# Mast Arm Fatigue

Current as of March 18, 2008

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Sample: 10-2S-WY-PB-A

Geometry:

**Results:**

Length: 86 11/16

All lengths measured in inches

| | |
|---|---|
| Sr | 12 |
| Smean | 22 |
| Cycles | 6,734,487 |
| Location: | |

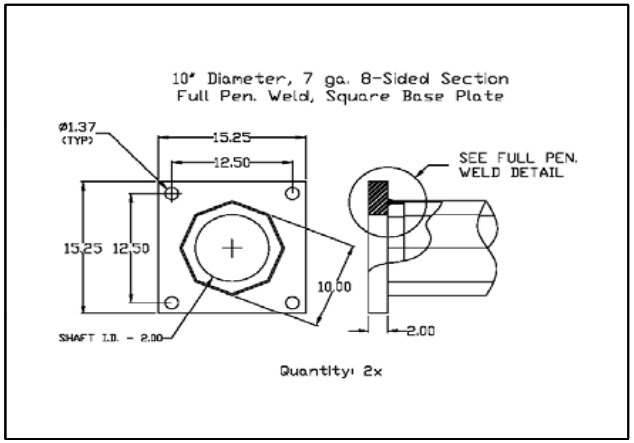
| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 3/4 | 0.192 |
| 2 | 9 13/16 | 0.194 |
| 3 | 9 15/16 | 0.190 |
| Average | 9.833 | 0.192 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.035 | 9/16 | 1/4 |
| 2.028 | 5/8 | 1/4 |
| 2.035 | 9/16 | 1/4 |
| 2.033 | 0.583 | 0.250 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.390 | $in^3$ | $P_{max}$ | 8.537 kip |
| | | | $P_{min}$ | 4.885 kip |
| $S_{max}$ | 28 | ksi | | |
| $S_{min}$ | 16 | ksi | | |

View from 45° left of vertical

Sample: 10-2S-WY-PB-B

Geometry:

**Results:**

Length:

All lengths measured in inches

| | |
|---|---|
| Sr | 12 |
| Smean | 22 |
| Cycles | 5,219,304 |
| Location: | Base Plate Weld Toe |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | 0.19 |
| 2 | 9 13/16 | 0.19 |
| 3 | 10 | 0.183 |
| Average | 9.938 | 0.188 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.035 | 9/16 | 1/4 |
| 2.03 | 5/8 | 1/4 |
| 2.035 | 5/8 | 1/4 |
| 2.033 | 0.604 | 0.250 |

Loads:

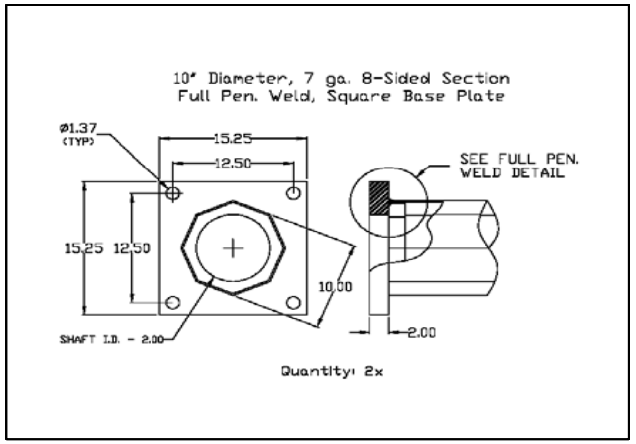
Modulus ____ $in^3$

$P_{max}$ 8.537 kip

$P_{min}$ 4.885 kip

$S_{max}$ 28 ksi

$S_{min}$ 16 ksi

Sample: 10-2S-WY-VG-A

Geometry:

**Results:**

Length: 86 11/16

All lengths measured in inches

| | |
|---|---|
| Sr | 12 |
| Smean | 22 |
| Cycles | 12,602,940 |
| Location: | RUNOUT |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | 0.195 |
| 2 | 9 15/16 | 0.183 |
| 3 | | 0.19 |
| Average | 9.969 | 0.189 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.016 | 3/4 | 2/5 |
| 2.012 | 11/16 | 3/8 |
| 2.014 | 11/16 | 11/32 |
| 2.014 | 0.7083 | 0.375 |

Loads: (Average section modulus for both sample A and B)

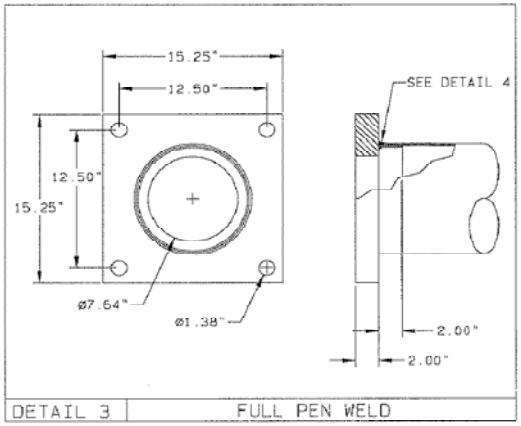
Modulus 13.230 $in^3$

$P_{max}$ 8.335 kip

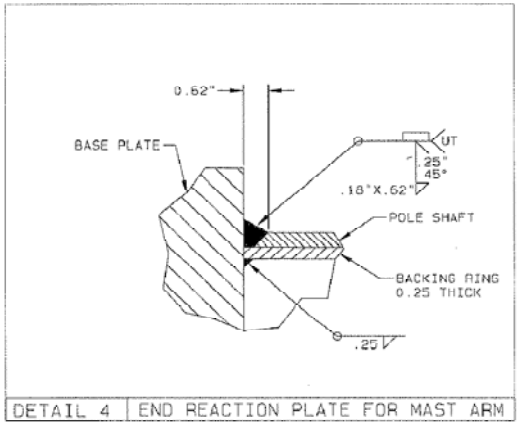
$P_{min}$ 4.763 kip

$S_{max}$ 28 ksi

$S_{min}$ 16 ksi




DETAIL 3 FULL PEN WELD




DETAIL 4 END REACTION PLATE FOR MAST ARM

Sample: 10-2S-WY-VG-B

Geometry:

**Results:**

Length: 86 5/8

All lengths measured in inches

| | |
|---|---|
| Sr | 12 |
| Smean | 22 |
| Cycles | 12,602,940 |
| Location: | RUNOUT |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | 0.186 |
| 2 | 10 | 0.186 |
| 3 | | 0.185 |
| Average | 10 | 0.186 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.014 | 5/8 | 1/3 |
| 2.016 | 13/16 | 7/16 |
| 2.031 | 3/4 | 7/16 |
| 2.02 | 0.729 | 0.396 |

Loads: (Average section modulus for both sample A and B)

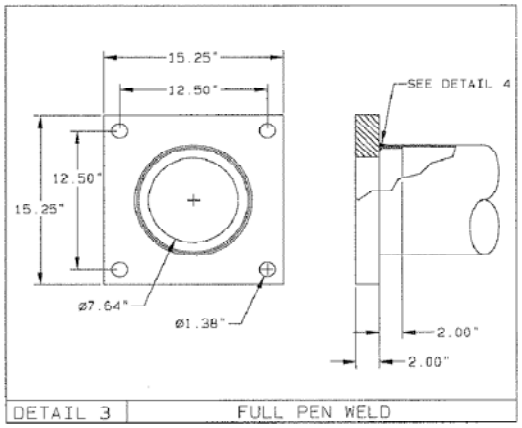
Modulus 13.230 $in^3$

$P_{max}$ 8.335 kip

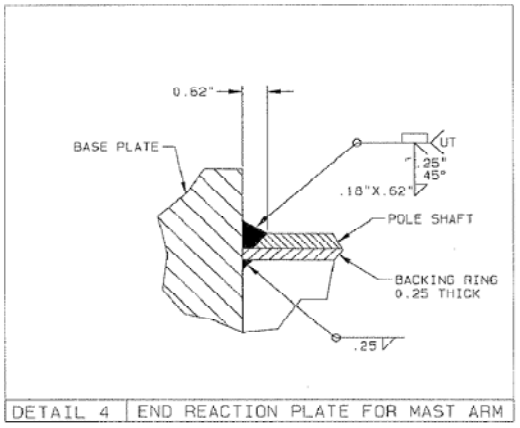
$P_{min}$ 4.763 kip

$S_{max}$ 28 ksi

$S_{min}$ 16 ksi




DETAIL 3 FULL PEN WELD




DETAIL 4 END REACTION PLATE FOR MAST ARM

Sample: 8-2S-WY-VG-A

Geometry:

**Results:**

Length: 86 5/8

All lengths measured in inches

Failure 1

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 856,122 |
| Location: | Backing bar |

Failure 2

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 747,510 |
| Location: | Weld toe |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 8 | 0.17 |
| 2 | 7 15/16 | 0.168 |
| 3 | | 0.17 |
| Average | 7.969 | 0.169 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.016 | 7/16 | 13/16 |
| 2.017 | 7/16 | 7/8 |
| 2.008 | 7/16 | 13/16 |
| 2.014 | 7/16 | 0.833 |

Loads: (average modulus for A and B)

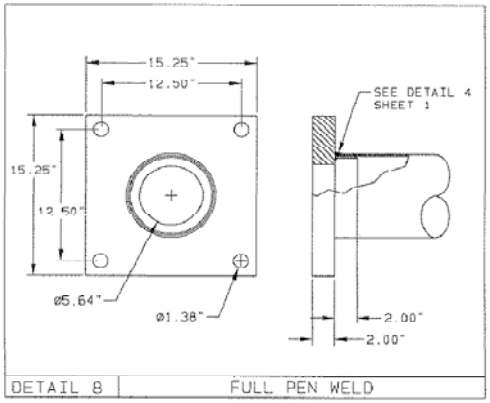
Modulus 7.862 $in^3$

$P_{max}$ 6.017 kip

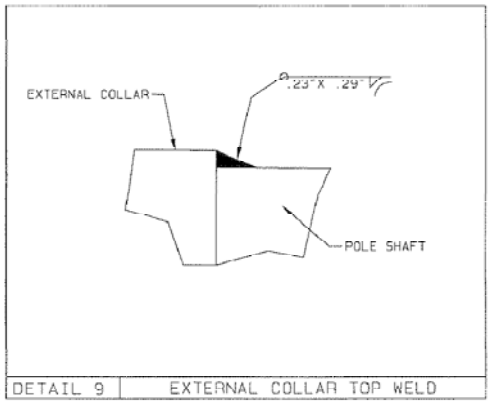
$P_{min}$ 1.77 kip

$S_{max}$ 34 ksi

$S_{min}$ 10 ksi

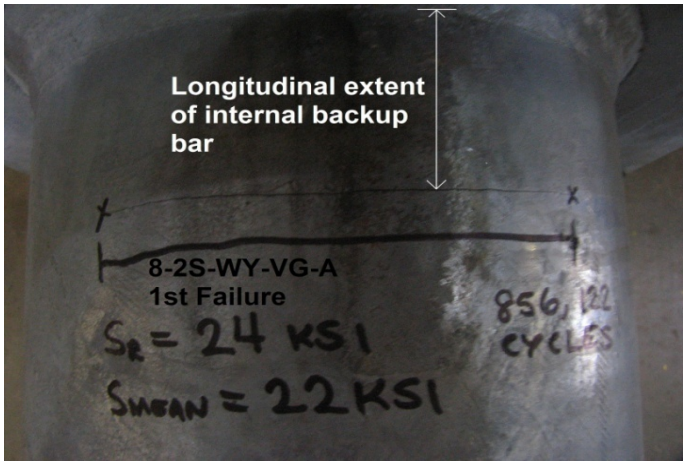



DETAIL 8 FULL PEN WELD

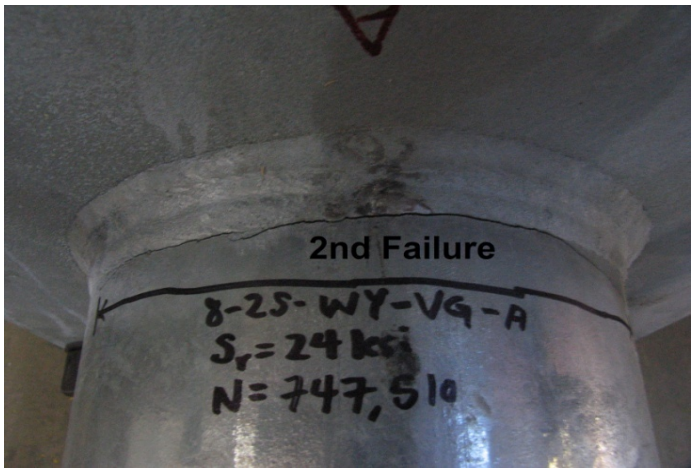



DETAIL 9 EXTERNAL COLLAR TOP WELD

Failure 1




Failure 2




Back up bar fit up

Sample: 8-2S-WY-VG-B

Geometry:

**Results:**

Length: 86 5/8

All lengths measured in inches

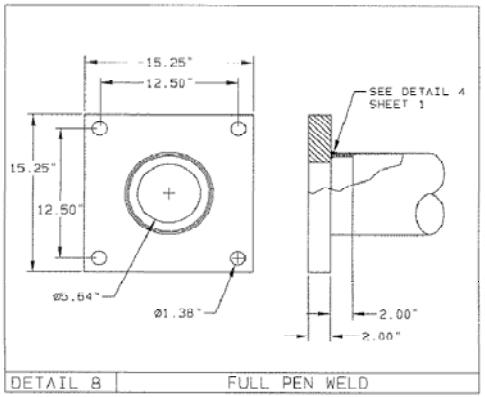
| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 1,603,632 |
| Location: | RUNOUT |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 8 | 0.163 |
| 2 | 7 15/16 | 0.166 |
| 3 | | 0.168 |
| Average | 7.98 | 0.166 |

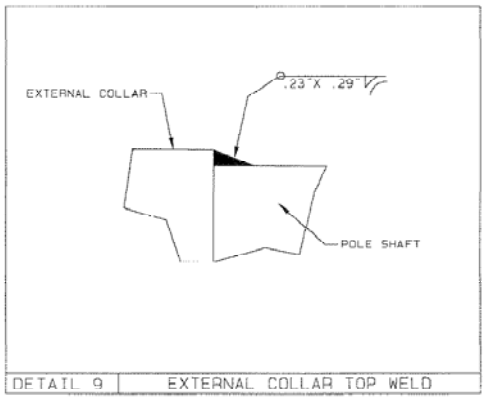
| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.017 | 7/16 | 13/16 |
| | 7/16 | 7/8 |
| | 7/16 | 7/8 |
| 2.017 | 7/16 | 0.854 |

Loads: (average modulus for A and B)

| | | | | |
|---|---|---|---|---|
| Modulus | 7.862 | $in^3$ | $P_{max}$ | 6.017 kip |
| | | | $P_{min}$ | 1.77 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |



DETAIL 8 FULL PEN WELD



DETAIL 9 EXTERNAL COLLAR TOP WELD

Sample: 8-2S-EC-VG-A

Geometry:

**Results:**

Length: 86 5/8

All lengths measured in inches

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 512,860 |
| Location: | COLLAR WELD |

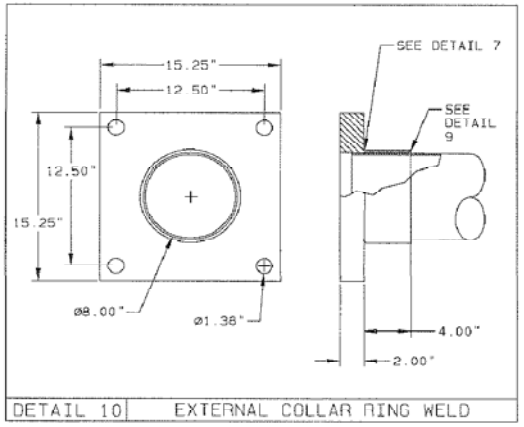
| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 7 9/16 | 0.186 |
| 2 | 7 9/16 | 0.19 |
| 3 | | 0.194 |
| Average | 7 9/16 | 0.19 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 1.997 | 13/16 | 13/32 |
| 1.996 | 13/16 | 7/16 |
| 2.044 | 13/16 | 13/32 |
| 2.0123 | 0.813 | 0.417 |

| Collar | | |
|---|---|---|
| | Weld | |
| Height | Wall | Collar |
| 4 1/16 | 5/8 | 1/4 |
| 4 1/8 | 9/16 | 1/4 |
| | 5/8 | 1/4 |
| 4 3/32 | 0.604 | 0.25 |

Loads: (average for A and B)

| | | | | |
|---|---|---|---|---|
| Modulus | 8.712 | $in^3$ | $P_{max}$ | 6.077 kip |
| | | | $P_{min}$ | 2.549 kip |
| $S_{max}$ | 31 | ksi | | |
| $S_{min}$ | 13 | ksi | | |

Sample: 8-2S-EC-VG-B

Geometry:

**Results:**

Length: 86 11/16

All lengths measured in inches

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 653,208 |
| Location: | COLLAR WELD |

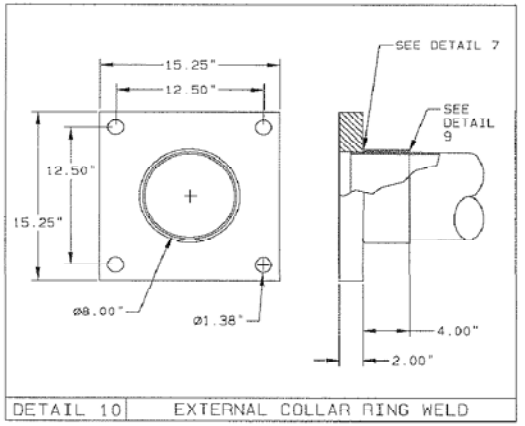
| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 7 5/8 | 0.186 |
| 2 | 7 5/8 | 0.188 |
| 3 | | 0.181 |
| Average | 7 5/8 | 0.185 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 1.992 | 3/4 | 1/3 |
| 1.991 | 11/16 | 3/8 |
| 1.990 | 3/4 | 5/16 |
| 1.991 | 0.729 | 0.333 |

| Collar | | |
|---|---|---|
| | Weld | |
| Height | Wall | Collar |
| 4 | 9/16 | 1/5 |
| 4 | 5/8 | 5/16 |
| | 9/16 | 3/16 |
| 4 | 0.583 | 0.229 |

Loads: (average for A and B)

| | | | | |
|---|---|---|---|---|
| Modulus | 8.712 | $in^3$ | $P_{max}$ | 6.077 kip |
| | | | $P_{min}$ | 2.549 kip |
| $S_{max}$ | 31 | ksi | | |
| $S_{min}$ | 13 | ksi | | |

Sample: 12-2S-WY-VG-A

Geometry:

**Results:**

Length: 86 5/8

All lengths measured in inches

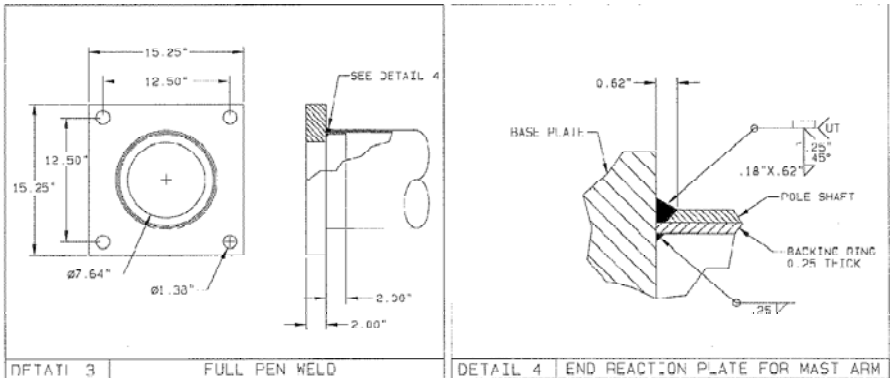
| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 1,053,554 |
| Location: | Base plate weld toe |

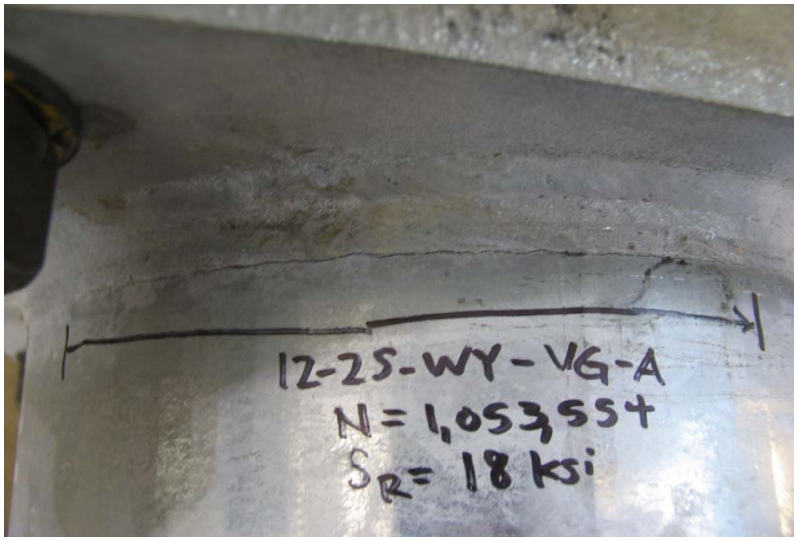
| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 7 9/16 | 0.186 |
| 2 | 7 9/16 | 0.19 |
| 3 | | 0.194 |
| Average | 7 9/16 | 0.19 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 1.997 | 5/8 | 1/4 |
| 1.996 | 9/16 | 1/4 |
| 2.044 | 5/8 | 1/4 |
| 2.012 | 0.604 | 0.250 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 18.980 | $in^3$ | $P_{max}$ | 5.540 kip |
| | | | $P_{min}$ | 13.22 kip |
| $S_{max}$ | 31 | ksi | | |
| $S_{min}$ | 13 | ksi | | |



Sample: 12-2S-WY-VG-B

Geometry:

**Results:**

Length: 85 15/16

All lengths measured in inches

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 880,807 |
| Location: | Base Plate Weld |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 12 | 0.178 |
| 2 | 11 13/16 | 0.179 |
| 3 | | 0.177 |
| Average | 11.969 | 0.178 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.055 | 13/16 | 1/2 |
| 1.989 | 13/16 | 7/16 |
| 2.010 | 13/16 | 7/16 |
| 2.018 | 0.8125 | 0.458 |

Loads:

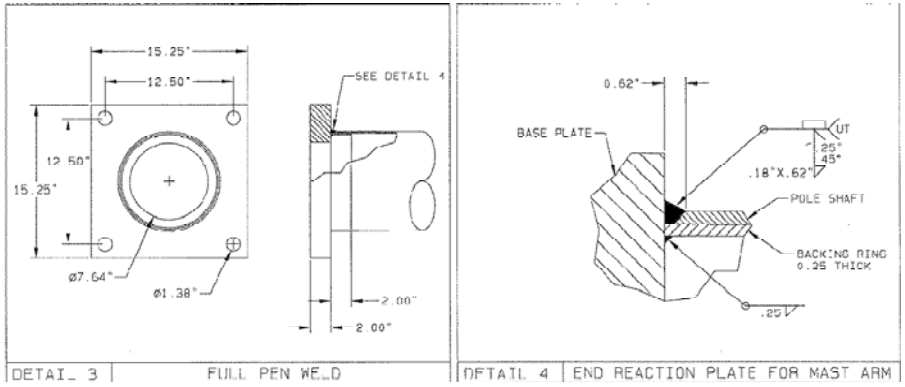
Modulus 19.050 $in^3$

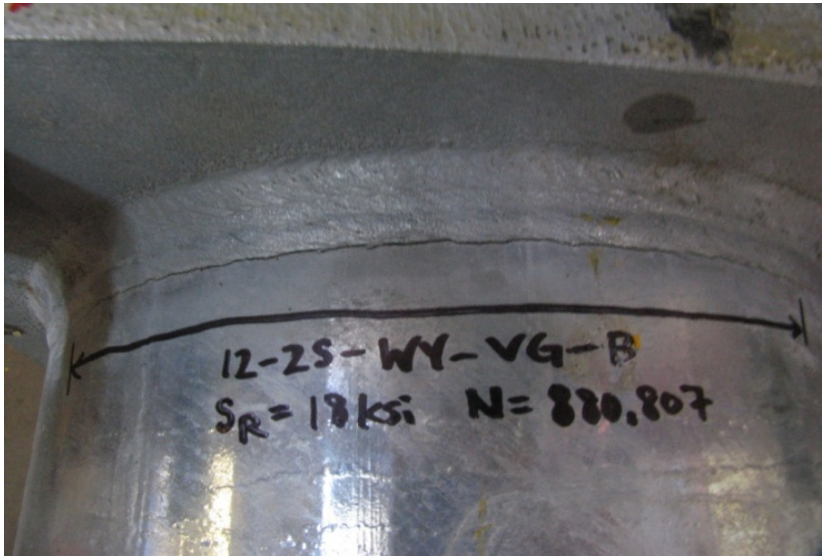
$P_{max}$ 13.270 kip

$P_{min}$ 5.565 kip

$S_{max}$ 31 ksi

$S_{min}$ 13 ksi



**Sample:** 12-2S-EC-VG-A

Geometry:

**Results:**

Length: 85 15/16

All lengths measured in inches

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 805,991 |
| Location: | RUNOUT |

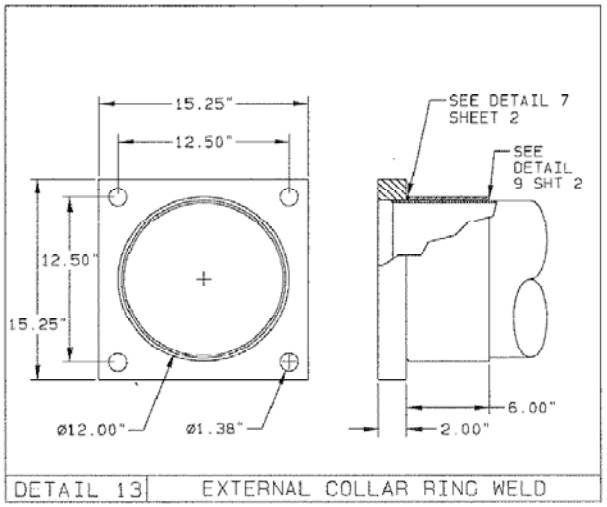
| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 11 5/8 | 0.178 |
| 2 | 11 1/16 | 0.179 |
| 3 | | 0.18 |
| Average | 11.344 | 0.179 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.003 | 11/16 | 5/16 |
| 1.999 | 11/16 | 5/16 |
| 2.008 | 5/8 | 9/32 |
| 2.003 | 0.667 | 0.302 |

| Collar | | |
|---|---|---|
| | Weld | |
| Height | Wall | Collar |
| 6 | 5/8 | 1/4 |
| 6 | 5/8 | 1/4 |
| | 5/8 | 1/4 |
| 6 | 0.625 | 0.250 |

Loads: (average for A and B)

| | | | | |
|---|---|---|---|---|
| Modulus | 19.174 | $in^3$ | $P_{max}$ | 13.375 kip |
| | | | $P_{min}$ | 5.609 kip |
| $S_{max}$ | 31 | ksi | | |
| $S_{min}$ | 13 | ksi | | |



Sample: 12-2S-EC-VG-B

Geometry:

**Results:**

Length: 85 7/8

All lengths measured in inches

Failure 1

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 468,601 |
| Location: | Collar Weld Toe |

Failure 2

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 337,390 |
| Location: | Collar Weld Toe |

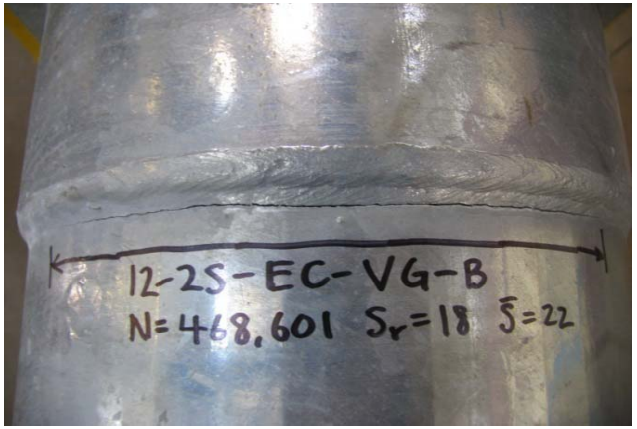
| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 11 5/8 | 0.178 |
| 2 | 11 11/16 | 0.179 |
| 3 | | 0.239 |
| Average | 11.656 | 0.199 |

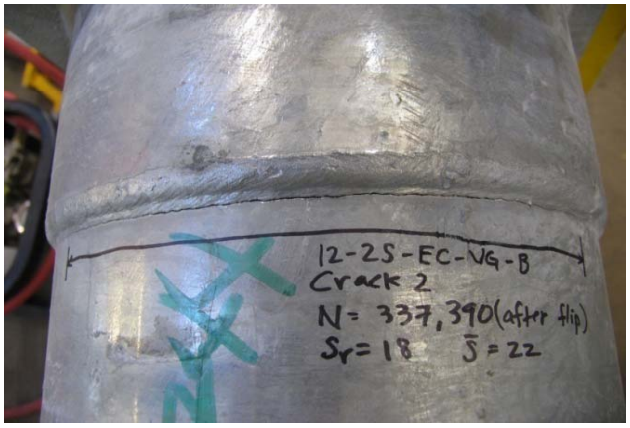
| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 1.996 | 3/4 | 7/16 |
| 1.994 | 3/4 | 1/2 |
| 2.010 | 7/8 | 15/32 |
| 2.000 | 0.792 | 0.469 |

| Collar | | |
|---|---|---|
| | Weld | |
| Height | Wall | Collar |
| 6 1/8 | 5/8 | 1/4 |
| 6 1/8 | 1/2 | 9/32 |
| | 9/16 | 1/4 |
| 6 1/8 | 0.563 | 0.260 |

Loads: (average modulus for A and B)

| | | | | |
|---|---|---|---|---|
| Modulus | 19.174 | $in^3$ | $P_{max}$ | 13.375 kip |
| | | | $P_{min}$ | 5.609 kip |
| $S_{max}$ | 31 | ksi | | |
| $S_{min}$ | 13 | ksi | | |



Sample: 10-3R-WY-VG-A

**TEST 1**

Geometry:

**Results:**

Length: 86 11/16

All lengths measured in inches

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 8,037,420 |
| Location: | RUNOUT |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.177 |
| 2 | 9 15/16 | 0.175 |
| 3 | | 0.174 |
| Average | 9 15/16 | 0.175 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.025 | 23/32 | 9/32 |
| 3.024 | 3/4 | 11/32 |
| 3.027 | 25/32 | 3/8 |
| 3.025 | 0.750 | 0.333 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 12.801 | $in^3$ | $P_{max}$ | 9.032 kip |
| | | | $P_{min}$ | 3.788 kip |
| $S_{max}$ | 31 | ksi | | |
| $S_{min}$ | 13 | ksi | | |

Sample: 10-3R-WY-VG-B

**TEST 1**

Geometry:

**Results:**

Length: 86 3/4

All lengths measured in inches

| | |
|---|---|
| Sr | 18 |
| Smean | 22 |
| Cycles | 8,037,420 |
| Location: | RUNOUT |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.176 |
| 2 | 9 7/8 | 0.17 |
| 3 | | 0.175 |
| Average | 9 29/32 | 0.174 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.021 | 3/4 | 9/32 |
| 3.019 | 3/4 | 11/32 |
| 3.025 | 23/32 | 9/32 |
| 3.022 | 0.740 | 0.302 |

Loads:

Modulus 12.801 $in^3$

$P_{max}$ 9.032 kip

$P_{min}$ 3.788 kip

$S_{max}$ 31 ksi

$S_{min}$ 13 ksi

Sample: 10-3R-WY-VG-A

**TEST 2**

Geometry:

**Results:**

Length: 86 3/4

All lengths measured in inches

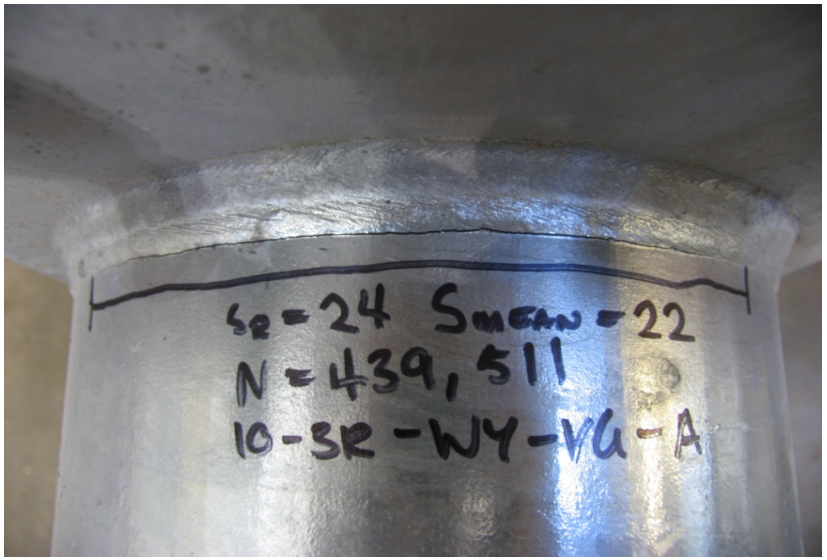
| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 439,511 |
| Location: | |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.177 |
| 2 | 9 15/16 | 0.175 |
| 3 | | 0.174 |
| Average | 9 15/16 | 0.175 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.025 | 23/32 | 9/32 |
| 3.024 | 3/4 | 11/32 |
| 3.027 | 25/32 | 3/8 |
| 3.025 | 0.750 | 0.333 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 12.801 | $in^3$ | $P_{max}$ | 9.906 kip |
| | | | $P_{min}$ | 2.914 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |



Sample: 10-3R-WY-VG-B

**TEST 2**

Geometry:

**Results:**

Length: 86 3/4

All lengths measured in inches

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 343,175 |
| Location: | Weld Toe |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.176 |
| 2 | 9 7/8 | 0.17 |
| 3 | | 0.175 |
| Average | 9 29/32 | 0.174 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.021 | 3/4 | 9/32 |
| 3.019 | 3/4 | 11/32 |
| 3.025 | 23/32 | 9/32 |
| 3.022 | 0.740 | 0.302 |

Loads:

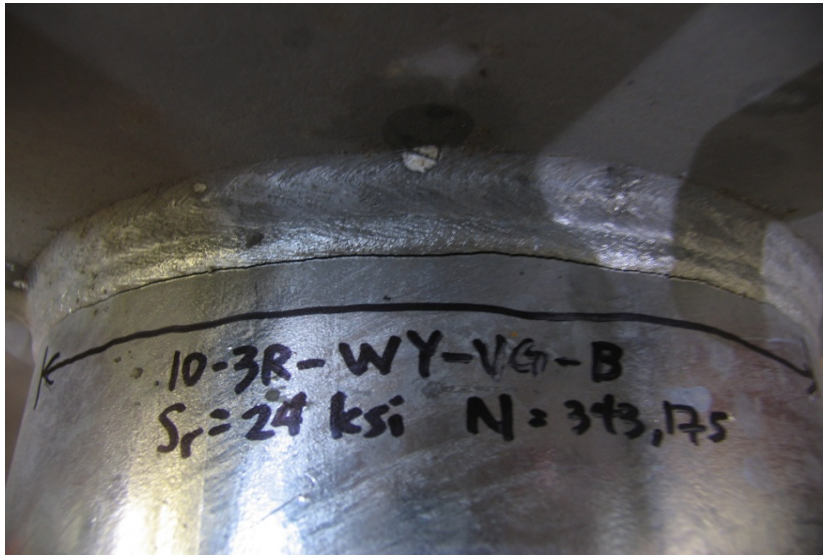
Modulus 12.801 $in^3$

$P_{max}$ 9.906 kip

$P_{min}$ 2.914 kip

$S_{max}$ 34 ksi

$S_{min}$ 10 ksi



**Effective Stress Range Calculations**

**10-3R-WY-VG-A**

| | |
|---|---|
| Sr1 = | 18 |
| Sr2 = | 24 |
| n18 = | 8037420 |
| n24 = | 343175 |
| Ntot = | 8380595 |
| γ18 = | 0.959051 |
| γ24 = | 0.040949 |
| **(Sr)eff =** | **18.33** |

**10-3R-WY-VG-B**

| | |
|---|---|
| Sr1 = | 18 |
| Sr2 = | 24 |
| n18 = | 8037420 |
| n24 = | 439511 |
| Ntot = | 8476931 |
| γ18 = | 0.948152 |
| γ24 = | 0.051848 |
| **(Sr)eff =** | **18.42** |

Miners Rule:

$$S_{r,eff} = \left(\sum \gamma_i S_r^3\right)^{1/3}$$

Sample: 10-3R-WY-VG-A

**Effective Stress Range**

**Results:**

| | |
|---|---|
| Sr | 18.33 |
| Smean | |
| Cycles | 8,380,595 |
| Location: | |

Geometry:

Length: 86 3/4

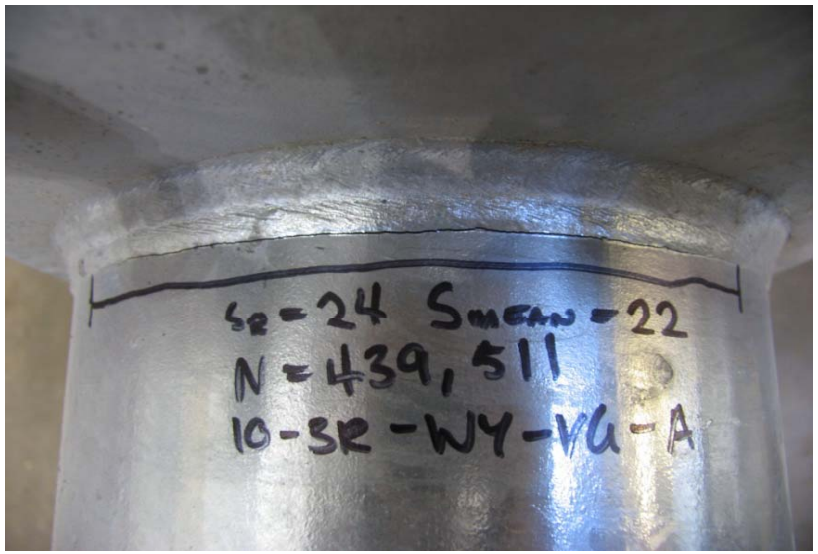
All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.177 |
| 2 | 9 15/16 | 0.175 |
| 3 | | 0.174 |
| Average | 9 15/16 | 0.175 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.025 | 23/32 | 9/32 |
| 3.024 | 3/4 | 11/32 |
| 3.027 | 25/32 | 3/8 |
| 3.025 | 0.750 | 0.333 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 12.801 | $in^3$ | $P_{max}$ | 9.906 kip |
| | | | $P_{min}$ | 2.914 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |



Sample: 10-3R-WY-VG-B

**Effective Stress Range**

**Results:**

| | |
|---|---|
| Sr | 18.42 |
| Smean | |
| Cycles | 8,476,931 |
| Location: | Weld Toe |

Geometry:

Length: 86 3/4

All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.176 |
| 2 | 9 7/8 | 0.17 |
| 3 | | 0.175 |
| Average | 9 29/32 | 0.174 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.021 | 3/4 | 9/32 |
| 3.019 | 3/4 | 11/32 |
| 3.025 | 23/32 | 9/32 |
| 3.022 | 0.740 | 0.302 |

Loads:

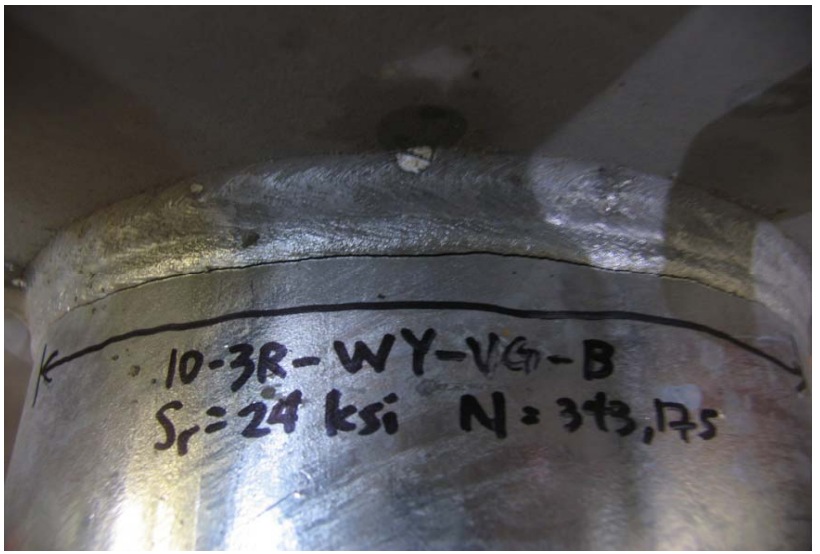
Modulus 12.801 $in^3$

$P_{max}$ 9.906 kip

$P_{min}$ 2.914 kip

$S_{max}$ 34 ksi

$S_{min}$ 10 ksi



Sample: 10-3R-WY-VP-A

Geometry:

**Results:**

Length: 86 11/16

All lengths measured in inches

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 10,055,123 |
| Location: | RUNOUT |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.177 |
| 2 | 9 15/16 | 0.178 |
| 3 | | 0.177 |
| Average | 9 15/16 | 0.177 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.025 | 25/32 | 2/7 |
| 3.014 | 25/32 | 9/32 |
| 3.025 | 13/16 | 5/16 |
| 3.021 | 19/24 | 7/24 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.040 | $in^3$ | $P_{max}$ | 10.120 kip |
| | | | $P_{min}$ | 2.98 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |

Sample: 10-3R-WY-VP-B

Geometry:

**Results:**

Length: 86 11/16

All lengths measured in inches

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 10,055,123 |
| Location: | RUNOUT |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | 0.177 |
| 2 | 9 15/16 | 0.178 |
| 3 | | 0.176 |
| Average | 9 31/32 | 0.177 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.007 | 23/32 | 5/16 |
| 3.007 | 3/4 | 11/32 |
| 3.016 | 25/32 | 3/8 |
| 3.010 | 3/4 | 11/32 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.120 | $in^3$ | $P_{max}$ | 10.12 kip |
| | | | $P_{min}$ | 2.98 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |

Sample: 10-3R-WY-VB-A

**Incorrect Loads**

**Results:**

| | |
|---|---|
| Sr | 16.37 |
| Smean | 14.975 |
| Cycles | 1,630,350 |
| Location: | RUNOUT |

Geometry:

Length: 86 3/4

All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.182 |
| 2 | 9 15/16 | 0.179 |
| 3 | | 0.176 |
| Average | 9 15/16 | 0.179 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.994 | 25/32 | 3/8 |
| 2.990 | 27/32 | 3/8 |
| 2.992 | | |
| 2.992 | 13/16 | 3/8 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.130 | $in^3$ | $P_{max}$ | 6.92 kip |
| | | | $P_{min}$ | 2.03 kip |
| $S_{max}$ | 6.79 | ksi | | |
| $S_{min}$ | 23.16 | ksi | | |

Sample: 10-3R-WY-VB-B

**Incorrect Loads**

**Results:**

| | |
|---|---|
| Sr | 16.37 |
| Smean | 14.975 |
| Cycles | 1,630,350 |
| Location: | RUNOUT |

Geometry:

Length: 86 3/4

All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | 0.175 |
| 2 | 10 | 0.176 |
| 3 | | 0.178 |
| Average | 10 | 0.176 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.992 | 13/16 | 9/32 |
| 2.997 | 11/16 | 11/32 |
| 2.990 | | |
| 2.993 | 3/4 | 5/16 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.130 | $in^3$ | $P_{max}$ | 6.92 kip |
| | | | $P_{min}$ | 2.03 kip |
| $S_{max}$ | 23.16 | ksi | | |
| $S_{min}$ | 6.79 | ksi | | |

Sample: 10-3R-WY-VB-A

**Correct Loads**

**Results:**

Failure 1

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 602,392 |
| Location: | Weld Toe |

Failure 2

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 490,121 |
| Location: | Weld Toe |

Geometry:

Length: 86 3/4

All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.182 |
| 2 | 9 15/16 | 0.179 |
| 3 | | 0.176 |
| Average | 9 15/16 | 0.179 |

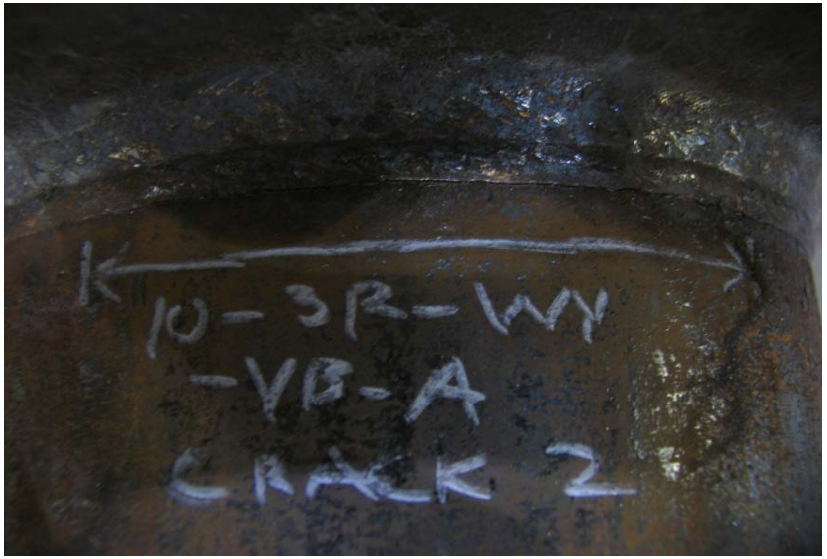
| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.994 | 25/32 | 3/8 |
| 2.990 | 27/32 | 3/8 |
| 2.992 | | |
| 2.992 | 13/16 | 3/8 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.130 | $in^3$ | $P_{max}$ | 10.16 kip |
| | | | $P_{min}$ | 2.99 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |

Failure 1


Failure 2



Sample: 10-3R-WY-VB-B

**Correct Loads**

**Results:**

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 1,886,425 |
| Location: | 8" Away from Weld |

Geometry:

Length: 86 3/4

All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | 0.175 |
| 2 | 10 | 0.176 |
| 3 | | 0.178 |
| Average | 10 | 0.176 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.992 | 13/16 | 9/32 |
| 2.997 | 11/16 | 11/32 |
| 2.990 | | |
| 2.993 | 3/4 | 5/16 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.130 | $in^3$ | $P_{max}$ | 10.16 kip |
| | | | $P_{min}$ | 2.99 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |

**Effective Stress Range Calculations**

**10-3R-WY-VB-A1**

| | |
|---|---|
| Sr1 = | 16.37 |
| Sr2 = | 24 |
| n18 = | 1630350 |
| n24 = | 602392 |
| Ntot = | 2232742 |
| γ18 = | 0.730201 |
| γ24 = | 0.269799 |
| **(Sr)eff =** | **19.07** |

**10-3R-WY-VB-A2**

| | |
|---|---|
| Sr1 = | 16.37 |
| Sr2 = | 24 |
| n18 = | 1630350 |
| n24 = | 1092513 |
| Ntot = | 2722863 |
| γ18 = | 0.598763 |
| γ24 = | 0.401237 |
| **(Sr)eff =** | **20.14** |

**10-3R-WY-VB-B**

| | |
|---|---|
| Sr1 = | 16.37 |
| Sr2 = | 24 |
| n18 = | 1630350 |
| n24 = | 1886425 |
| Ntot = | 3516775 |
| γ18 = | 0.463592 |
| γ24 = | 0.536408 |
| **(Sr)eff =** | **21.14** |

Miners Rule:

$$S_{r,eff} = \left(\sum \gamma_i S_r^3\right)^{1/3}$$

Sample: 10-3R-WY-VB-A

**Effective**

Geometry:

**Results:**

Length: 86 3/4

All lengths measured in inches

Failure 1

| | |
|---|---|
| Sr | 19.07 |
| Smean | |
| Cycles | 2,232,742 |
| Location: | Weld Toe |

Failure 2

| | |
|---|---|
| Sr | 20.14 |
| Smean | |
| Cycles | 2,722,863 |
| Location: | Weld Toe |

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | 0.182 |
| 2 | 9 15/16 | 0.179 |
| 3 | | 0.176 |
| Average | 9 15/16 | 0.179 |

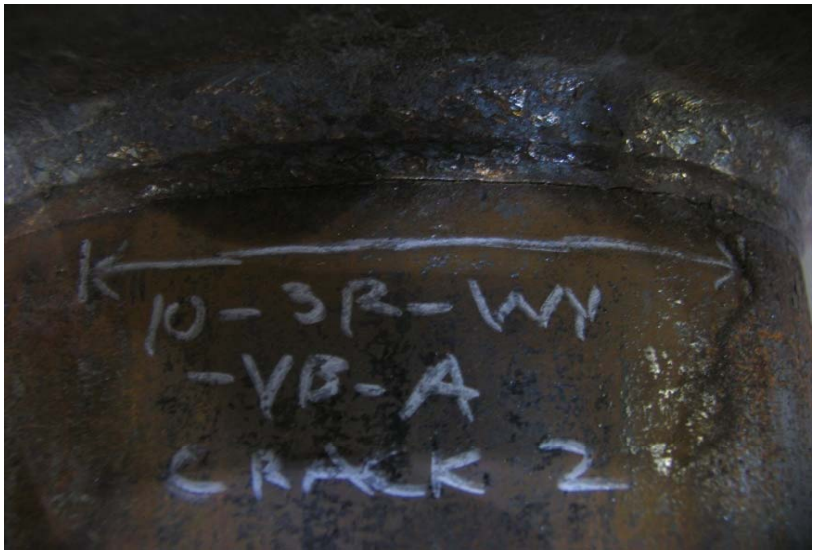
| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.994 | 25/32 | 3/8 |
| 2.990 | 27/32 | 3/8 |
| 2.992 | | |
| 2.992 | 13/16 | 3/8 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.130 | $in^3$ | $P_{max}$ | 10.16 kip |
| | | | $P_{min}$ | 2.99 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |

Failure 1


Failure 2



Sample: 10-3R-WY-VB-B

**Effective**

**Results:**

| | |
|---|---|
| Sr | 21.14 |
| Smean | |
| Cycles | 3,516,775 |
| Location: | 8" Away from Weld |

Geometry:

Length: 86 3/4

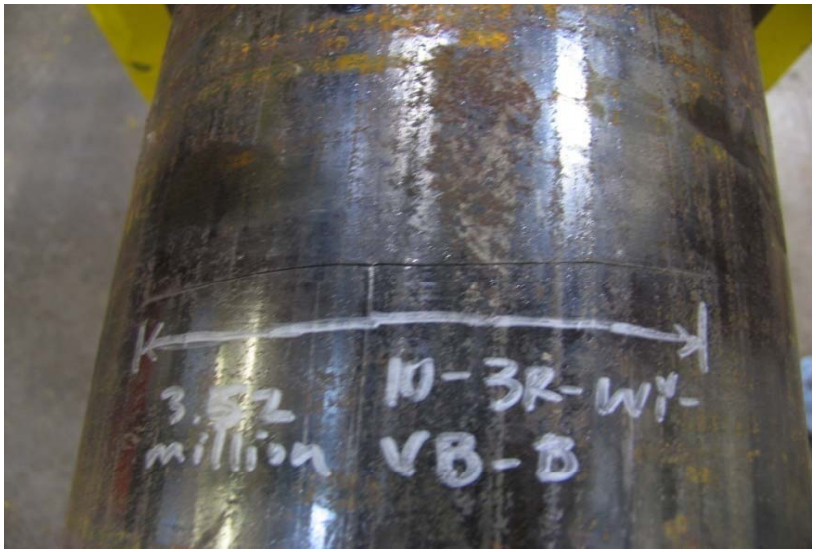
All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | 0.175 |
| 2 | 10 | 0.176 |
| 3 | | 0.178 |
| Average | 10 | 0.176 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 2.992 | 13/16 | 9/32 |
| 2.997 | 11/16 | 11/32 |
| 2.990 | | |
| 2.993 | 3/4 | 5/16 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.130 | $in^3$ | $P_{max}$ | 10.16 kip |
| | | | $P_{min}$ | 2.99 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |



Sample: Ameron A

Geometry:

**Results:**

Length: 86 3/4

All lengths measured in inches

Failure 1

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 222,649 |
| Location: | |

Failure 2

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 212,891 |
| Location: | Weld Toe |

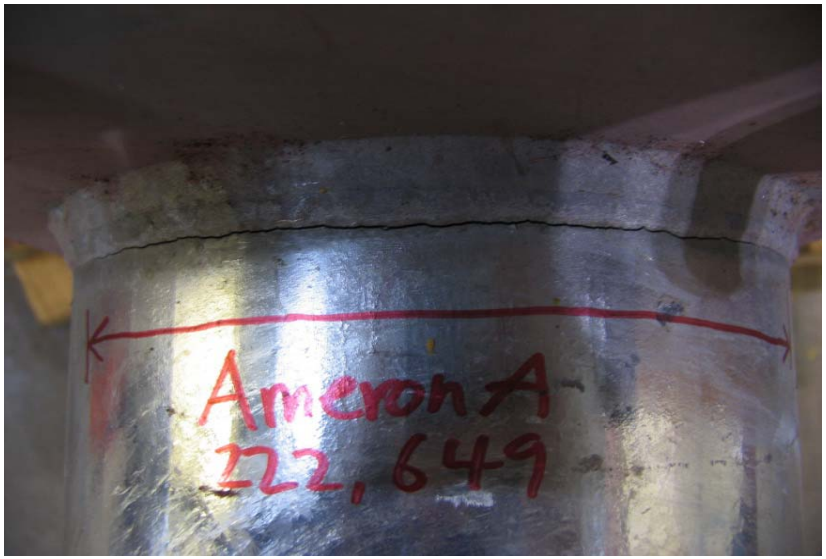
| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 10 | Nominal |
| 2 | 10 | |
| 3 | | |
| Average | 10 | 0.179 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.030 | 11/16 | 1/4 |
| 3.030 | 5/8 | 9/32 |
| 3.050 | | |
| 3.037 | 21/32 | 17/64 |

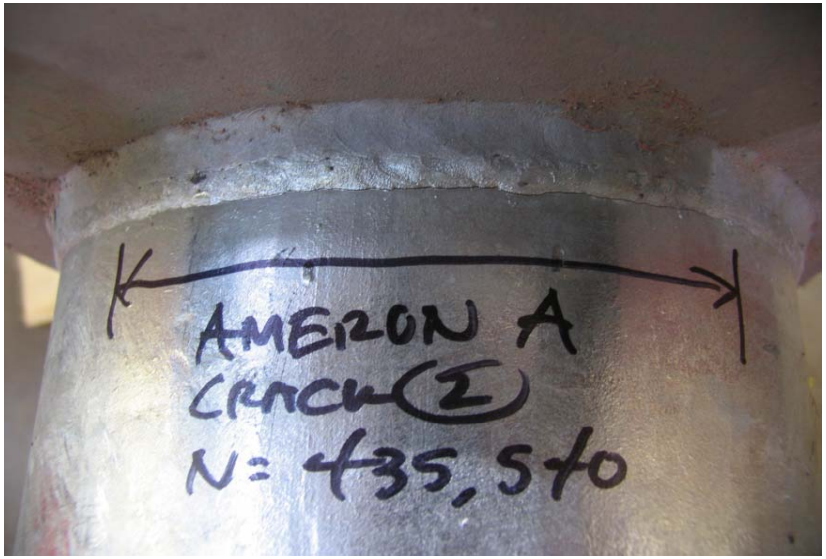
Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.260 | $in^3$ | $P_{max}$ | 10.29 kip |
| | | | $P_{min}$ | 3.03 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |

Failure 1




Failure 2



Sample: Union Metal A

Geometry:

**Results:**

| | |
|---|---|
| Sr | 24 |
| Smean | 22 |
| Cycles | 1,873,499 |
| Location: | |

Length: 86 7/8

All lengths measured in inches

| | Mast Arm | |
|---|---|---|
| | Diameter | Thickness |
| 1 | 9 15/16 | Nominal |
| 2 | 10 | |
| 3 | | |
| Average | 9 31/32 | 0.179 |

| Base Plate | | |
|---|---|---|
| | Weld | |
| Thickness | Wall | Baseplate |
| 3.050 | 15/32 | 5/16 |
| 3.055 | 17/32 | 5/16 |
| 3.040 | | |
| 3.048 | 1/2 | 5/16 |

Loads:

| | | | | |
|---|---|---|---|---|
| Modulus | 13.240 | $in^3$ | $P_{max}$ | 10.29 kip |
| | | | $P_{min}$ | 3.03 kip |
| $S_{max}$ | 34 | ksi | | |
| $S_{min}$ | 10 | ksi | | |