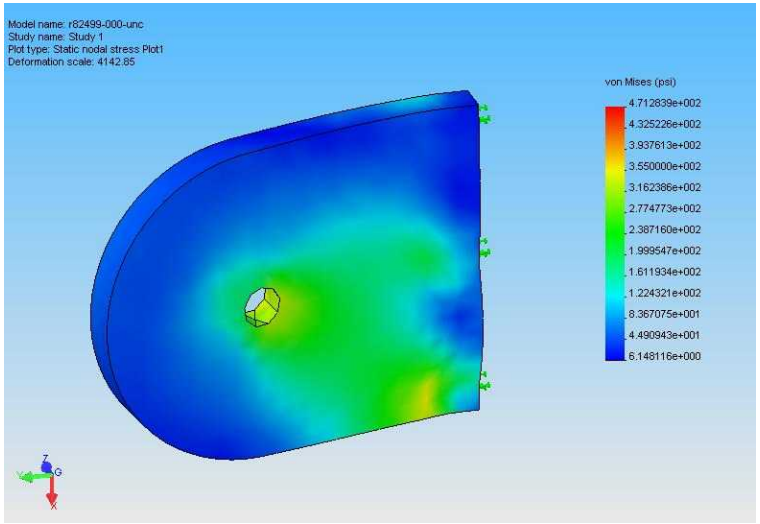


PE Box Lifting Fixture Vertical

- **Preliminary Design Analysis**
  - **Using the DLL of 130lbs the Design Yield Load = 3*DLL results in a force of 390lbf.**

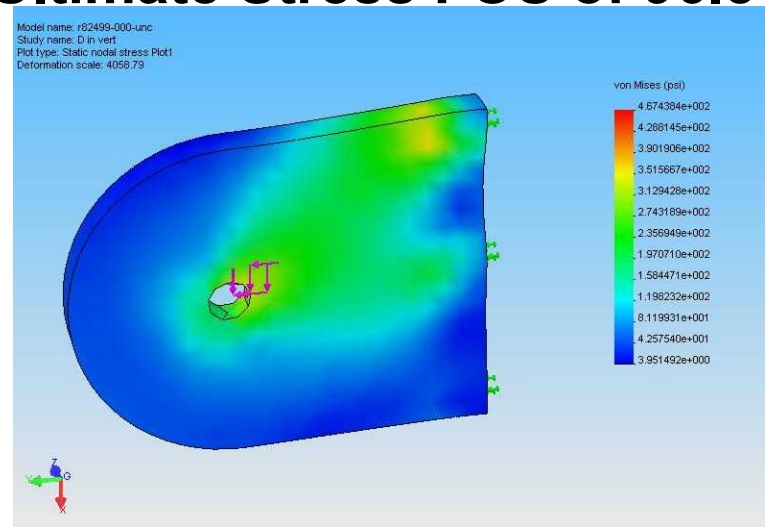
On part R82499 Pinned

- **Yield Stress FOS of 85**
- **Ultimate Stress FOS of 95.5**



On part 82499 Bolted

- **Yield Stress FOS of 85**
- **Ultimate Stress FOS of 96.3**

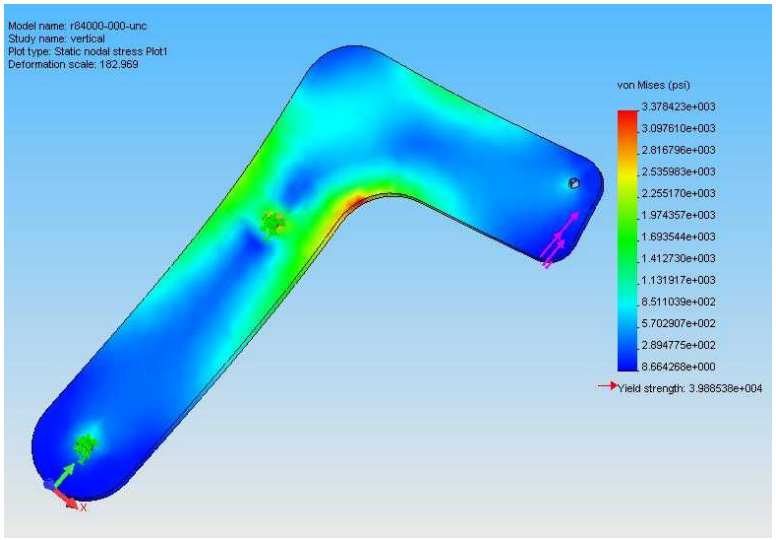


PE Box Lifting Fixture Vertical

- **Preliminary Design Analysis**
  - **Using the DLL of 130lbs the Design Yield Load = 3*DLL results in a force of 390lbf.**

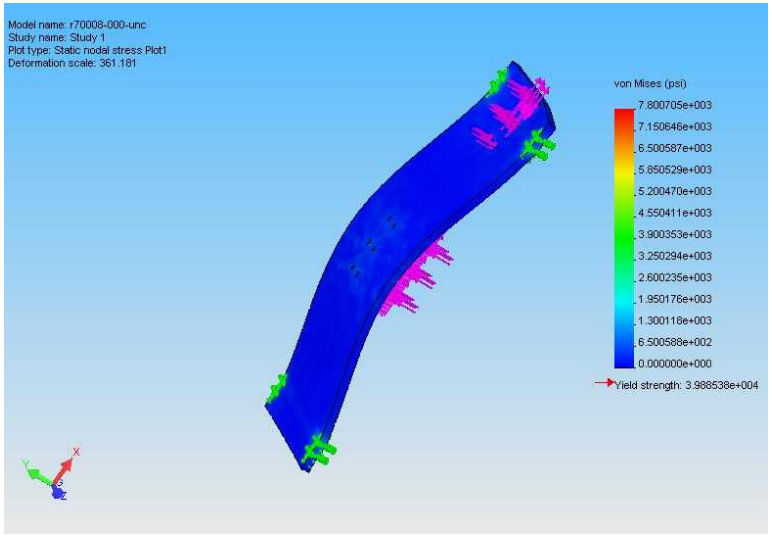
On part R84000

- **Yield Stress FOS of 12**
- **Ultimate Stress FOS of 13.3**



On part 70008

- **Yield Stress FOS of 5.1**
- **Ultimate Stress FOS of 5.8**



PE Box Lifting Fixture Vertical

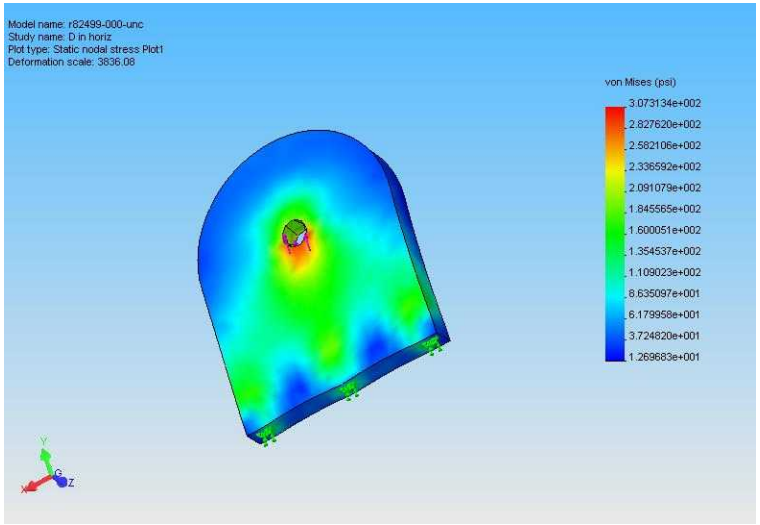
- Preliminary Design Analysis
  - Fasteners
  - – Yield Strength and Ultimate Tensile Strength per FF-S-86 are 120 ksi and 160 ksi respectively
    - NAS1352N3-12
      - Yield FOS — Ultimate FOS
      - – Shear = 19.2 — Shear = 25.7
    - NAS1352N4-10
      - Yield FOS — Ultimate FOS
      - – Shear = 75 — Shear = 100
    - 316 stainless ½ shoulder bolt
      - Yield FOS — Ultimate FOS
      - – Shear = 5.21 — Shear = 13.9
- Hardware
  - – Shackle
    - Yield FOS = 3.22
  - – Kwik-lock pin
    - Yield FOS = 116

PE Box Lifting Fixture Horizontal

- **Preliminary Design Analysis**
  - **Using the DLL of 130lbs the Design Yield Load = 3*DLL results in a force of 390lbf.**

On part R82499 Bolted

- **Yield Stress FOS of 130**
- **Ultimate Stress FOS of 146**

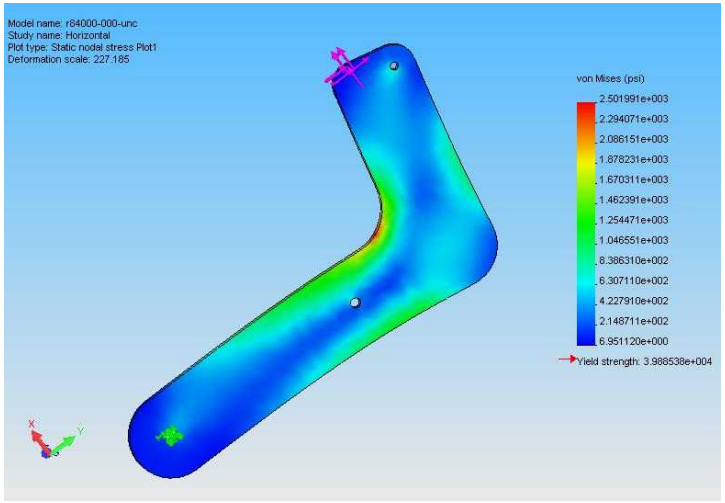


PE Box Lifting Fixture Horizontal

- **Preliminary Design Analysis**
  - **Using the DLL of 130lbs the Design Yield Load = 3*DLL results in a force of 390lbf.**

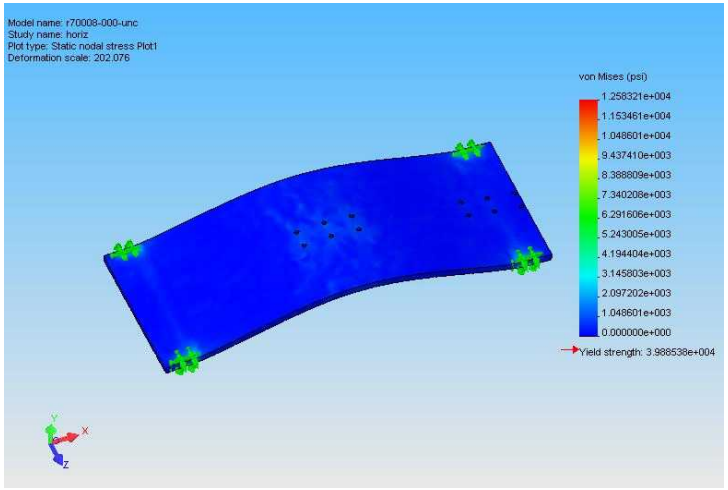
On part R84000

- **Yield Stress FOS of 16**
- **Ultimate Stress FOS of 18**



On part 70008

- **Yield Stress FOS of 3.2**
- **Ultimate Stress FOS of 3.6**



PE Box Lifting Fixture Horizontal

- Preliminary Design Analysis
  - Fasteners
  - – Yield Strength and Ultimate Tensile Strength per FF-S-86 are 120 ksi and 160 ksi respectively
    - NAS1352N3-12
      - Yield FOS — Ultimate FOS
      - – Tensile = 25 — Tensile = 33
    - NAS1352N4-10
      - Yield FOS — Ultimate FOS
      - – Tensile =33 — Tensile = 45
    - 316 stainless ½ shoulder bolt
      - Yield FOS — Ultimate FOS
      - – Shear = 4.8 — Shear = 12.8
- Hardware
  - – Shackle
    - Yield FOS = 3.22

PE Box Lifting Fixture

- Test Procedure
  - Proof load (260 lbf) is applied for a total of three cycles (0-100%-0) and held at 100% for 10 minutes during each cycle.
  - Visual inspection performed before each critical lift
- Operation Test
  - Uses equivalent weight
- MAGE is traversed vertically using appropriate crane hoist

Schedule

- SE Box Fixture
  - In shop next week hopefully out by April 1st
  - Pull testing first of April till mid April
  - Lift Testing mid April till early May
- PE Box Fixture
  - Pull testing end of March till early April
  - Lift testing mid April till early May
- PE Horizontal Lifting Fixture
  - Pull testing end of March till early April
- If removing boxes in mid May to late May I will not be there.