SAND2007-4362P

Horizontal Lifting Fixtures

SE and PE Boxes

June 25, 2007

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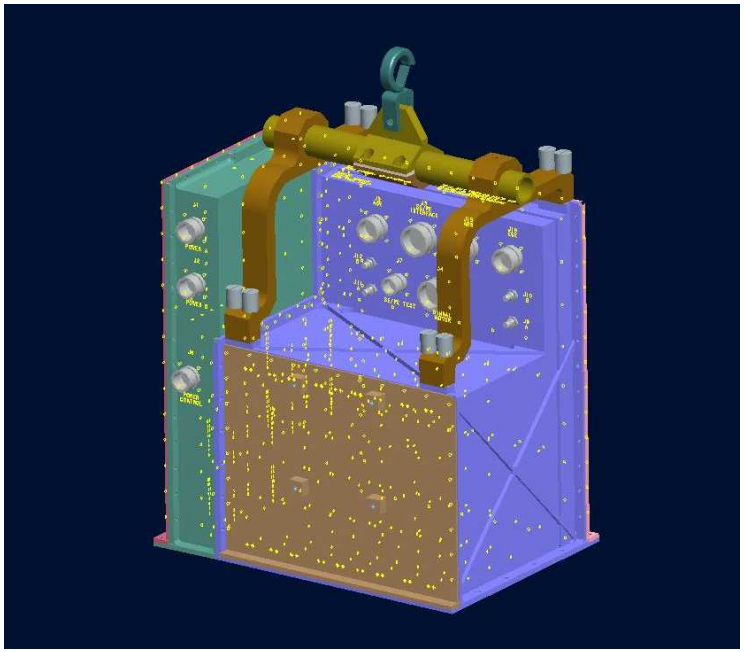
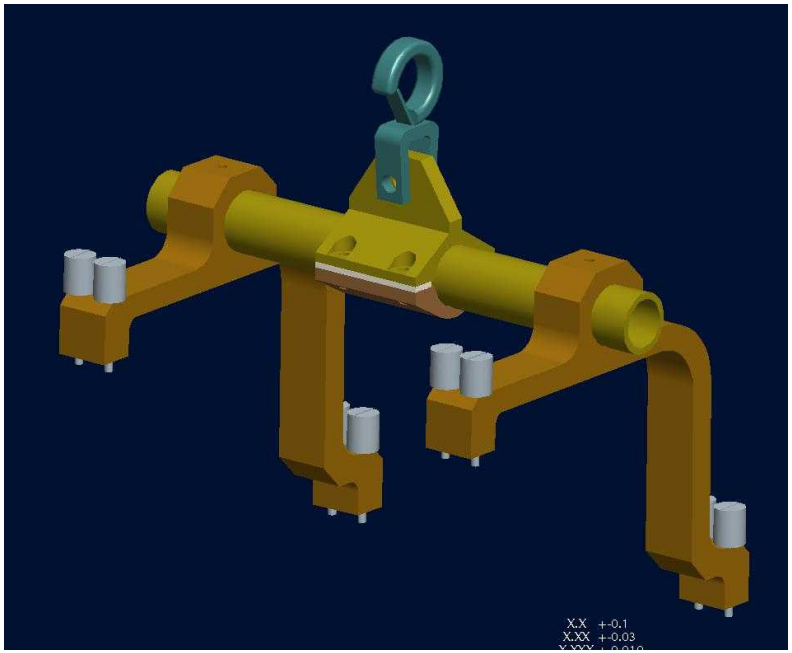
LOCKHEED MARTIN

Sandia National Laboratories

SE Box Lifting Fixture

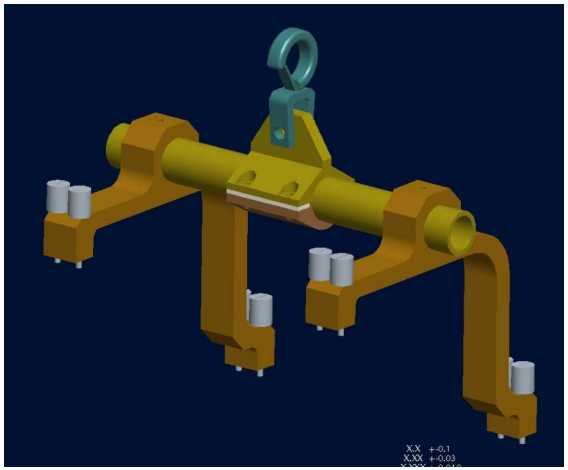
- Design to hook, Host hardware from there.

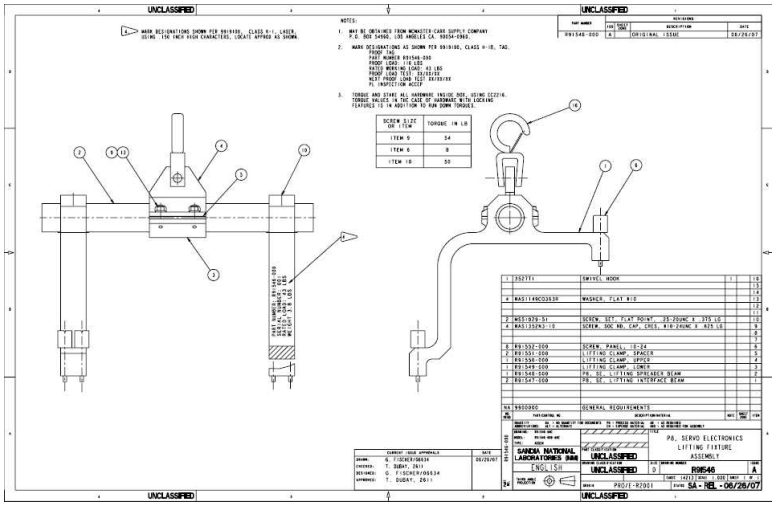




SE Box Lifting Fixture

- Assembly Drawing R91546
- Material: Aluminum Alloy 6061-T6 per QQ-A-250/11.
  - R91551 Lifting Clamp Spacer
  - R91547 Interface Beam
  - R91548 Spreader Beam
  - R91549 Lifting Clamp Lower
  - R91550 Lifting Clamp Upper
- Material: 303 Stainless Steel.
  - R91552 Panel Screw





SE Box Lifting Fixture

- Fasteners
  - NAS1352N3-10 Socket Head #10-24
  - MS51029-51 Set Screw .25-20
    Material: Heat-Resistant steel per FF-S-86.
  - Panel Screw
    Material: 303 Stainless Steel

- Hardware
  - Crosby Swivel Hook
    Safe Working Load 1000 pounds
    Material: Forged steel in accordance with procurement specification

SE Box Lifting Fixture

- **Hardware**

  NAS1149C0363R, Flat washer

  Material: Steel, Corrosion Resistant 301 per MIL-S-7952 or 1025.

- **All hardware is captive.**

SE Box Lifting Fixture

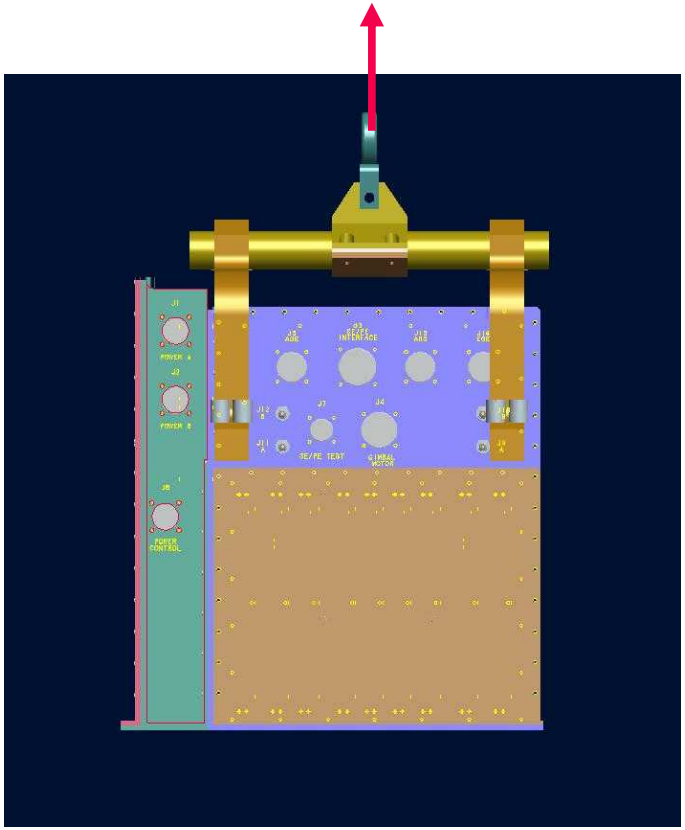
- Surface Finish
  - R91547 and R91548 are Anodize per 9904102 Class 2, color Red.
  - R91549 and R91550 are Alodine per Mil-c-5541C Class 3
  - Screws, NAS1352 and MS51029 are passivated per QQ-P-35.
  - Washers, NAS1149 are passivated per QQ-P-35 or AMS2700.
  - Crosby Swivel Hook, uncoated.

SE Box Lifting Fixture

- Identification
  - Part Identification will be on R91547.
    - Part Number: R91546
    - Serial Number: 001
    - Rated Load: 43 pounds
    - Weight: 3.8 pounds
  - Proof Tag will be attached on R91547
    - Part Number: R91546
    - Proof Load: 116 pounds
    - Rated Working Load: 43 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
- Proof weight applied and measured at hook



SE Box Lifting Fixture

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

MAGE Specs

Live Load (LL)	42.6
Dead Load (DL)	3.8
BTH= LL + DL	46.4

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	4
Lift Rated Load	43
Sling Rated Load	46
DLL	58
Proof Weight	116
Design Yield Load	174
Design Ultimate Load	290

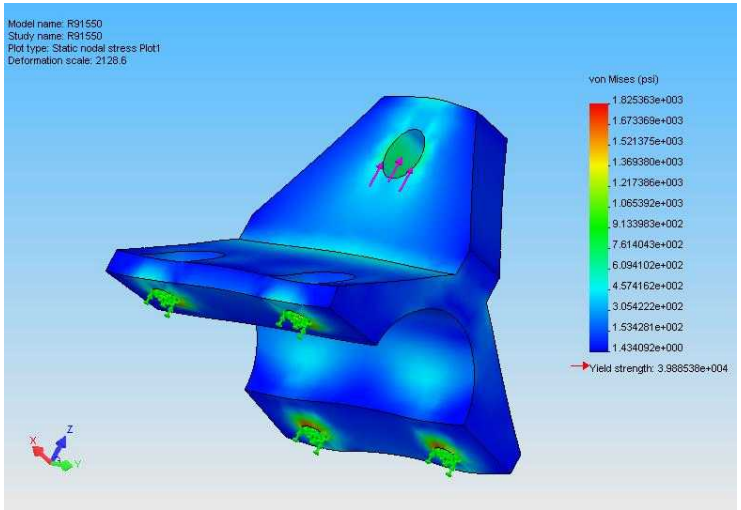
SE Box Lifting Fixture

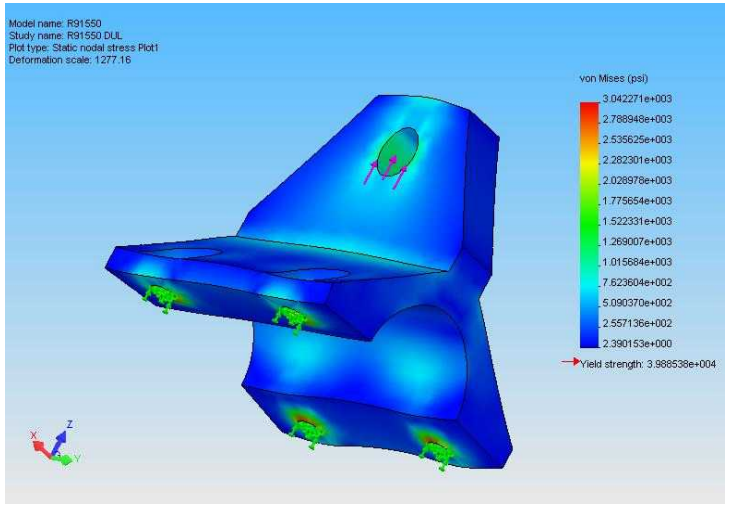
- **Preliminary Design Analysis**
  - **Using the DLL of 58lbs the Design Yield Load = 3*DLL = 174lbf and Design Ultimate Load = 5*DLL = 290lbs**

    On part R91550

    - **Yield Stress FOS of 22**

Ultimate Stress FOS of 14.8





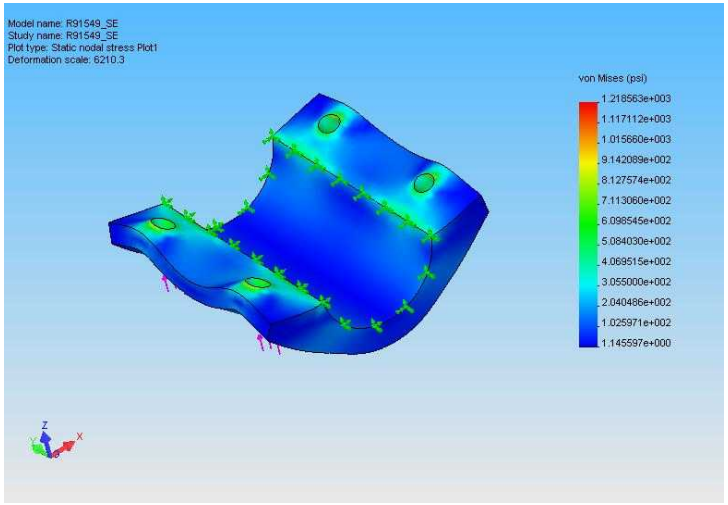
SE Box Lifting Fixture

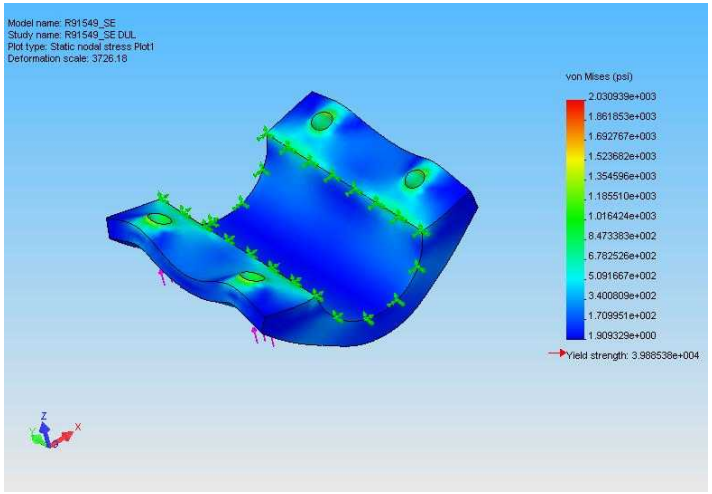
- **Preliminary Design Analysis**
  - **Using the DLL of 58lbs the Design Yield Load = 3*DLL = 174lbf and Design Ultimate Load = 5*DLL = 290lbs**

    On part R91549

    - **Yield Stress FOS of 33**

Ultimate Stress FOS of 22





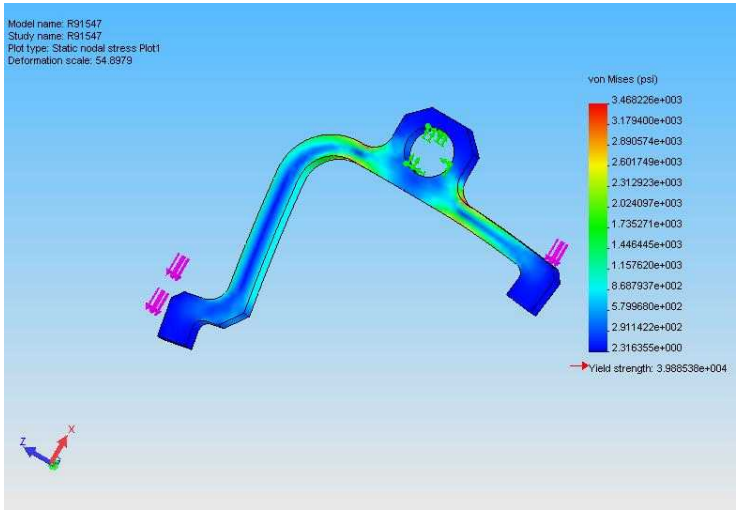
SE Box Lifting Fixture

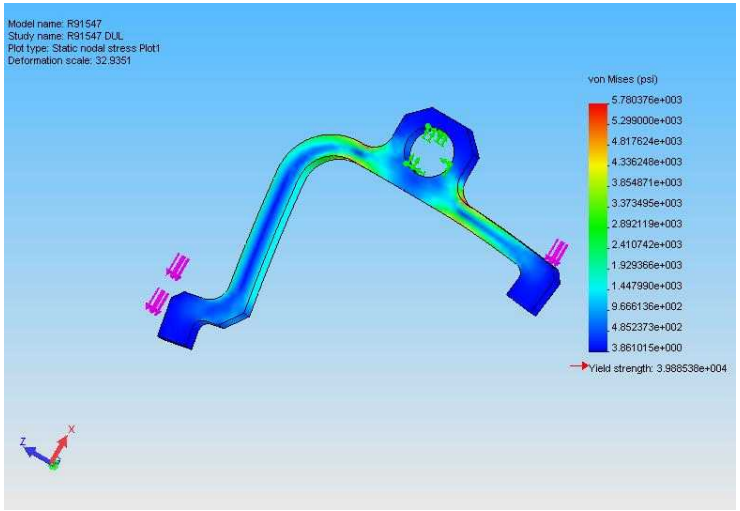
- **Preliminary Design Analysis**
  - **Using the DLL of 58lbs the Design Yield Load = 3*DLL = 174lbf and Design Ultimate Load = 5*DLL = 290lbs**

    On part R91547

    - **Yield Stress FOS of 11.5**

Ultimate Stress FOS of 8





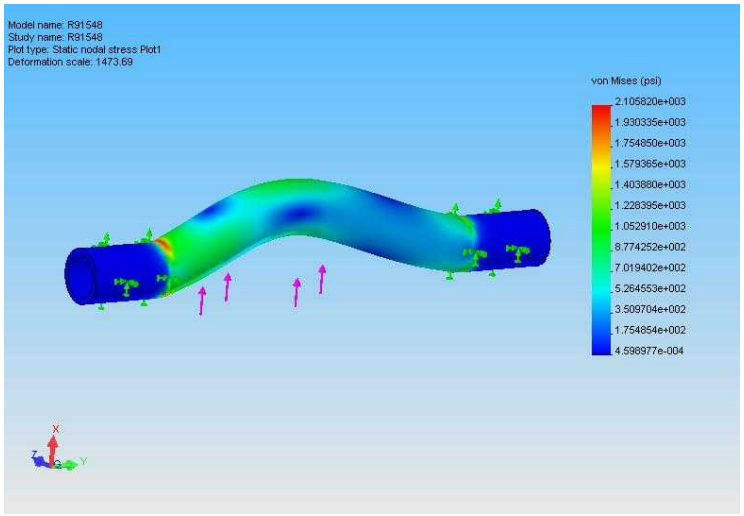
SE Box Lifting Fixture

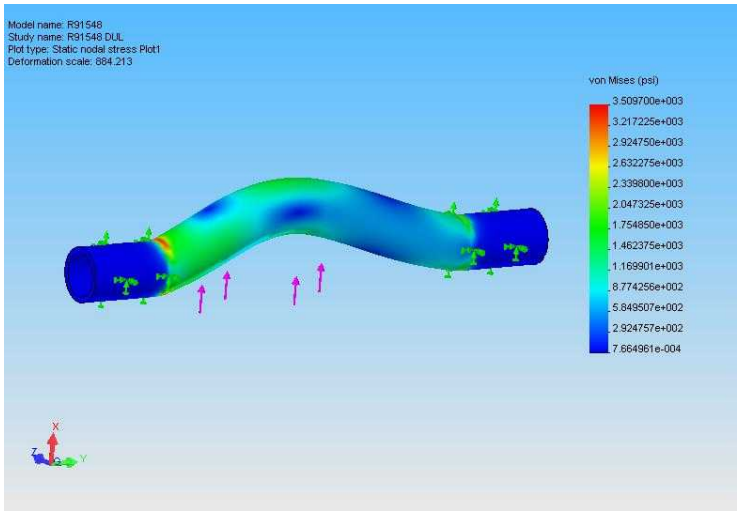
- **Preliminary Design Analysis**
  - **Using the DLL of 58lbs the Design Yield Load = 3*DLL = 174lbf and Design Ultimate Load = 5*DLL = 290lbs**

    On part R91548

    - **Yield Stress FOS of 19**

Ultimate Stress FOS of 13





SE Box Lifting Fixture

- **Preliminary Design Analysis**
  - **Fasteners**
    - **NAS1352N3-10 Socket Head #10**
      - **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**
        - **Yield FOS**

          Tensile = 27

          Ultimate FOS

          Tensile = 22
    - **Thumbscrews**
      - **Yield Strength and Ultimate Tensile Strength are 35 ksi and 87.3 ksi respectively**
      - **Yield FOS**

        Tensile = 22

        Ultimate FOS

        Tensile = 33

SE Box Lifting Fixture

- Preliminary Design Analysis
- Hardware
  - Crosby Swivel Hook

    Safe Working Load 1000 lbs
  - After .57 Derating safe working load = 570 lbs
    - Yield FOS using Design Yield Strength = 3*DLL
      - Tensile = 3.3

SE Box Lifting Fixture

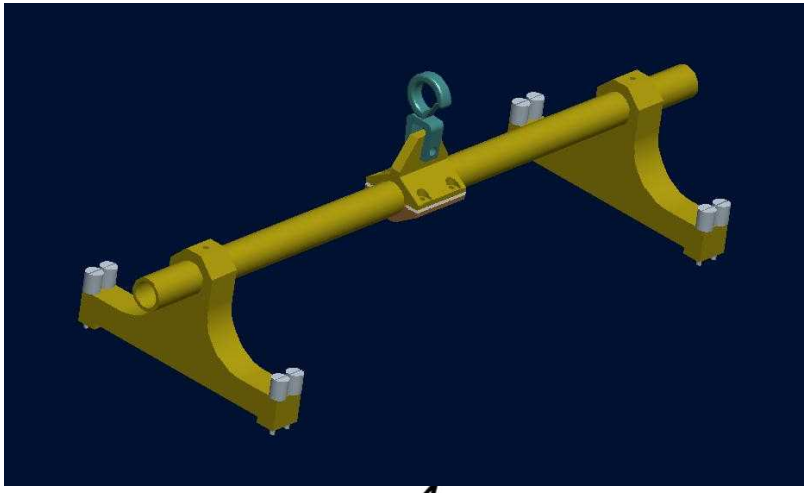
- Test Procedure
  - Proof Load (116 lbf) is applied for a total of three cycles (0-100%-0) and held at 100% for (10) minutes during each cycle.
  - Visual Inspection performed before each critical lift

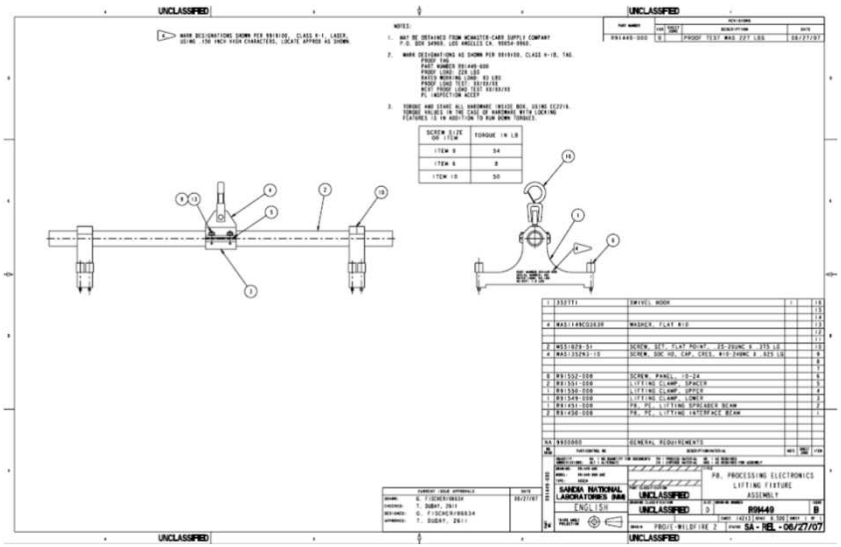
SE Box Lifting Fixture

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

PE Box Lifting Fixture

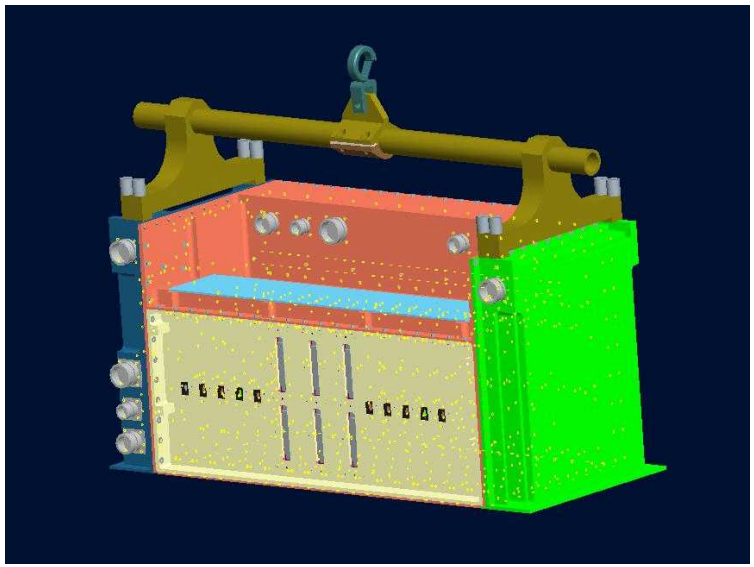
- Assembly Drawing R91449
- Material: Aluminum Alloy 6061-T6 per QQ-A-250/11.
  - R91551 Lifting Clamp Spacer
  - R91450 Interface Beam
  - R91451 Spreader Beam
  - R91549 Lifting Clamp Lower
  - R91550 Lifting Clamp Upper
- Material: 303 Stainless Steel.
  - R91552 Panel Screw

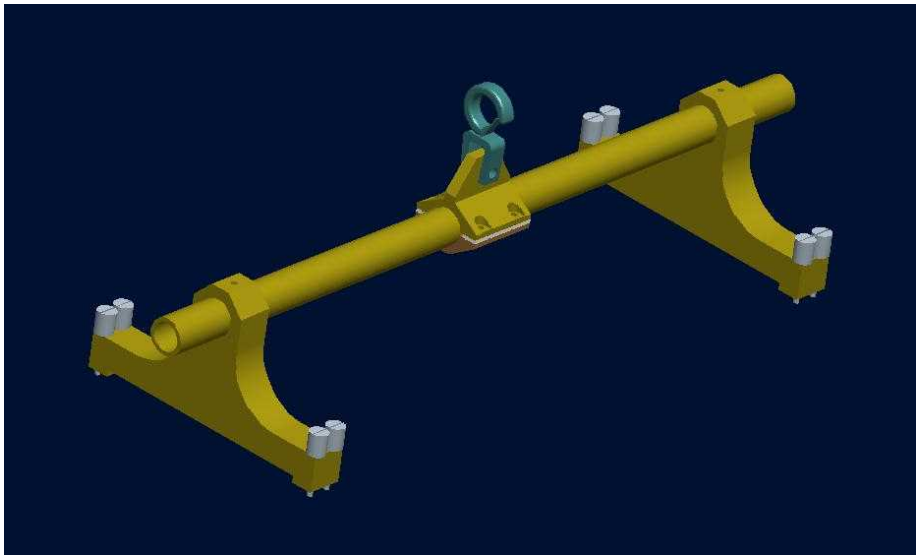




PE Box Lifting Fixture

- **Design to hook, Host hardware after that.**





PE Box Lifting Fixture

- Fasteners
  - NAS1352N3-10 Socket Head #10
  - MS51029-51 Set Screw .25-20
    Material: Heat-Resistant steel per FF-S-86.
  - Panel Screw
    Material: 303 Stainless Steel

- Hardware
  - Crosby Swivel Hook
    Safe Working Load 1000 pounds
    Material: Forged steel in accordance with procurement specification
  - All hardware is captive.

PE Box Lifting Fixture

- Surface Finish
  - R91450 and R91451 are Anodize per 9904102 Class 2, color Red.
  - R91549 and R91550 are Alodine per Mil-c-5541C Class 3
  - Screws, NAS1352 and MS51029 are passivated per QQ-P-35.
  - Washers, NAS1149 are passivated per QQ-P-35 or AMS2700.
  - Crosby Swivel Hook, is uncoated.

PE Box Lifting Fixture

- Identification
  - Part Identification will be on R91450
    - Part Number: R91449
    - Serial Number: 001
    - Rated Load: 83 Pounds
    - Weight: 7.9 pounds
  - Proof Tag will be attached on R91450
    - Part Number: R91449
    - Proof Load: 228 pounds
    - Rated Working Load: 83 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)	7.9
BTH= LL + DL	90.9

Factors of Safety

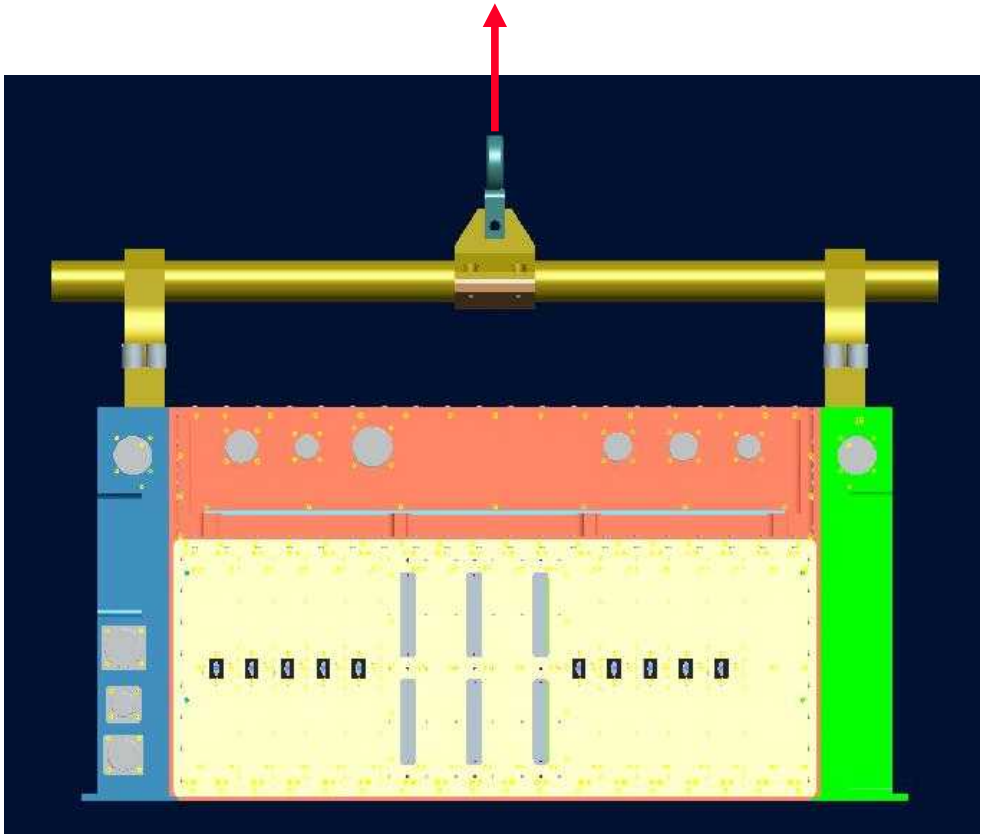
	Static MAGE
Working Load	1
Design Limit Load (DLL)	1.25
Proof Load	1.5
Design Yield	2.5
Design Ultimate	4

Proof Test Options (lbf)

	Option 1
	One static test
Mage Weight	8
Lift Rated Load	83
Sling Rated Load	91
DLL	114
Proof Weight	228
Design Yield Load	342
Design Ultimate Load	570

PE Box Lifting Fixture

- Designed to lift in vertical direction
- Proof weight applied and measured at hook



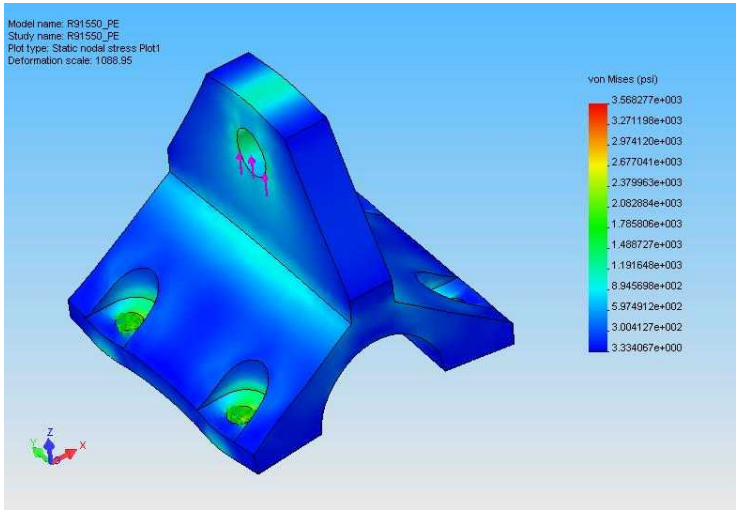
PE Box Lifting Fixture

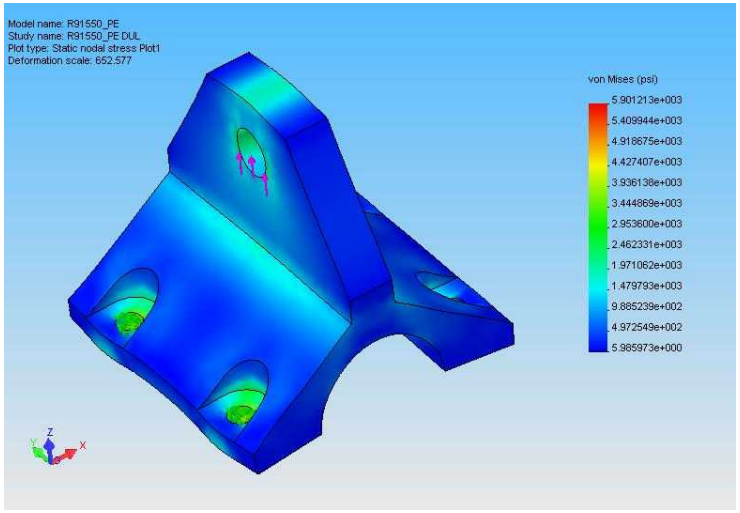
- **Preliminary Design Analysis**
  - **Using the DLL of 114lbs the Design Yield Load = 3*DLL = 342lbf and Design Ultimate Load = 5*DLL = 570lbs**

    On part R91550_PE

    - **Yield Stress FOS of 11**

Ultimate Stress FOS of 8



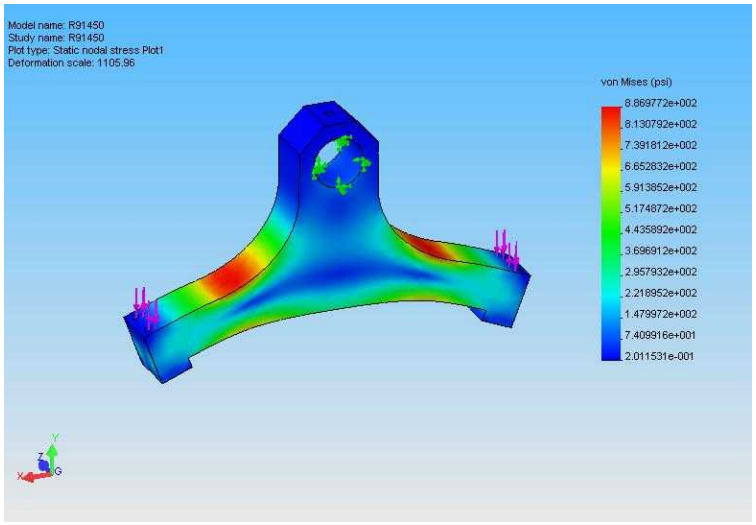


PE Box Lifting Fixture

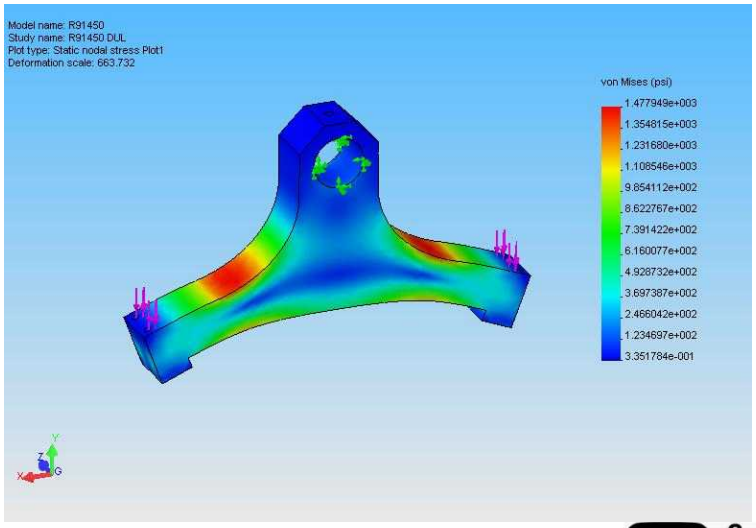
- **Preliminary Design Analysis**
  - **Using the DLL of 114lbs the Design Yield Load = 3*DLL = 342lbf and Design Ultimate Load = 5*DLL = 570lbs**

    On part R91450

    - **Yield Stress FOS of 45**



Ultimate Stress FOS of 30



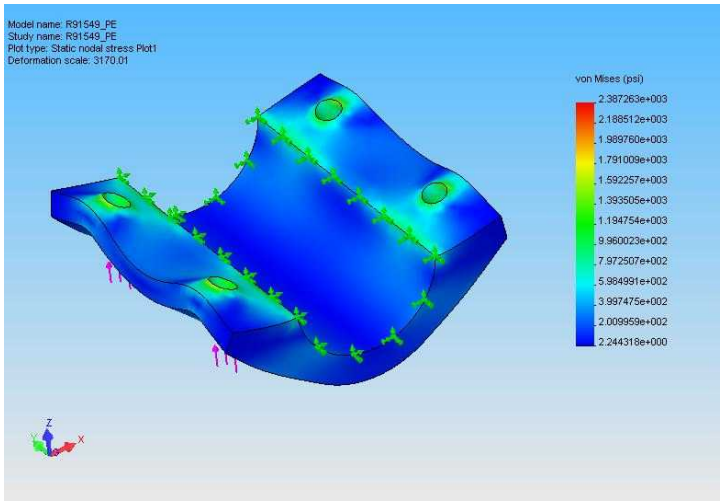
PE Box Lifting Fixture

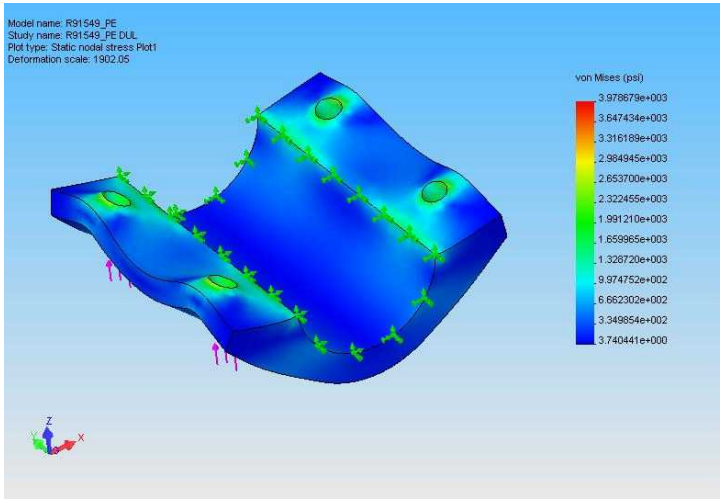
- **Preliminary Design Analysis**
  - **Using the DLL of 114lbs the Design Yield Load = 3*DLL = 342lbf and Design Ultimate Load = 5*DLL = 570lbs**

    On part R91459_PE

    - **Yield Stress FOS of 17**

Ultimate Stress FOS of 11



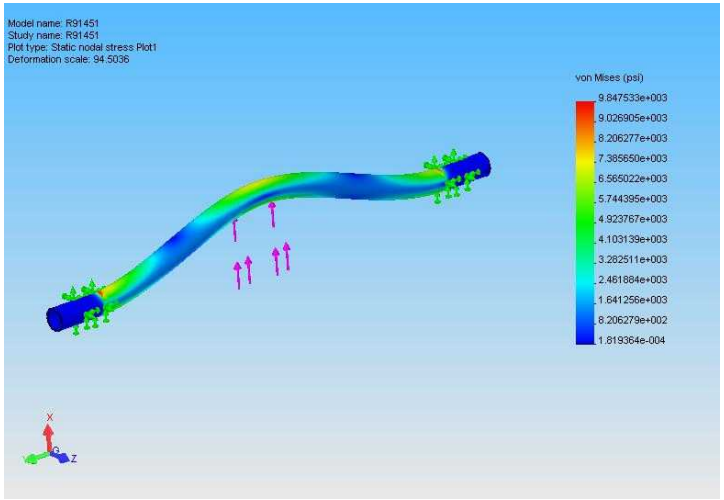


PE Box Lifting Fixture

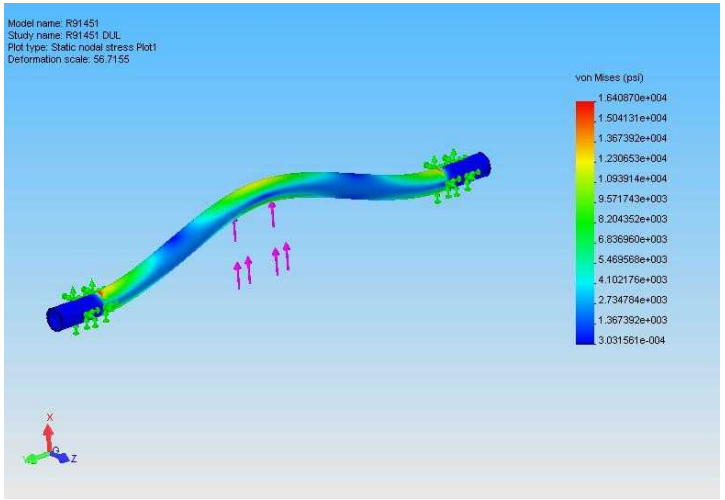
- **Preliminary Design Analysis**
  - **Using the DLL of 114lbs the Design Yield Load = 3*DLL = 342lbf and Design Ultimate Load = 5*DLL = 570lbs**

    On part R91451

    - **Yield Stress FOS of 4**



Ultimate Stress FOS of 2.7



PE Box Lifting Fixture

- **Preliminary Design Analysis**
  - **Fasteners**
    - **NAS1352N3-10 Socket Head #10**
      - **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**
        - **Yield FOS**

          Tensile = 14

          Ultimate FOS

          Tensile = 11
    - **Thumbscrews**
      - **Yield Strength and Ultimate Tensile Strength are 35 ksi and 87.3 ksi respectively**
      - **Yield FOS**

        Tensile = 14.5

        Ultimate FOS

        Tensile = 22

PE Box Lifting Fixture

- Preliminary Design Analysis
- Hardware
  - Crosby Swivel Hook

    Safe Working Load 1000 lbs
  - After .57 Derating safe working load = 570 lbs
    - Yield FOS using Design Yield Strength = 3*DLL
      - Tensile = 1.7

PE Box Lifting Fixture

- Test Procedure
  - Proof load (228 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