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## **ENCANA**

### **72" X 180" 250 PSI 3-PHASE HORIZONTAL SEPARATOR**

**S/N 129959**

**J2465**

**RFID #90009685**

**P O NUMBER: 67231**

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# **ENCANA**

**72" X 180" 3-PHASE SEPARATOR**

**J2465 / SERIAL NO.: 129959**

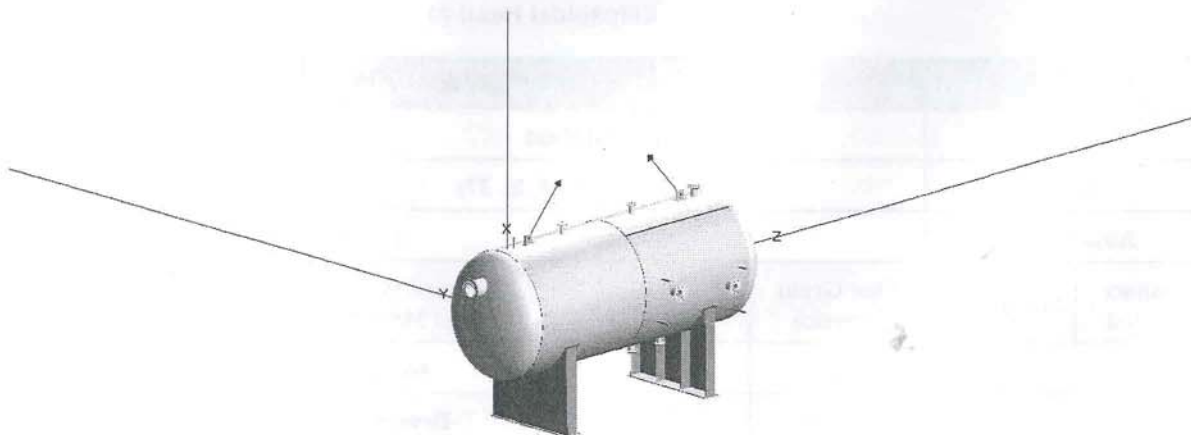
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# Dragon Products LTD

Liberty, Texas



## COMPRESS Pressure Vessel Design Calculations

**Item:** 72 x 180 3-Phase Separator

**Vessel No:** J2465

**Customer:** Encana

**Director of Engineering:** G. Markham

**Designer:** Joe Fecko

**Date:** January 14, 2016

This vessel conforms to Section VIII, Division I, 2015 Edition of the ASME Code.

*Jim Rogers 5/17/12*  
*JW Mary A.I.*



### Ellipsoidal Head #1

| ASME Section VIII Division 1, 2015 Edition |            |                                |                         |                                |
|--------------------------------------------|------------|--------------------------------|-------------------------|--------------------------------|
| Component                                  |            | Ellipsoidal Head               |                         |                                |
| Material                                   |            | SA-516 70 (II-D p. 18, ln. 37) |                         |                                |
| Attached To                                |            | Cylinder #1                    |                         |                                |
| Impact Tested                              | Normalized | Fine Grain Practice            | PWHT                    | Optimize MDMT/<br>Find MAWP    |
| No                                         | No         | No                             | No                      | No                             |
|                                            |            | Design Pressure (psi)          | Design Temperature (°F) | Design MDMT (°F)               |
| Internal                                   |            | 250                            | 200                     | -20                            |
| Static Liquid Head                         |            |                                |                         |                                |
| Condition                                  |            | P <sub>s</sub> (psi)           | H <sub>s</sub> (in)     | SG                             |
| Test horizontal                            |            | 2.84                           | 78.625                  | 1                              |
| Dimensions                                 |            |                                |                         |                                |
| Inner Diameter                             |            | 72"                            |                         |                                |
| Head Ratio                                 |            | 2                              |                         |                                |
| Minimum Thickness                          |            | 0.513"                         |                         |                                |
| Corrosion                                  | Inner      | 0.0625"                        |                         |                                |
|                                            | Outer      | 0"                             |                         |                                |
| Length L <sub>sf</sub>                     |            | 2"                             |                         |                                |
| Nominal Thickness t <sub>sf</sub>          |            | 0.625"                         |                         |                                |
| Weight and Capacity                        |            |                                |                         |                                |
|                                            |            | Weight (lb) <sup>1</sup>       |                         | Capacity (US gal) <sup>1</sup> |
| New                                        |            | 952.34                         |                         | 246.76                         |
| Corroded                                   |            | 839.81                         |                         | 248.35                         |
| Radiography                                |            |                                |                         |                                |
| Category A joints                          |            | Seamless No RT                 |                         |                                |
| Head to shell seam                         |            | Spot UW-11(a)(5)(b) Type 1     |                         |                                |

<sup>1</sup> includes straight flange





| Results Summary                               |                              |
|-----------------------------------------------|------------------------------|
| Governing condition                           | internal pressure            |
| Minimum thickness per UG-16                   | $0.0625" + 0.0625" = 0.125"$ |
| Design thickness due to internal pressure (t) | <u>0.5129"</u>               |
| <u>Straight Flange</u> governs MDMT           | -20°F                        |

| Factor K                            |                                                |        |
|-------------------------------------|------------------------------------------------|--------|
| $K = (1/6) * [2 + (D / (2 * h))^2]$ |                                                |        |
| Corroded                            | $K = (1/6) * [2 + (72.125 / (2 * 18.0625))^2]$ | 0.9977 |
| New                                 | $K = (1/6) * [2 + (72 / (2 * 18))^2]$          | 1      |

**Design thickness for internal pressure, (Corroded at 200 °F) Appendix 1-4(c)**

$$\begin{aligned}
 t &= P * D * K / (2 * S * E - 0.2 * P) + \text{Corrosion} \\
 &= 250 * 72.125 * 0.997695 / (2 * 20,000 * 1 - 0.2 * 250) + 0.0625 \\
 &= \underline{0.5128"}
 \end{aligned}$$

**% Extreme fiber elongation - UCS-79(d)**

$$\begin{aligned}
 EFE &= (75 * t / R_f) * (1 - R_f / R_o) \\
 &= (75 * 0.625 / 12.5525) * (1 - 12.5525 / \infty) \\
 &= 3.7343\%
 \end{aligned}$$

The extreme fiber elongation does not exceed 5%.



**Straight Flange on Ellipsoidal Head #1**

| ASME Section VIII Division 1, 2015 Edition |            |                                |                         |                             |
|--------------------------------------------|------------|--------------------------------|-------------------------|-----------------------------|
| Component                                  |            | Cylinder                       |                         |                             |
| Material                                   |            | SA-516 70 (II-D p. 18, ln. 37) |                         |                             |
| Impact Tested                              | Normalized | Fine Grain Practice            | PWHT                    | Optimize MDMT/<br>Find MAWP |
| No                                         | No         | No                             | No                      | No                          |
|                                            |            | Design Pressure (psi)          | Design Temperature (°F) | Design MDMT (°F)            |
| Internal                                   |            | 250                            | 200                     | -20                         |
| Static Liquid Head                         |            |                                |                         |                             |
| Condition                                  |            | P <sub>s</sub> (psi)           | H <sub>s</sub> (in)     | SG                          |
| Test horizontal                            |            | 2.84                           | 78.625                  | 1                           |
| Dimensions                                 |            |                                |                         |                             |
| Inner Diameter                             |            | 72"                            |                         |                             |
| Length                                     |            | 2"                             |                         |                             |
| Nominal Thickness                          |            | 0.625"                         |                         |                             |
| Corrosion                                  | Inner      | 0.0625"                        |                         |                             |
|                                            | Outer      | 0"                             |                         |                             |
| Weight and Capacity                        |            |                                |                         |                             |
|                                            |            | Weight (lb)                    |                         | Capacity (US gal)           |
| New                                        |            | 80.71                          |                         | 35.25                       |
| Corroded                                   |            | 72.7                           |                         | 35.37                       |
| Radiography                                |            |                                |                         |                             |
| Longitudinal seam                          |            | Seamless No RT                 |                         |                             |
| Right Circumferential seam                 |            | Spot UW-11(a)(5)(b) Type 1     |                         |                             |



| Results Summary                               |                              |
|-----------------------------------------------|------------------------------|
| Governing condition                           | Internal pressure            |
| Minimum thickness per UG-16                   | $0.0625" + 0.0625" = 0.125"$ |
| Design thickness due to internal pressure (t) | <u>0.5167"</u>               |
| Rated MDMT                                    | -20 °F                       |

| UCS-66 Material Toughness Requirements                                           |        |
|----------------------------------------------------------------------------------|--------|
| Governing thickness, $t_g =$                                                     | 0.625" |
| MDMT =                                                                           | -20°F  |
| Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F. |        |

**Design thickness, (at 200 °F) UG-27(c)(1)**

$$\begin{aligned} t &= P \cdot R / (S \cdot E - 0.60 \cdot P) + \text{Corrosion} \\ &= 250 \cdot 36.0625 / (20,000 \cdot 1.00 - 0.60 \cdot 250) + 0.0625 \\ &= \underline{0.5167"} \end{aligned}$$

**% Extreme fiber elongation - UCS-79(d)**

$$\begin{aligned} \text{EFE} &= (50 \cdot t / R_f) \cdot (1 - R_f / R_o) \\ &= (50 \cdot 0.625 / 36.3125) \cdot (1 - 36.3125 / \infty) \\ &= 0.8606\% \end{aligned}$$

The extreme fiber elongation does not exceed 5%.



**Cylinder #1**

| ASME Section VIII Division 1, 2015 Edition |            |                                |                         |                             |
|--------------------------------------------|------------|--------------------------------|-------------------------|-----------------------------|
| Component                                  |            | Cylinder                       |                         |                             |
| Material                                   |            | SA-516 70 (II-D p. 18, ln. 37) |                         |                             |
| Impact Tested                              | Normalized | Fine Grain Practice            | PWHT                    | Optimize MDMT/<br>Find MAWP |
| No                                         | No         | No                             | No                      | No                          |
|                                            |            | Design Pressure (psi)          | Design Temperature (°F) | Design MDMT (°F)            |
| Internal                                   |            | 250                            | 200                     | -20                         |
| Static Liquid Head                         |            |                                |                         |                             |
| Condition                                  |            | P <sub>s</sub> (psi)           | H <sub>s</sub> (in)     | SG                          |
| Test horizontal                            |            | 2.84                           | 78.625                  | 1                           |
| Dimensions                                 |            |                                |                         |                             |
| Inner Diameter                             |            | 72"                            |                         |                             |
| Length                                     |            | 90"                            |                         |                             |
| Nominal Thickness                          |            | 0.625"                         |                         |                             |
| Corrosion                                  | Inner      | 0.0625"                        |                         |                             |
|                                            | Outer      | 0"                             |                         |                             |
| Weight and Capacity                        |            |                                |                         |                             |
|                                            |            | Weight (lb)                    |                         | Capacity (US gal)           |
| New                                        |            | 3,627.85                       |                         | 1,586.3                     |
| Corroded                                   |            | 3,267.88                       |                         | 1,591.81                    |
| Radiography                                |            |                                |                         |                             |
| Longitudinal seam                          |            | Full UW-11(a) Type 1           |                         |                             |
| Left Circumferential seam                  |            | Spot UW-11(a)(5)(b) Type 1     |                         |                             |
| Right Circumferential seam                 |            | Spot UW-11(a)(5)(b) Type 1     |                         |                             |



| Results Summary                               |                              |
|-----------------------------------------------|------------------------------|
| Governing condition                           | Internal pressure            |
| Minimum thickness per UG-16                   | $0.0625" + 0.0625" = 0.125"$ |
| Design thickness due to internal pressure (t) | <u>0.5167"</u>               |
| Rated MDMT                                    | -20 °F                       |

| UCS-66 Material Toughness Requirements                                           |        |
|----------------------------------------------------------------------------------|--------|
| Governing thickness, $t_g =$                                                     | 0.625" |
| MDMT =                                                                           | -20°F  |
| Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F. |        |

**Design thickness, (at 200 °F) UG-27(c)(1)**

$$\begin{aligned} t &= P \cdot R / (S \cdot E - 0.60 \cdot P) + \text{Corrosion} \\ &= 250 \cdot 36.0625 / (20,000 \cdot 1.00 - 0.60 \cdot 250) + 0.0625 \\ &= \underline{0.5167"} \end{aligned}$$

**% Extreme fiber elongation - UCS-79(d)**

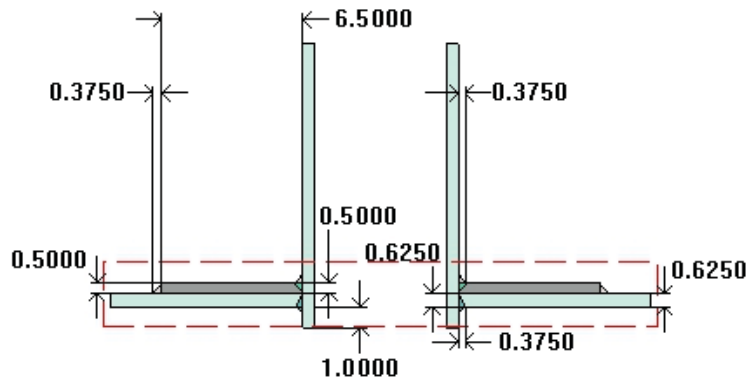
$$\begin{aligned} \text{EFE} &= (50 \cdot t / R_f) \cdot (1 - R_f / R_o) \\ &= (50 \cdot 0.625 / 36.3125) \cdot (1 - 36.3125 / \infty) \\ &= 0.8606\% \end{aligned}$$

The extreme fiber elongation does not exceed 5%.



# MANWAY (N1)

## ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

## Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 270°        |
| Nozzle center line offset to datum line | 108"        |
| End of nozzle to shell center           | 48.625"     |
| Passes through a Category A joint       | No          |

## Nozzle

|                                                                    |                                         |
|--------------------------------------------------------------------|-----------------------------------------|
| Description                                                        | NPS 24 XS                               |
| Access opening                                                     | No                                      |
| Material specification                                             | SA-106 B Smls pipe (II-D p. 14, ln. 15) |
| Inside diameter, new                                               | 23"                                     |
| Pipe nominal wall thickness                                        | 0.5"                                    |
| Pipe minimum wall thickness <sup>1</sup>                           | 0.4375"                                 |
| Corrosion allowance                                                | 0.0625"                                 |
| Projection available outside vessel, L <sub>pr</sub>               | 11.5"                                   |
| Internal projection, h <sub>new</sub>                              | 1"                                      |
| Projection available outside vessel to flange face, L <sub>f</sub> | 12"                                     |
| Local vessel minimum thickness                                     | 0.625"                                  |
| Liquid static head included                                        | 0 psi                                   |



|                               |                                |
|-------------------------------|--------------------------------|
| Longitudinal joint efficiency | 1                              |
| <b>Reinforcing Pad</b>        |                                |
| Material specification        | SA-516 70 (II-D p. 18, ln. 37) |
| Diameter, $D_p$               | 37"                            |
| Thickness, $t_e$              | 0.5"                           |
| Is split                      | No                             |
| <b>Welds</b>                  |                                |
| Inner fillet, $Leg_{41}$      | 0.375"                         |
| Outer fillet, $Leg_{42}$      | 0.375"                         |
| Lower fillet, $Leg_{43}$      | 0.375"                         |
| Nozzle to vessel groove weld  | 0.625"                         |
| Pad groove weld               | 0.5"                           |

<sup>1</sup> Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 24 Class 150 SO A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | Yes                                                       |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| External fillet weld leg (UW-21)                                                                                                | 0.625" (0.6125 in min)                                    |
| Internal fillet weld leg (UW-21)                                                                                                | 0.375" (0.3393 in min)                                    |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| <b>Notes</b>                                                                                                                    |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |



| UCS-66 Material Toughness Requirements Nozzle                             |         |
|---------------------------------------------------------------------------|---------|
| Governing thickness, $t_g =$                                              | 0.4375" |
| Exemption temperature from Fig UCS-66 Curve B =                           | -13°F   |
| $t_r = 250 * 11.5625 / (17,100 * 1 - 0.6 * 250) =$                        | 0.1705" |
| Stress ratio $= t_r * E^* / (t_n - c) = 0.1705 * 1 / (0.4375 - 0.0625) =$ | 0.4548  |
| Reduction in MDMT, $T_R$ from Fig UCS-66.1 =                              | 68.9°F  |
| MDMT = max[ MDMT - $T_R$ , -55] = max[ -13 - 68.9 , -55] =                | -55°F   |
| Material is exempt from impact testing at the Design MDMT of -20°F.       |         |

| UCS-66 Material Toughness Requirements Pad                               |         |
|--------------------------------------------------------------------------|---------|
| Governing thickness, $t_g =$                                             | 0.5"    |
| Exemption temperature from Fig UCS-66 Curve B =                          | -7°F    |
| $t_r = 250 * 36.0625 / (20,000 * 1 - 0.6 * 250) =$                       | 0.4542" |
| Stress ratio $= t_r * E^* / (t_n - c) = 0.4542 * 1 / (0.625 - 0.0625) =$ | 0.8075  |
| Reduction in MDMT, $T_R$ from Fig UCS-66.1 =                             | 19.3°F  |
| MDMT = max[ MDMT - $T_R$ , -55] = max[ -7 - 19.3 , -55] =                | -26.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F.      |         |

### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 10.5608                                                          | 10.5648     | 2.4909         | 0.6421         | 0.6012         | 6.5            | 0.3306  | 0.3906                  | 0.4375           |





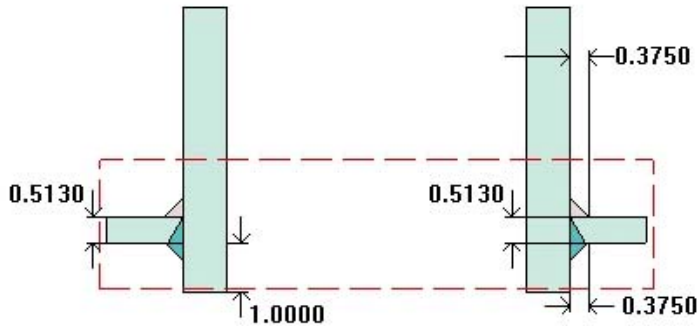
| UG-41 Weld Failure Path Analysis Summary (lb <sub>f</sub> )   |                               |                      |                               |                      |                               |                      |
|---------------------------------------------------------------|-------------------------------|----------------------|-------------------------------|----------------------|-------------------------------|----------------------|
| All failure paths are stronger than the applicable weld loads |                               |                      |                               |                      |                               |                      |
| Weld load<br>W                                                | Weld load<br>W <sub>1-1</sub> | Path 1-1<br>strength | Weld load<br>W <sub>2-2</sub> | Path 2-2<br>strength | Weld load<br>W <sub>3-3</sub> | Path 3-3<br>strength |
| 163,017.97                                                    | 148,058                       | 407,415.66           | 37,081.84                     | 801,525.53           | 169,893.84                    | 617,685.81           |

| UW-16 Weld Sizing Summary                 |                            |                          |                       |
|-------------------------------------------|----------------------------|--------------------------|-----------------------|
| Weld description                          | Required weld<br>size (in) | Actual weld<br>size (in) | Status                |
| Nozzle to pad fillet (Leg <sub>41</sub> ) | 0.25                       | 0.2625                   | weld size is adequate |
| Pad to shell fillet (Leg <sub>42</sub> )  | 0.25                       | 0.2625                   | weld size is adequate |



### INLET (N4)

#### ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

#### Location and Orientation

|                                   |                     |
|-----------------------------------|---------------------|
| Located on                        | Ellipsoidal Head #1 |
| Orientation                       | 0°                  |
| End of nozzle to datum line       | -32.9906"           |
| Calculated as hillside            | Yes                 |
| Distance to head center, R        | 19.375"             |
| Passes through a Category A joint | No                  |

#### Nozzle

|                                                                    |                             |
|--------------------------------------------------------------------|-----------------------------|
| Access opening                                                     | No                          |
| Material specification                                             | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                               | 8"                          |
| Nominal wall thickness                                             | 0.875"                      |
| Corrosion allowance                                                | 0.0625"                     |
| Opening chord length                                               | 8.5367"                     |
| Projection available outside vessel, L <sub>pr</sub>               | 6.88"                       |
| Internal projection, h <sub>new</sub>                              | 1"                          |
| Projection available outside vessel to flange face, L <sub>f</sub> | 8"                          |
| Local vessel minimum thickness                                     | 0.513"                      |
| Liquid static head included                                        | 0 psi                       |



|                                 |        |
|---------------------------------|--------|
| Longitudinal joint efficiency   | 1      |
| <b>Welds</b>                    |        |
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Lower fillet, Leg <sub>43</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.513" |

| ASME B16.5-2013 Flange                                                                                                          |                                               |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Description                                                                                                                     | NPS 8 Class 150 LWN A105                      |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                            |
| Rated MDMT                                                                                                                      | -32.3°F                                       |
| Liquid static head                                                                                                              | 0 psi                                         |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                               |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                |
| PWHT performed                                                                                                                  | No                                            |
| Impact Tested                                                                                                                   | No                                            |
| Notes                                                                                                                           |                                               |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                               |

| UCS-66 Material Toughness Requirements Nozzle                                    |        |
|----------------------------------------------------------------------------------|--------|
| Governing thickness, $t_g$ =                                                     | 0.513" |
| MDMT =                                                                           | -20°F  |
| Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F. |        |

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                    | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| 3.4615                                                           | 3.7275         | 0.3842         | 1.7148         | 1.4063         | --             | 0.2222     | 0.3819                     | 0.875            |

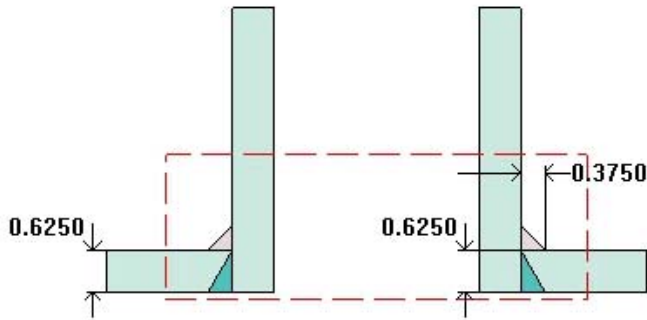
| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                              | 0.2625                          | weld size is adequate |



### GAS OUTLET (N5)

#### ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

#### Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 0°          |
| Nozzle center line offset to datum line | 162"        |
| End of nozzle to shell center           | 42.625"     |
| Passes through a Category A joint       | No          |

#### Nozzle

|                                                                    |                             |
|--------------------------------------------------------------------|-----------------------------|
| Access opening                                                     | No                          |
| Material specification                                             | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                               | 3"                          |
| Nominal wall thickness                                             | 0.625"                      |
| Corrosion allowance                                                | 0.0625"                     |
| Projection available outside vessel, L <sub>pr</sub>               | 5.06"                       |
| Projection available outside vessel to flange face, L <sub>f</sub> | 6"                          |
| Local vessel minimum thickness                                     | 0.625"                      |
| Liquid static head included                                        | 0 psi                       |
| Longitudinal joint efficiency                                      | 1                           |

#### Welds

|                                 |        |
|---------------------------------|--------|
| Inner fillet, Leg <sub>41</sub> | 0.375" |
|---------------------------------|--------|



|                              |        |
|------------------------------|--------|
| Nozzle to vessel groove weld | 0.625" |
|------------------------------|--------|

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 3 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |



## Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 1.4193                                                           | 2.0057      | 0.3385         | 1.5266         | --             | --             | 0.1406  | 0.2699                  | 0.625            |

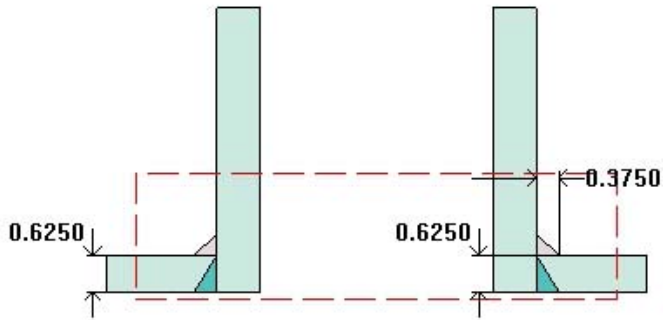
| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |



## WATER LLC (N6)

## ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

## Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 90°         |
| Nozzle center line offset to datum line | 108"        |
| End of nozzle to shell center           | 42.625"     |
| Offset from center, Lo                  | 1"          |
| Passes through a Category A joint       | No          |

## Nozzle

|                                                        |                             |
|--------------------------------------------------------|-----------------------------|
| Access opening                                         | No                          |
| Material specification                                 | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                   | 4"                          |
| Nominal wall thickness                                 | 0.75"                       |
| Corrosion allowance                                    | 0.0625"                     |
| Opening chord length                                   | 4.1266"                     |
| Projection available outside vessel, Lpr               | 5.06"                       |
| Projection available outside vessel to flange face, Lf | 6"                          |
| Local vessel minimum thickness                         | 0.625"                      |
| Liquid static head included                            | 0 psi                       |
| Longitudinal joint efficiency                          | 1                           |





| Welds                           |        |
|---------------------------------|--------|
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

| ASME B16.5-2013 Flange                                                                                                          |                                              |
|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Description                                                                                                                     | NPS 4 Class 150 LWN A105                     |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt ≤ 2 1/2 (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                           |
| Rated MDMT                                                                                                                      | -32.3°F                                      |
| Liquid static head                                                                                                              | 0 psi                                        |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                              |
| MAP rating                                                                                                                      | 285 psi @ 70°F                               |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                               |
| PWHT performed                                                                                                                  | No                                           |
| Impact Tested                                                                                                                   | No                                           |
| Notes                                                                                                                           |                                              |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                              |

| UCS-66 Material Toughness Requirements Nozzle                                    |        |
|----------------------------------------------------------------------------------|--------|
| Governing thickness, $t_g$ =                                                     | 0.625" |
| MDMT =                                                                           | -20°F  |
| Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F. |        |

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 0.9371                                                           | 3.3852      | 1.3841         | 1.8605         | --             | --             | 0.1406  | 0.2883                  | 0.75             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |

**Reinforcement check in the plane parallel to the longitudinal axis****Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 1.8735                                                           | 2.4479      | 0.4468         | 1.8605         | --             | --             | 0.1406  | 0.2883                  | 0.75             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

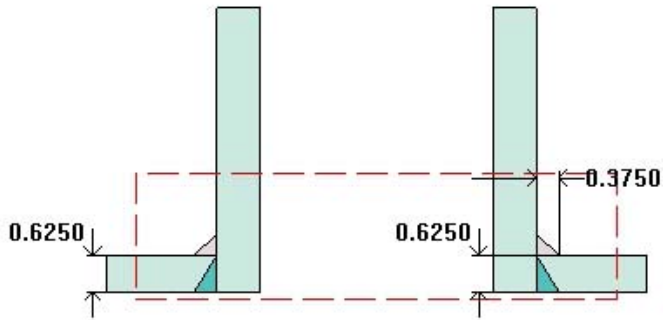


| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |



## OIL LLC (N7)

## ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

## Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 90°         |
| Nozzle center line offset to datum line | 156"        |
| End of nozzle to shell center           | 42.625"     |
| Offset from center, Lo                  | 6"          |
| Passes through a Category A joint       | No          |

## Nozzle

|                                                        |                             |
|--------------------------------------------------------|-----------------------------|
| Access opening                                         | No                          |
| Material specification                                 | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                   | 4"                          |
| Nominal wall thickness                                 | 0.75"                       |
| Corrosion allowance                                    | 0.0625"                     |
| Opening chord length                                   | 4.1828"                     |
| Projection available outside vessel, Lpr               | 5.2045"                     |
| Projection available outside vessel to flange face, Lf | 6.1445"                     |
| Local vessel minimum thickness                         | 0.625"                      |
| Liquid static head included                            | 0 psi                       |
| Longitudinal joint efficiency                          | 1                           |



| Welds                           |        |
|---------------------------------|--------|
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

| ASME B16.5-2013 Flange                                                                                                          |                                               |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Description                                                                                                                     | NPS 4 Class 150 LWN A105                      |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt <= 2 1/2 (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                            |
| Rated MDMT                                                                                                                      | -32.3°F                                       |
| Liquid static head                                                                                                              | 0 psi                                         |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                               |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                |
| PWHT performed                                                                                                                  | No                                            |
| Impact Tested                                                                                                                   | No                                            |
| Notes                                                                                                                           |                                               |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                               |

| UCS-66 Material Toughness Requirements Nozzle                                    |        |
|----------------------------------------------------------------------------------|--------|
| Governing thickness, $t_g$ =                                                     | 0.625" |
| MDMT =                                                                           | -20°F  |
| Material is exempt from impact testing per UG-20(f) at the Design MDMT of -20°F. |        |

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 0.9499                                                           | 3.404       | 1.4029         | 1.8605         | --             | --             | 0.1406  | 0.2883                  | 0.75             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |

**Reinforcement check in the plane parallel to the longitudinal axis****Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 1.8735                                                           | 2.4479      | 0.4468         | 1.8605         | --             | --             | 0.1406  | 0.2883                  | 0.75             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |



| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |



### OIL OUTLET (N8)

| ASME Section VIII Division 1, 2015 Edition                         |                             |
|--------------------------------------------------------------------|-----------------------------|
|                                                                    |                             |
| Note: round inside edges per UG-76(c)                              |                             |
| Location and Orientation                                           |                             |
| Located on                                                         | Cylinder #2                 |
| Orientation                                                        | 180°                        |
| Nozzle center line offset to datum line                            | 156"                        |
| End of nozzle to shell center                                      | 42.625"                     |
| Passes through a Category A joint                                  | No                          |
| Nozzle                                                             |                             |
| Access opening                                                     | No                          |
| Material specification                                             | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                               | 3"                          |
| Nominal wall thickness                                             | 0.625"                      |
| Corrosion allowance                                                | 0.0625"                     |
| Projection available outside vessel, L <sub>pr</sub>               | 5.06"                       |
| Projection available outside vessel to flange face, L <sub>f</sub> | 6"                          |
| Local vessel minimum thickness                                     | 0.625"                      |
| Liquid static head included                                        | 0 psi                       |
| Longitudinal joint efficiency                                      | 1                           |
| Welds                                                              |                             |
| Inner fillet, Leg <sub>41</sub>                                    | 0.375"                      |





|                              |        |
|------------------------------|--------|
| Nozzle to vessel groove weld | 0.625" |
|------------------------------|--------|

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 3 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |



## Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 1.4193                                                           | 2.0057      | 0.3385         | 1.5266         | --             | --             | 0.1406  | 0.2699                  | 0.625            |

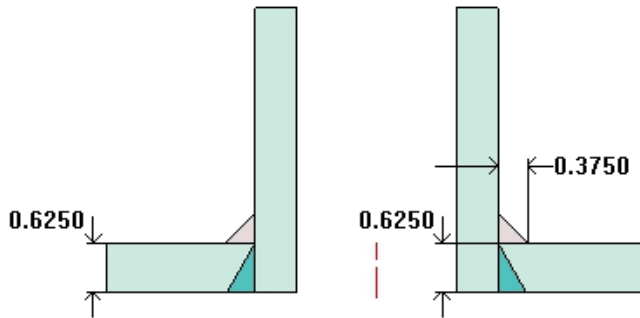
| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |



### DRAIN (N9)

#### ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

#### Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 180°        |
| Nozzle center line offset to datum line | 132"        |
| End of nozzle to shell center           | 42.625"     |
| Passes through a Category A joint       | No          |

#### Nozzle

|                                                                    |                             |
|--------------------------------------------------------------------|-----------------------------|
| Access opening                                                     | No                          |
| Material specification                                             | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                               | 2"                          |
| Nominal wall thickness                                             | 0.53"                       |
| Corrosion allowance                                                | 0.0625"                     |
| Projection available outside vessel, L <sub>pr</sub>               | 5.25"                       |
| Projection available outside vessel to flange face, L <sub>f</sub> | 6"                          |
| Local vessel minimum thickness                                     | 0.625"                      |
| Liquid static head included                                        | 0 psi                       |
| Longitudinal joint efficiency                                      | 1                           |

#### Welds

|                                 |        |
|---------------------------------|--------|
| Inner fillet, Leg <sub>41</sub> | 0.375" |
|---------------------------------|--------|



|                              |        |
|------------------------------|--------|
| Nozzle to vessel groove weld | 0.625" |
|------------------------------|--------|

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 2 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary<br>(in)   |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.2515                     | 0.53             |

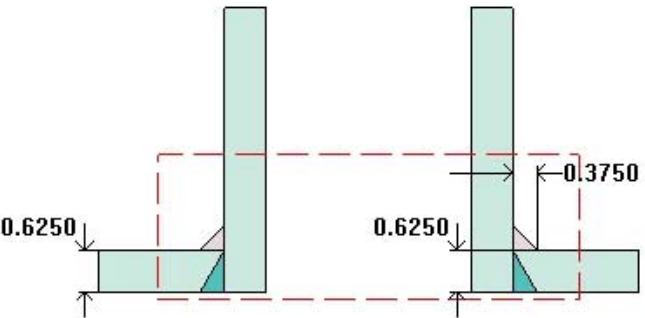
| UG-41 Weld Failure Path Analysis Summary                             |  |
|----------------------------------------------------------------------|--|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |  |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                              | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



### WATER OUTLET (N10)

| ASME Section VIII Division 1, 2015 Edition                                        |                             |
|-----------------------------------------------------------------------------------|-----------------------------|
|  |                             |
| Note: round inside edges per UG-76(c)                                             |                             |
| Location and Orientation                                                          |                             |
| Located on                                                                        | Cylinder #2                 |
| Orientation                                                                       | 180°                        |
| Nozzle center line offset to datum line                                           | 108"                        |
| End of nozzle to shell center                                                     | 42.625"                     |
| Passes through a Category A joint                                                 | No                          |
| Nozzle                                                                            |                             |
| Access opening                                                                    | No                          |
| Material specification                                                            | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                                              | 3"                          |
| Nominal wall thickness                                                            | 0.625"                      |
| Corrosion allowance                                                               | 0.0625"                     |
| Projection available outside vessel, L <sub>pr</sub>                              | 5.06"                       |
| Projection available outside vessel to flange face, L <sub>f</sub>                | 6"                          |
| Local vessel minimum thickness                                                    | 0.625"                      |
| Liquid static head included                                                       | 0 psi                       |
| Longitudinal joint efficiency                                                     | 1                           |
| Welds                                                                             |                             |
| Inner fillet, Leg <sub>41</sub>                                                   | 0.375"                      |



|                              |        |
|------------------------------|--------|
| Nozzle to vessel groove weld | 0.625" |
|------------------------------|--------|

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 3 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |



### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 1.4193                                                           | 2.0057      | 0.3385         | 1.5266         | --             | --             | 0.1406  | 0.2699                  | 0.625            |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

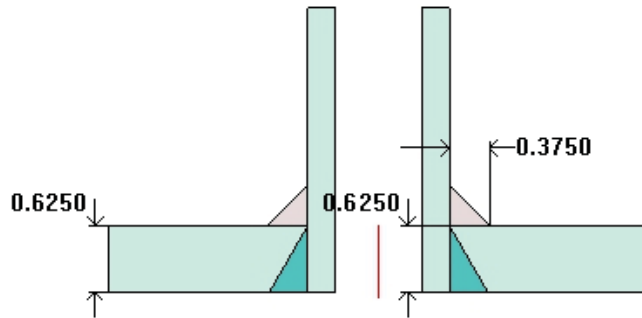
| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |





### PRESSURE INDICATOR / TRANSMITTER (N11)

#### ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

#### Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #1 |
| Orientation                             | 0°          |
| Nozzle center line offset to datum line | 6"          |
| End of nozzle to shell center           | 42.625"     |
| Passes through a Category A joint       | No          |

#### Nozzle

|                                                      |                                         |
|------------------------------------------------------|-----------------------------------------|
| Description                                          | NPS 1 Sch 160                           |
| Access opening                                       | No                                      |
| Material specification                               | SA-106 B Smls pipe (II-D p. 14, ln. 15) |
| Inside diameter, new                                 | 0.815"                                  |
| Pipe nominal wall thickness                          | 0.25"                                   |
| Pipe minimum wall thickness <sup>1</sup>             | 0.2188"                                 |
| Corrosion allowance                                  | 0.0625"                                 |
| Projection available outside vessel, L <sub>pr</sub> | 6"                                      |
| Local vessel minimum thickness                       | 0.625"                                  |
| Liquid static head included                          | 0 psi                                   |
| Longitudinal joint efficiency                        | 1                                       |

#### Welds



|                                 |        |
|---------------------------------|--------|
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

<sup>1</sup> Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

| UCS-66 Material Toughness Requirements Nozzle                       |        |
|---------------------------------------------------------------------|--------|
| Impact test exempt per UCS-66(d) (NPS 4 or smaller pipe) =          | -155°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |        |

### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |

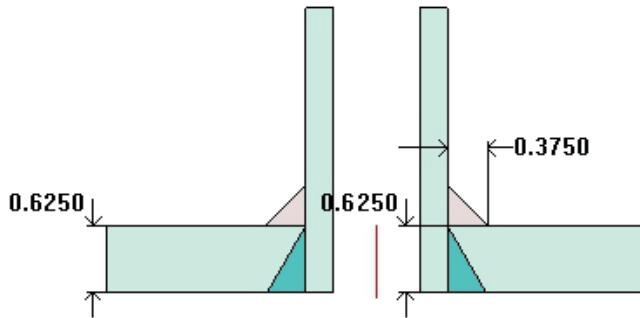
| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

This opening does not require reinforcement per UG-36(c)(3)(a)



## WATER LEVEL GAUGE (TOP) (N13A)

ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

## Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 90°         |
| Nozzle center line offset to datum line | 99"         |
| End of nozzle to shell center           | 42"         |
| Offset from center, Lo                  | -7.5"       |
| Passes through a Category A joint       | No          |

## Nozzle

|                                                      |                                         |
|------------------------------------------------------|-----------------------------------------|
| Description                                          | NPS 1 Sch 160                           |
| Access opening                                       | No                                      |
| Material specification                               | SA-106 B Smls pipe (II-D p. 14, ln. 15) |
| Inside diameter, new                                 | 0.815"                                  |
| Pipe nominal wall thickness                          | 0.25"                                   |
| Pipe minimum wall thickness <sup>1</sup>             | 0.2188"                                 |
| Corrosion allowance                                  | 0.0625"                                 |
| Opening chord length                                 | 0.9607"                                 |
| Projection available outside vessel, L <sub>pr</sub> | 6.0199"                                 |
| Local vessel minimum thickness                       | 0.625"                                  |
| Liquid static head included                          | 0 psi                                   |



|                                 |        |
|---------------------------------|--------|
| Longitudinal joint efficiency   | 1      |
| Welds                           |        |
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

<sup>1</sup> Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

| UCS-66 Material Toughness Requirements Nozzle                       |        |
|---------------------------------------------------------------------|--------|
| Impact test exempt per UCS-66(d) (NPS 4 or smaller pipe) =          | -155°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |        |

### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

This opening does not require reinforcement per UG-36(c)(3)(a)

### Reinforcement check in the plane parallel to the longitudinal axis

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |  |
|----------------------------------------------------------------------|--|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |  |

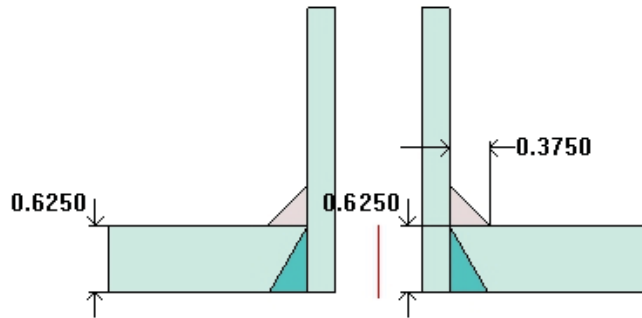
| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



## WATER LEVEL GAUGE (BOTTOM) (N13B)

## ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

## Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 90°         |
| Nozzle center line offset to datum line | 99"         |
| End of nozzle to shell center           | 42"         |
| Offset from center, Lo                  | 17.5"       |
| Passes through a Category A joint       | No          |

## Nozzle

|                                                      |                                         |
|------------------------------------------------------|-----------------------------------------|
| Description                                          | NPS 1 Sch 160                           |
| Access opening                                       | No                                      |
| Material specification                               | SA-106 B Smls pipe (II-D p. 14, ln. 15) |
| Inside diameter, new                                 | 0.815"                                  |
| Pipe nominal wall thickness                          | 0.25"                                   |
| Pipe minimum wall thickness <sup>1</sup>             | 0.2188"                                 |
| Corrosion allowance                                  | 0.0625"                                 |
| Opening chord length                                 | 1.073"                                  |
| Projection available outside vessel, L <sub>pr</sub> | 9.4774"                                 |
| Local vessel minimum thickness                       | 0.625"                                  |
| Liquid static head included                          | 0 psi                                   |



|                                 |        |
|---------------------------------|--------|
| Longitudinal joint efficiency   | 1      |
| Welds                           |        |
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

<sup>1</sup> Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

| UCS-66 Material Toughness Requirements Nozzle                       |        |
|---------------------------------------------------------------------|--------|
| Impact test exempt per UCS-66(d) (NPS 4 or smaller pipe) =          | -155°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |        |

### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

This opening does not require reinforcement per UG-36(c)(3)(a)

### Reinforcement check in the plane parallel to the longitudinal axis

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |  |
|----------------------------------------------------------------------|--|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |  |

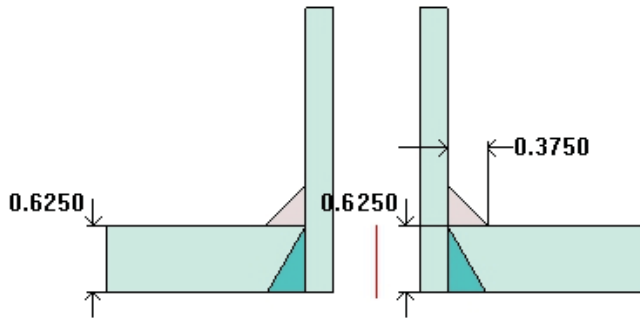
| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



### OIL LEVEL GAUGE (TOP) (N14A)

ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

## Location and Orientation

|                                                |             |
|------------------------------------------------|-------------|
| <b>Located on</b>                              | Cylinder #2 |
| <b>Orientation</b>                             | 90°         |
| <b>Nozzle center line offset to datum line</b> | 165"        |
| <b>End of nozzle to shell center</b>           | 42"         |
| <b>Offset from center, Lo</b>                  | -2.5"       |
| <b>Passes through a Category A joint</b>       | No          |

## Nozzle

|                                                            |                                         |
|------------------------------------------------------------|-----------------------------------------|
| <b>Description</b>                                         | NPS 1 Sch 160                           |
| <b>Access opening</b>                                      | No                                      |
| <b>Material specification</b>                              | SA-106 B Smls pipe (II-D p. 14, ln. 15) |
| <b>Inside diameter, new</b>                                | 0.815"                                  |
| <b>Pipe nominal wall thickness</b>                         | 0.25"                                   |
| <b>Pipe minimum wall thickness<sup>1</sup></b>             | 0.2188"                                 |
| <b>Corrosion allowance</b>                                 | 0.0625"                                 |
| <b>Opening chord length</b>                                | 0.9422"                                 |
| <b>Projection available outside vessel, L<sub>pr</sub></b> | 5.4214"                                 |
| <b>Local vessel minimum thickness</b>                      | 0.625"                                  |
| <b>Liquid static head included</b>                         | 0 psi                                   |



|                                 |        |
|---------------------------------|--------|
| Longitudinal joint efficiency   | 1      |
| Welds                           |        |
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

<sup>1</sup> Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

| UCS-66 Material Toughness Requirements Nozzle                       |        |
|---------------------------------------------------------------------|--------|
| Impact test exempt per UCS-66(d) (NPS 4 or smaller pipe) =          | -155°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |        |

### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

This opening does not require reinforcement per UG-36(c)(3)(a)

### Reinforcement check in the plane parallel to the longitudinal axis

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |  |
|----------------------------------------------------------------------|--|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |  |

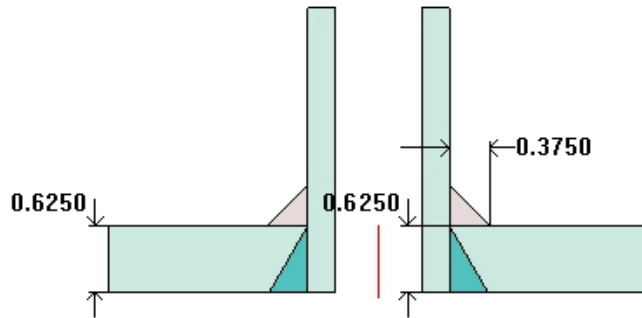
| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



### OIL LEVEL GAUGE (BOTTOM) (N14B)

ASME Section VIII Division 1, 2015 Edition



Note: round inside edges per UG-76(c)

#### Location and Orientation

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #2 |
| Orientation                             | 90°         |
| Nozzle center line offset to datum line | 165"        |
| End of nozzle to shell center           | 42"         |
| Offset from center, Lo                  | 22.5"       |
| Passes through a Category A joint       | No          |

#### Nozzle

|                                          |                                         |
|------------------------------------------|-----------------------------------------|
| Description                              | NPS 1 Sch 160                           |
| Access opening                           | No                                      |
| Material specification                   | SA-106 B Smls pipe (II-D p. 14, ln. 15) |
| Inside diameter, new                     | 0.815"                                  |
| Pipe nominal wall thickness              | 0.25"                                   |
| Pipe minimum wall thickness <sup>1</sup> | 0.2188"                                 |
| Corrosion allowance                      | 0.0625"                                 |
| Opening chord length                     | 1.1982"                                 |
| Projection available outside vessel, Lpr | 12.6011"                                |
| Local vessel minimum thickness           | 0.625"                                  |
| Liquid static head included              | 0 psi                                   |



|                                 |        |
|---------------------------------|--------|
| Longitudinal joint efficiency   | 1      |
| Welds                           |        |
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

<sup>1</sup> Pipe minimum thickness = nominal thickness times pipe tolerance factor of 0.875.

| UCS-66 Material Toughness Requirements Nozzle                       |        |
|---------------------------------------------------------------------|--------|
| Impact test exempt per UCS-66(d) (NPS 4 or smaller pipe) =          | -155°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |        |

### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

This opening does not require reinforcement per UG-36(c)(3)(a)

### Reinforcement check in the plane parallel to the longitudinal axis



## Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary (in)      |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.1789                     | 0.2188           |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.1312                            | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



### RELIEF (N15)

| ASME Section VIII Division 1, 2015 Edition                         |                             |
|--------------------------------------------------------------------|-----------------------------|
|                                                                    |                             |
| Note: round inside edges per UG-76(c)                              |                             |
| Location and Orientation                                           |                             |
| Located on                                                         | Cylinder #2                 |
| Orientation                                                        | 0°                          |
| Nozzle center line offset to datum line                            | 108"                        |
| End of nozzle to shell center                                      | 42.625"                     |
| Passes through a Category A joint                                  | No                          |
| Nozzle                                                             |                             |
| Access opening                                                     | No                          |
| Material specification                                             | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                               | 2"                          |
| Nominal wall thickness                                             | 0.53"                       |
| Corrosion allowance                                                | 0.0625"                     |
| Projection available outside vessel, L <sub>pr</sub>               | 5.25"                       |
| Projection available outside vessel to flange face, L <sub>f</sub> | 6"                          |
| Local vessel minimum thickness                                     | 0.625"                      |
| Liquid static head included                                        | 0 psi                       |
| Longitudinal joint efficiency                                      | 1                           |
| Welds                                                              |                             |
| Inner fillet, Leg <sub>41</sub>                                    | 0.375"                      |



|                              |        |
|------------------------------|--------|
| Nozzle to vessel groove weld | 0.625" |
|------------------------------|--------|

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 2 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |



**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary<br>(in)   |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.2515                     | 0.53             |

| UG-41 Weld Failure Path Analysis Summary                             |  |
|----------------------------------------------------------------------|--|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |  |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                              | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



### LEVEL SWITCH BRIDLE (TOP) (N16A)

| ASME Section VIII Division 1, 2015 Edition                         |                             |
|--------------------------------------------------------------------|-----------------------------|
|                                                                    |                             |
| Note: round inside edges per UG-76(c)                              |                             |
| Location and Orientation                                           |                             |
| Located on                                                         | Cylinder #1                 |
| Orientation                                                        | 0°                          |
| Nozzle center line offset to datum line                            | 48"                         |
| End of nozzle to shell center                                      | 42.625"                     |
| Passes through a Category A joint                                  | No                          |
| Nozzle                                                             |                             |
| Access opening                                                     | No                          |
| Material specification                                             | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                               | 2"                          |
| Nominal wall thickness                                             | 0.53"                       |
| Corrosion allowance                                                | 0.0625"                     |
| Projection available outside vessel, L <sub>pr</sub>               | 5.25"                       |
| Projection available outside vessel to flange face, L <sub>f</sub> | 6"                          |
| Local vessel minimum thickness                                     | 0.625"                      |
| Liquid static head included                                        | 0 psi                       |
| Longitudinal joint efficiency                                      | 1                           |
| Welds                                                              |                             |
| Inner fillet, Leg <sub>41</sub>                                    | 0.375"                      |



|                              |        |
|------------------------------|--------|
| Nozzle to vessel groove weld | 0.625" |
|------------------------------|--------|

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 2 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary<br>(in)   |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.2515                     | 0.53             |

| UG-41 Weld Failure Path Analysis Summary                             |  |
|----------------------------------------------------------------------|--|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |  |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                              | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



LEVEL SWITCH BRIDLE (BOTTOM) (N16B)

| ASME Section VIII Division 1, 2015 Edition                         |                             |
|--------------------------------------------------------------------|-----------------------------|
|                                                                    |                             |
| Note: round inside edges per UG-76(c)                              |                             |
| Location and Orientation                                           |                             |
| Located on                                                         | Cylinder #1                 |
| Orientation                                                        | 180°                        |
| Nozzle center line offset to datum line                            | 48"                         |
| End of nozzle to shell center                                      | 42.625"                     |
| Passes through a Category A joint                                  | No                          |
| Nozzle                                                             |                             |
| Access opening                                                     | No                          |
| Material specification                                             | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                               | 2"                          |
| Nominal wall thickness                                             | 0.53"                       |
| Corrosion allowance                                                | 0.0625"                     |
| Projection available outside vessel, L <sub>pr</sub>               | 5.25"                       |
| Projection available outside vessel to flange face, L <sub>f</sub> | 6"                          |
| Local vessel minimum thickness                                     | 0.625"                      |
| Liquid static head included                                        | 0 psi                       |
| Longitudinal joint efficiency                                      | 1                           |
| Welds                                                              |                             |
| Inner fillet, Leg <sub>41</sub>                                    | 0.375"                      |



|                              |        |
|------------------------------|--------|
| Nozzle to vessel groove weld | 0.625" |
|------------------------------|--------|

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 2 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |

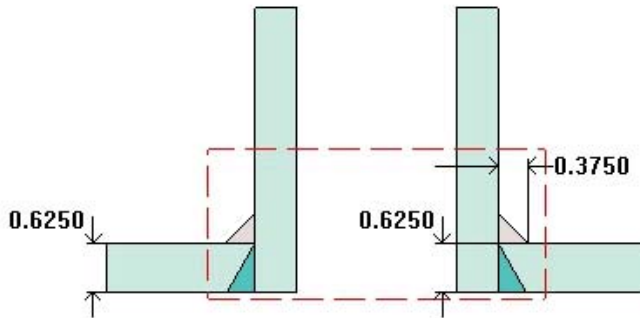
**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary<br>(in <sup>2</sup> )               |                |                |                |                |                |            | UG-45<br>Summary<br>(in)   |                  |
|--------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|------------|----------------------------|------------------|
| For P = 250 psi @ 200 °F                                           |                |                |                |                |                |            | The nozzle passes<br>UG-45 |                  |
| A<br>required                                                      | A<br>available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A<br>welds | t <sub>req</sub>           | t <sub>min</sub> |
| This nozzle is exempt from area<br>calculations per UG-36(c)(3)(a) |                |                |                |                |                |            | 0.2515                     | 0.53             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |

| UW-16 Weld Sizing Summary                   |                                   |                                 |                       |
|---------------------------------------------|-----------------------------------|---------------------------------|-----------------------|
| Weld description                            | Required weld<br>throat size (in) | Actual weld<br>throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                              | 0.2625                          | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**

**ANODE (N17A)****ASME Section VIII Division 1, 2015 Edition**

Note: round inside edges per UG-76(c)

**Location and Orientation**

|                                         |             |
|-----------------------------------------|-------------|
| Located on                              | Cylinder #1 |
| Orientation                             | 270°        |
| Nozzle center line offset to datum line | 42"         |
| End of nozzle to shell center           | 29.0402"    |
| Offset from center, Lo                  | -30"        |
| Passes through a Category A joint       | No          |

**Nozzle**

|                                                        |                             |
|--------------------------------------------------------|-----------------------------|
| Access opening                                         | No                          |
| Material specification                                 | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                   | 2"                          |
| Nominal wall thickness                                 | 0.53"                       |
| Corrosion allowance                                    | 0.0625"                     |
| Opening chord length                                   | 3.7878"                     |
| Projection available outside vessel, Lpr               | 5.25"                       |
| Projection available outside vessel to flange face, Lf | 6"                          |
| Local vessel minimum thickness                         | 0.625"                      |
| Liquid static head included                            | 0 psi                       |
| Longitudinal joint efficiency                          | 1                           |





| Welds                           |        |
|---------------------------------|--------|
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

| ASME B16.5-2013 Flange                                                                                                          |                                                           |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Description                                                                                                                     | NPS 2 Class 150 LWN A105                                  |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt $\leq 2 \frac{1}{2}$ (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                                        |
| Rated MDMT                                                                                                                      | -32.3°F                                                   |
| Liquid static head                                                                                                              | 0 psi                                                     |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                                           |
| MAP rating                                                                                                                      | 285 psi @ 70°F                                            |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                                            |
| PWHT performed                                                                                                                  | No                                                        |
| Impact Tested                                                                                                                   | No                                                        |
| Notes                                                                                                                           |                                                           |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                                           |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |



### Reinforcement Calculations for Internal Pressure

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 0.8602                                                           | 2.4725      | 1.2704         | 1.0615         | --             | --             | 0.1406  | 0.2515                  | 0.53             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |

### Reinforcement check in the plane parallel to the longitudinal axis

### Reinforcement Calculations for Internal Pressure

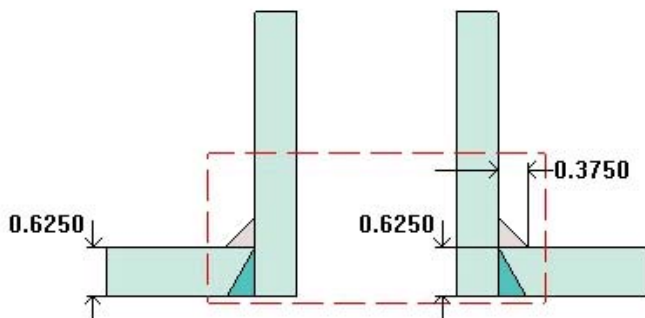
| UG-37 Area Calculation Summary (in <sup>2</sup> )               |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|-----------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F                                        |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                      | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| This nozzle is exempt from area calculations per UG-36(c)(3)(a) |             |                |                |                |                |         | 0.2515                  | 0.53             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |



| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**

**ANODE (N17B)**

Note: round inside edges per UG-76(c)

| Location and Orientation                               |                             |
|--------------------------------------------------------|-----------------------------|
| Located on                                             | Cylinder #2                 |
| Orientation                                            | 270°                        |
| Nozzle center line offset to datum line                | 126"                        |
| End of nozzle to shell center                          | 29.0402"                    |
| Offset from center, Lo                                 | -30"                        |
| Passes through a Category A joint                      | No                          |
| Nozzle                                                 |                             |
| Access opening                                         | No                          |
| Material specification                                 | SA-105 (II-D p. 18, ln. 23) |
| Inside diameter, new                                   | 2"                          |
| Nominal wall thickness                                 | 0.53"                       |
| Corrosion allowance                                    | 0.0625"                     |
| Opening chord length                                   | 3.7878"                     |
| Projection available outside vessel, Lpr               | 5.25"                       |
| Projection available outside vessel to flange face, Lf | 6"                          |
| Local vessel minimum thickness                         | 0.625"                      |
| Liquid static head included                            | 0 psi                       |
| Longitudinal joint efficiency                          | 1                           |



| Welds                           |        |
|---------------------------------|--------|
| Inner fillet, Leg <sub>41</sub> | 0.375" |
| Nozzle to vessel groove weld    | 0.625" |

| ASME B16.5-2013 Flange                                                                                                          |                                              |
|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Description                                                                                                                     | NPS 2 Class 150 LWN A105                     |
| Bolt Material                                                                                                                   | SA-193 B7 Bolt ≤ 2 1/2 (II-D p. 344, ln. 31) |
| Blind included                                                                                                                  | No                                           |
| Rated MDMT                                                                                                                      | -32.3°F                                      |
| Liquid static head                                                                                                              | 0 psi                                        |
| MAWP rating                                                                                                                     | 260 psi @ 200°F                              |
| MAP rating                                                                                                                      | 285 psi @ 70°F                               |
| Hydrotest rating                                                                                                                | 450 psi @ 70°F                               |
| PWHT performed                                                                                                                  | No                                           |
| Impact Tested                                                                                                                   | No                                           |
| Notes                                                                                                                           |                                              |
| Flange rated MDMT per UCS-66(b)(1)(b) = -32.3°F (Coincident ratio = 0.8772)<br>Bolts rated MDMT per Fig UCS-66 note (c) = -55°F |                                              |

| UCS-66 Material Toughness Requirements                              |         |
|---------------------------------------------------------------------|---------|
| LWN rated MDMT per UCS-66(c)(4) =                                   | -32.3°F |
| Material is exempt from impact testing at the Design MDMT of -20°F. |         |

**Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary (in <sup>2</sup> )                |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|------------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F<br>The opening is adequately reinforced |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                       | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| 0.8602                                                           | 2.4725      | 1.2704         | 1.0615         | --             | --             | 0.1406  | 0.2515                  | 0.53             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(1) |

| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |

**Reinforcement check in the plane parallel to the longitudinal axis****Reinforcement Calculations for Internal Pressure**

| UG-37 Area Calculation Summary (in <sup>2</sup> )               |             |                |                |                |                |         | UG-45 Summary (in)      |                  |
|-----------------------------------------------------------------|-------------|----------------|----------------|----------------|----------------|---------|-------------------------|------------------|
| For P = 250 psi @ 200 °F                                        |             |                |                |                |                |         | The nozzle passes UG-45 |                  |
| A required                                                      | A available | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>5</sub> | A welds | t <sub>req</sub>        | t <sub>min</sub> |
| This nozzle is exempt from area calculations per UG-36(c)(3)(a) |             |                |                |                |                |         | 0.2515                  | 0.53             |

| UG-41 Weld Failure Path Analysis Summary                             |
|----------------------------------------------------------------------|
| The nozzle is exempt from weld strength calculations per UW-15(b)(2) |



| UW-16 Weld Sizing Summary                   |                                |                              |                       |
|---------------------------------------------|--------------------------------|------------------------------|-----------------------|
| Weld description                            | Required weld throat size (in) | Actual weld throat size (in) | Status                |
| Nozzle to shell fillet (Leg <sub>41</sub> ) | 0.25                           | 0.2625                       | weld size is adequate |

**This opening does not require reinforcement per UG-36(c)(3)(a)**



## Lifting Lug #2

### Minimum report

| Geometry Inputs                           |              |
|-------------------------------------------|--------------|
|                                           |              |
| Attached To                               | Cylinder #2  |
| Material                                  | A36          |
| Orientation                               | Longitudinal |
| Distance of Lift Point From Datum         | 150"         |
| Angular Position                          | 0°           |
| Length, L                                 | 6"           |
| Height, H                                 | 5"           |
| Thickness, t                              | 1"           |
| Hole Diameter, d                          | 1.25"        |
| Pin Diameter, Dp                          | 1.15"        |
| Load Eccentricity, $a_1$                  | 0"           |
| Distance from Load to Shell or Pad, $a_2$ | 2.5"         |
| Load Angle Normal to Vessel, $\beta$      | 45°          |
| Load Angle from Vertical, $\phi$          | 45°          |
| Welds                                     |              |
| Size, $t_w$                               | 0.5"         |
| Reinforcement Pad                         |              |
| Width, $B_p$                              | 3"           |
| Length, $L_p$                             | 8"           |
| Thickness, $t_p$                          | 0.5"         |
| Weld Size, $t_{wp}$                       | 0.4375"      |





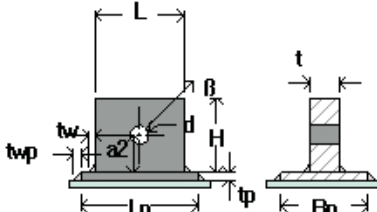
| Intermediate Values                                  |             |
|------------------------------------------------------|-------------|
| Load Factor                                          | 1.5000      |
| Vessel Weight (new, incl. Load Factor), W            | 17,422.3 lb |
| Lug Weight (new), $W_{lug}$                          | 12.6 lb     |
| Distance from Center of Gravity to this lug, $x_1$   | 64.7768"    |
| Distance from Center of Gravity to second lug, $x_2$ | 67.2232"    |
| Allowable Stress, Tensile, $\sigma_t$                | 19,980 psi  |
| Allowable Stress, Shear, $\sigma_s$                  | 13,320 psi  |
| Allowable Stress, Bearing, $\sigma_p$                | 29,970 psi  |
| Allowable Stress, Bending, $\sigma_b$                | 22,201 psi  |
| Allowable Stress, Weld Shear, $\tau_{allowable}$     | 13,320 psi  |
| Allowable Stress set to 1/3 Sy per ASME B30.20       | No          |

| Summary Values                          |                         |
|-----------------------------------------|-------------------------|
| Required Lift Pin Diameter, $d_{reqd}$  | <a href="#">0.7744"</a> |
| Required Lug Thickness, $t_{reqd}$      | <a href="#">0.3641"</a> |
| Lug Stress Ratio, $\sigma_{ratio}$      | <a href="#">0.24</a>    |
| Weld Shear Stress Ratio, $\tau_{ratio}$ | <a href="#">0.42</a>    |
| Lug Design                              | Acceptable              |
| Local Stresses WRC 107                  | Acceptable              |



# Lifting Lug #1

## Minimum report

| Geometry Inputs                                                                   |              |
|-----------------------------------------------------------------------------------|--------------|
|  |              |
| Attached To                                                                       | Cylinder #1  |
| Material                                                                          | A36          |
| Orientation                                                                       | Longitudinal |
| Distance of Lift Point From Datum                                                 | 18"          |
| Angular Position                                                                  | 0°           |
| Length, L                                                                         | 6"           |
| Height, H                                                                         | 5"           |
| Thickness, t                                                                      | 1"           |
| Hole Diameter, d                                                                  | 1.25"        |
| Pin Diameter, Dp                                                                  | 1.15"        |
| Load Eccentricity, a <sub>1</sub>                                                 | 0"           |
| Distance from Load to Shell or Pad, a <sub>2</sub>                                | 2.5"         |
| Load Angle Normal to Vessel, β                                                    | -45°         |
| Load Angle from Vertical, φ                                                       | -45°         |
| Welds                                                                             |              |
| Size, t <sub>w</sub>                                                              | 0.5"         |
| Reinforcement Pad                                                                 |              |
| Width, B <sub>p</sub>                                                             | 3"           |
| Length, L <sub>p</sub>                                                            | 8"           |
| Thickness, t <sub>p</sub>                                                         | 0.5"         |
| Weld Size, t <sub>wp</sub>                                                        | 0.4375"      |



| Intermediate Values                                  |             |
|------------------------------------------------------|-------------|
| Load Factor                                          | 1.5000      |
| Vessel Weight (new, incl. Load Factor), W            | 17,422.3 lb |
| Lug Weight (new), $W_{lug}$                          | 12.6 lb     |
| Distance from Center of Gravity to this lug, $x_1$   | 67.2232"    |
| Distance from Center of Gravity to second lug, $x_2$ | 64.7768"    |
| Allowable Stress, Tensile, $\sigma_t$                | 19,980 psi  |
| Allowable Stress, Shear, $\sigma_s$                  | 13,320 psi  |
| Allowable Stress, Bearing, $\sigma_p$                | 29,970 psi  |
| Allowable Stress, Bending, $\sigma_b$                | 22,201 psi  |
| Allowable Stress, Weld Shear, $\tau_{allowable}$     | 13,320 psi  |
| Allowable Stress set to 1/3 Sy per ASME B30.20       | No          |

| Summary Values                          |                |
|-----------------------------------------|----------------|
| Required Lift Pin Diameter, $d_{reqd}$  | <u>0.7602"</u> |
| Required Lug Thickness, $t_{reqd}$      | <u>0.3508"</u> |
| Lug Stress Ratio, $\sigma_{ratio}$      | <u>0.23</u>    |
| Weld Shear Stress Ratio, $\tau_{ratio}$ | <u>0.4</u>     |
| Lug Design                              | Acceptable     |
| Local Stresses WRC 107                  | Acceptable     |



**Saddle #1**

| ASME Section VIII Division 1, 2015 Edition     |                    |              |
|------------------------------------------------|--------------------|--------------|
| Saddle Material                                | SA-36              |              |
| Saddle Construction                            | Web at edge of rib |              |
| Welded to Vessel                               | Yes                |              |
| Saddle Allowable Stress, S <sub>s</sub>        | 16,600 psi         |              |
| Saddle Yield Stress, S <sub>y</sub>            | 36,000 psi         |              |
| Foundation Allowable Stress                    | 1,658 psi          |              |
| Design Pressure                                | Left Saddle        | Right Saddle |
| Operating                                      | 250 psi            |              |
| Test                                           | 327.84 psi         |              |
| Dimensions                                     |                    |              |
| Right saddle distance to datum                 | 144"               |              |
| Tangent To Tangent Length, L                   | 184"               |              |
| Saddle separation, L <sub>s</sub>              | 120"               |              |
| Vessel Radius, R                               | 36.625"            |              |
| Tangent Distance Left, A <sub>l</sub>          | 32"                |              |
| Tangent Distance Right, A <sub>r</sub>         | 32"                |              |
| Saddle Height, H <sub>s</sub>                  | 68.625"            |              |
| Saddle Contact Angle, θ                        | 120°               |              |
| Web Plate Thickness, t <sub>s</sub>            | 0.375"             |              |
| Base Plate Length, E                           | 67"                |              |
| Base Plate Width, F                            | 12"                |              |
| Base Plate Thickness, t <sub>b</sub>           | 0.5"               |              |
| Number of Stiffening Ribs, n                   | 4                  |              |
| Largest Stiffening Rib Spacing, d <sub>i</sub> | 21.4869"           |              |
| Stiffening Rib Thickness, t <sub>w</sub>       | 0.375"             |              |
| Saddle Width, b                                | 8"                 |              |
| Reinforcing Plate                              |                    |              |
| Thickness, t <sub>p</sub>                      | 0.375"             |              |



|                                 |                        |           |
|---------------------------------|------------------------|-----------|
| Width, W <sub>p</sub>           | 12"                    |           |
| Contact Angle, θ <sub>w</sub>   | 126°                   |           |
| Bolting                         |                        |           |
| Material                        | SA-193-B7M             |           |
| Bolt Allowable Shear            | 15,000 psi             |           |
| Description                     | 1" series 8 threaded   |           |
| Corrosion on root               | 0.0625"                |           |
| Anchor Bolts per Saddle         | 2                      |           |
| Base coefficient of friction, μ | 0.45                   |           |
| Weight                          |                        |           |
|                                 | Operating,<br>Corroded | Hydrotest |
| Weight on Left Saddle           | 4,576 lb               | 20,393 lb |
| Weight on Right Saddle          | 4,845 lb               | 20,776 lb |
| Weight of Saddle Pair           | 1,216 lb               |           |

| Notes                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------|
| (1) Saddle calculations are based on the method presented in "Stresses in Large Cylindrical Pressure Vessels on Two Saddle Supports" by L.P. Zick. |



| Stress Summary |           |              |                                             |              |                       |              |                                           |              |                       |              |
|----------------|-----------|--------------|---------------------------------------------|--------------|-----------------------|--------------|-------------------------------------------|--------------|-----------------------|--------------|
| Load           | Condition | Saddle       | Bending + pressure between saddles<br>(psi) |              |                       |              | Bending + pressure at the saddle<br>(psi) |              |                       |              |
|                |           |              | S <sub>1</sub><br>(+)                       | allow<br>(+) | S <sub>1</sub><br>(-) | allow<br>(-) | S <sub>2</sub><br>(+)                     | allow<br>(+) | S <sub>2</sub><br>(-) | allow<br>(-) |
| Seismic        | Operating | Right Saddle | 8,046                                       | 20,400       | 32                    | 17,790       | 8,144                                     | 24,000       | 130                   | 17,790       |
|                |           | Left Saddle  |                                             |              |                       |              | 8,144                                     | 24,000       | 130                   | 17,790       |
| Wind           | Operating | Right Saddle | 8,041                                       | 20,400       | 27                    | 17,790       | 8,133                                     | 24,000       | 119                   | 17,790       |
|                |           | Left Saddle  |                                             |              |                       |              | 8,133                                     | 24,000       | 119                   | 17,790       |
|                | Test      | Right Saddle | 9,531                                       | 29,070       | 89                    | 17,790       | 9,912                                     | 34,200       | 470                   | 17,790       |
|                |           | Left Saddle  |                                             |              |                       |              | 9,912                                     | 34,200       | 470                   | 17,790       |
| Weight         | Operating | Right Saddle | 8.037                                       | 17,000       | 23                    | 14,825       | 8.133                                     | 20,000       | 119                   | 14,825       |
|                |           | Left Saddle  |                                             |              |                       |              | 8,133                                     | 20,000       | 119                   | 14,825       |



| Stress Summary |           |              |                        |        |                              |             |                          |        |                 |        |
|----------------|-----------|--------------|------------------------|--------|------------------------------|-------------|--------------------------|--------|-----------------|--------|
| Load           | Condition | Saddle       | Tangential shear (psi) |        | Circumferential stress (psi) |             | Stress over saddle (psi) |        | Splitting (psi) |        |
|                |           |              | S <sub>3</sub>         | allow  | S <sub>4</sub> (horns)       | allow (+/-) | S <sub>5</sub>           | allow  | S <sub>6</sub>  | allow  |
| Seismic        | Operating | Right Saddle | <u>262</u>             | 16,000 | <u>-2,368</u>                | 30,000      | <u>577</u>               | 17,400 | <u>152</u>      | 11,067 |
|                |           | Left Saddle  | 241                    | 16,000 | -2,237                       | 30,000      | 545                      | 17,400 | 143             | 11,067 |
| Wind           | Operating | Right Saddle | 213                    | 16,000 | -2,002                       | 30,000      | 487                      | 17,400 | 128             | 11,067 |
|                |           | Left Saddle  | 197                    | 16,000 | -1,908                       | 30,000      | 464                      | 17,400 | 122             | 11,067 |
|                | Test      | Right Saddle | 635                    | 27,360 | -6,011                       | 34,200      | 1,632                    | 32,400 | 472             | 32,400 |
|                |           | Left Saddle  | 616                    | 27,360 | -5,901                       | 34,200      | 1,602                    | 32,400 | 464             | 32,400 |
| Weight         | Operating | Right Saddle | 163                    | 16,000 | -1,696                       | 30,000      | 413                      | 17,400 | 109             | 11,067 |
|                |           | Left Saddle  | 147                    | 16,000 | -1,602                       | 30,000      | 390                      | 17,400 | 103             | 11,067 |

| Seismic base shear on vessel                                                |                            |
|-----------------------------------------------------------------------------|----------------------------|
| Vessel is assumed to be a rigid structure.                                  |                            |
| Method of seismic analysis                                                  | ASCE 7-10 ground supported |
| Vertical seismic accelerations considered                                   | Yes                        |
| Importance factor, I <sub>e</sub>                                           | 1                          |
| Site Class                                                                  | B                          |
| Short period spectral response acceleration as percent of g, S <sub>s</sub> | 100                        |
| From Table 11.4-1, F <sub>a</sub>                                           | 1                          |
| Risk Category (Table 1.5-1)                                                 | II                         |
| Equations                                                                   |                            |
| $S_{MS} = F_a * S_s$                                                        |                            |
| $S_{DS} = (2 / 3) * S_{MS}$                                                 |                            |
| $F_p = 0.3 * S_{DS} * W * I_e * 0.7$                                        |                            |
| Results                                                                     |                            |
| $S_{MS} = 1 * 1$                                                            | 1                          |
| $S_{DS} = (2 / 3) * 1$                                                      | 0.6667                     |
| Seismic Design Category (Section 11.6)                                      | D                          |
| $F_p = 0.3 * 0.6667 * 9,421 * 1 * 0.7$                                      | 1,318.94 lb <sub>f</sub>   |



| Saddle reactions due to weight + seismic                                        |              |                                                                            |                          |
|---------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------------|--------------------------|
| $V_v$ = vertical seismic force acting on the saddle                             |              |                                                                            |                          |
| $V$ = horizontal seismic shear acting on the saddle (worst case if not slotted) |              |                                                                            |                          |
| Seismic longitudinal reaction, $Q_l$                                            |              |                                                                            |                          |
| Seismic transverse reaction, $Q_t$                                              |              |                                                                            |                          |
| Equations                                                                       |              |                                                                            |                          |
| $Q_l = V * H_s / L_s + V_v$                                                     |              |                                                                            |                          |
| $Q_t = V * H_s / (R_o * \sin(\theta / 2)) + V_v$                                |              |                                                                            |                          |
| $Q = W + \max[Q_t, Q_l]$                                                        |              |                                                                            |                          |
| Results                                                                         |              |                                                                            |                          |
| Operating                                                                       | Right Saddle | $Q_l = 1,318.94 * 68.625 / 120 + 0.14 * 0.6667 * 4,845$                    | 1,206.47 lb <sub>f</sub> |
|                                                                                 |              | $Q_t = 678.3 * 68.625 / (36.625 * \sin(120 / 2)) + 0.14 * 0.6667 * 4,845$  | 1,919.76 lb <sub>f</sub> |
|                                                                                 |              | $Q = 4,845 + \max[1,919.76, 1,206.47]$                                     | 6,764.76 lb <sub>f</sub> |
|                                                                                 | Left Saddle  | $Q_l = 1,318.94 * 68.625 / 120 + 0.14 * 0.6667 * 4,576$                    | 1,181.36 lb <sub>f</sub> |
|                                                                                 |              | $Q_t = 640.64 * 68.625 / (36.625 * \sin(120 / 2)) + 0.14 * 0.6667 * 4,576$ | 1,813.17 lb <sub>f</sub> |
|                                                                                 |              | $Q = 4,576 + \max[1,813.17, 1,181.36]$                                     | 6,389.17 lb <sub>f</sub> |





| Saddle reactions due to weight + wind                                                                                |              |                                                                      |                           |
|----------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------|---------------------------|
| Wind longitudinal reaction, $Q_l$                                                                                    |              |                                                                      |                           |
| Wind transverse reaction, $Q_t$                                                                                      |              |                                                                      |                           |
| Wind pressure, $P_w$                                                                                                 |              |                                                                      | 14.7584 psf               |
| Equations                                                                                                            |              |                                                                      |                           |
| $V_{wt} = P_w * G * (C_{f(shell)} * (\text{Projected shell area}) + C_{f(saddle)} * (\text{Projected saddle area}))$ |              |                                                                      |                           |
| $V_{we} = P_w * G * (C_{f(shell)} * \pi * R_o^2 / 144 + C_{f(saddle)} * (\text{Projected saddle area}))$             |              |                                                                      |                           |
| $Q_t = V_{wt} * H_s / (R_o * \sin(\theta / 2))$                                                                      |              |                                                                      |                           |
| $Q_l = V_{we} * H_s / L_s$                                                                                           |              |                                                                      |                           |
| $Q = W + \max[Q_t, Q_l]$                                                                                             |              |                                                                      |                           |
| Results                                                                                                              |              |                                                                      |                           |
| Operating                                                                                                            | Right Saddle | $V_{wt} = 14.76 * 0.85 * (0.53 * 54.0701 + 2 * 1.7778)$              | 404.1 lb <sub>f</sub>     |
|                                                                                                                      |              | $V_{we} = 14.76 * 0.85 * (0.5 * \pi * 36.625^2 / 144 + 2 * 17.2981)$ | 617.56 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q_t = 404.1 * 68.625 / (36.625 * \sin(120 / 2))$                    | 874.3 lb <sub>f</sub>     |
|                                                                                                                      |              | $Q_l = 617.56 * 68.625 / 120$                                        | 353.16 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q = 4,845 + \max[874.3, 353.16]$                                    | 5,719.3 lb <sub>f</sub>   |
|                                                                                                                      | Left Saddle  | $V_{wt} = 14.76 * 0.85 * (0.53 * 54.0701 + 2 * 1.7778)$              | 404.1 lb <sub>f</sub>     |
|                                                                                                                      |              | $V_{we} = 14.76 * 0.85 * (0.5 * \pi * 36.625^2 / 144 + 2 * 17.2981)$ | 617.56 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q_t = 404.1 * 68.625 / (36.625 * \sin(120 / 2))$                    | 874.3 lb <sub>f</sub>     |
|                                                                                                                      |              | $Q_l = 617.56 * 68.625 / 120$                                        | 353.16 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q = 4,576 + \max[874.3, 353.16]$                                    | 5,450.3 lb <sub>f</sub>   |
| Test                                                                                                                 | Right Saddle | $V_{wt} = 4.87 * 0.85 * (0.53 * 54.0701 + 2 * 1.7778)$               | 133.35 lb <sub>f</sub>    |
|                                                                                                                      |              | $V_{we} = 4.87 * 0.85 * (0.5 * \pi * 36.625^2 / 144 + 2 * 17.2981)$  | 203.79 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q_t = 133.35 * 68.625 / (36.625 * \sin(120 / 2))$                   | 288.52 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q_l = 203.79 * 68.625 / 120$                                        | 116.54 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q = 20,776 + \max[288.52, 116.54]$                                  | 21,064.52 lb <sub>f</sub> |
|                                                                                                                      | Left Saddle  | $V_{wt} = 4.87 * 0.85 * (0.53 * 54.0701 + 2 * 1.7778)$               | 133.35 lb <sub>f</sub>    |
|                                                                                                                      |              | $V_{we} = 4.87 * 0.85 * (0.5 * \pi * 36.625^2 / 144 + 2 * 17.2981)$  | 203.79 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q_t = 133.35 * 68.625 / (36.625 * \sin(120 / 2))$                   | 288.52 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q_l = 203.79 * 68.625 / 120$                                        | 116.54 lb <sub>f</sub>    |
|                                                                                                                      |              | $Q = 20,393 + \max[288.52, 116.54]$                                  | 20,681.52 lb <sub>f</sub> |

**Longitudinal stress between saddles (Weight, Operating, right saddle loading and geometry govern)**

$$S_1 = \pm 3K_1 Q (L / 12) / (\pi R^2 t)$$

$$= 3 \cdot 0.2381 \cdot 4,845 \cdot (184 / 12) / (\pi \cdot 36.3438^2 \cdot 0.5625)$$

$$= 23 \text{ psi}$$

$$S_p = P \cdot R / (2 \cdot t)$$

$$= 250 \cdot 36.0625 / (2 \cdot 0.5625)$$

$$= 8,014 \text{ psi}$$

Maximum tensile stress  $S_{1t} = S_1 + S_p = 8,037 \text{ psi}$   
 Maximum compressive stress (shut down)  $S_{1c} = S_1 = 23 \text{ psi}$

Tensile stress is acceptable ( $\leq 1 \cdot S \cdot E = 17,000 \text{ psi}$ )  
 Compressive stress is acceptable ( $\leq 1 \cdot S_c = 14,825 \text{ psi}$ )

**Longitudinal stress at the left saddle (Weight, Operating)**

$$L_e = 2 \cdot (\text{Left head depth}) / 3 + L + 2 \cdot (\text{Right head depth}) / 3$$

$$= 2 \cdot 18.513 / 3 + 184 + 2 \cdot 18.513 / 3$$

$$= 208.684 \text{ in}$$

$$w = W_t / L_e = 9,421 / 208.684 = 45.14 \text{ lb/in}$$

Bending moment at the left saddle:

$$M_q = w \cdot (2 \cdot H \cdot A_1 / 3 + A_1^2 / 2 - (R^2 - H^2) / 4)$$

$$= 45.14 \cdot (2 \cdot 18.513 \cdot 32 / 3 + 32^2 / 2 - (36.625^2 - 18.513^2) / 4)$$

$$= 29,672.7 \text{ lb}_f \cdot \text{in}$$

$$S_2 = \pm M_q \cdot K_1' / (\pi R^2 t)$$

$$= 29,672.7 \cdot 9.3799 / (\pi \cdot 36.3438^2 \cdot 0.5625)$$

$$= 119 \text{ psi}$$

$$S_p = P \cdot R / (2 \cdot t)$$

$$= 250 \cdot 36.0625 / (2 \cdot 0.5625)$$

$$= 8,014 \text{ psi}$$

Maximum tensile stress  $S_{2t} = S_2 + S_p = 8,133 \text{ psi}$   
 Maximum compressive stress (shut down)  $S_{2c} = S_2 = 119 \text{ psi}$

Tensile stress is acceptable ( $\leq 1 \cdot S = 20,000 \text{ psi}$ )  
 Compressive stress is acceptable ( $\leq 1 \cdot S_c = 14,825 \text{ psi}$ )

**Tangential shear stress in the shell (right saddle, Seismic, Operating)**

$$Q_{\text{shear}} = Q - w \cdot (a + 2 \cdot H / 3)$$

$$= 6,764.76 - 49.36 \cdot (32 + 2 \cdot 18.513 / 3)$$

$$= 4,576.11 \text{ lb}_f$$



$$\begin{aligned}
 S_3 &= K_{2.2} * Q_{\text{shear}} / (R * t) \\
 &= 1.1707 * 4,576.11 / (36.3438 * 0.5625) \\
 &= \underline{262} \text{ psi}
 \end{aligned}$$

Tangential shear stress is acceptable ( $\leq 0.8 * S = 16,000$  psi)

#### Circumferential stress at the right saddle horns (Seismic, Operating)

$$\begin{aligned}
 S_4 &= -Q / (4 * t * (b + 1.56 * \text{Sqr}(R_o * t))) - 12 * K_3 * Q * R / (L * t^2) \\
 &= -6,764.76 / (4 * 0.5625 * (8 + 1.56 * \text{Sqr}(36.625 * 0.5625))) - 12 * 0.0428 * 6,764.76 * 36.3438 / (184 * 0.5625^2) \\
 &= \underline{-2,368} \text{ psi}
 \end{aligned}$$

Circumferential stress at saddle horns is acceptable ( $\leq 1.5 * S_a = 30,000$  psi)

#### Ring compression in shell over right saddle (Seismic, Operating)

$$\begin{aligned}
 S_5 &= K_5 * Q / ((t + t_p) * (t_s + 1.56 * \text{Sqr}(R_o * t_c))) \\
 &= 0.7603 * 6,764.76 / ((0.5625 + 0.375) * (0.375 + 1.56 * \text{Sqr}(36.625 * 0.9375))) \\
 &= \underline{577} \text{ psi}
 \end{aligned}$$

Ring compression in shell is acceptable ( $\leq 0.5 * S_y = 17,400$  psi)

#### Saddle splitting load (right, Seismic, Operating)

Area resisting splitting force = Web area + wear plate area

$$\begin{aligned}
 A_e &= H_{\text{eff}} * t_s + t_p * W_p \\
 &= 12.2083 * 0.375 + 0.375 * 12 \\
 &= 9.0781 \text{ in}^2
 \end{aligned}$$

$$\begin{aligned}
 S_6 &= K_8 * Q / A_e \\
 &= 0.2035 * 6,764.76 / 9.0781 \\
 &= \underline{152} \text{ psi}
 \end{aligned}$$

Stress in saddle is acceptable ( $\leq (2 / 3) * S_s = 11,067$  psi)

#### Shear stress in anchor bolting, one end slotted

Maximum seismic or wind base shear = 1,318.94 lb<sub>f</sub>

Thermal expansion base shear =  $W * \mu = 5,453 * 0.45 = 2,453.85$  lb<sub>f</sub>  
 Corroded root area for a 1" series 8 threaded bolt = 0.3988 in<sup>2</sup> ( 2 per saddle )

Bolt shear stress =  $2,453.85 / (0.3988 * 1 * 2) = 3,077$  psi

Anchor bolt stress is acceptable ( $\leq 15,000$  psi)

#### Shear stress in anchor bolting, transverse

Maximum seismic or wind base shear = 1,318.94 lb<sub>f</sub>  
 Corroded root area for a 1" series 8 threaded bolt = 0.3988 in<sup>2</sup> ( 2 per saddle )



$$\text{Bolt shear stress} = 1,318.94 / (0.3988 * 2 * 2) = 827 \text{ psi}$$

Anchor bolt stress is acceptable ( $\leq 15,000$  psi)

#### Web plate buckling check (Escoe pg 251)

Allowable compressive stress  $S_c$  is the lesser of 16,600 or 10,219 psi: (10,219)

$$\begin{aligned} S_c &= K_1 * \pi^2 * E / (12 * (1 - 0.3^2) * (d_i / t_s)^2) \\ &= 1.28 * \pi^2 * 29E+06 / (12 * (1 - 0.3^2) * (21.4869 / 0.375)^2) \\ &= 10,219 \text{ psi} \end{aligned}$$

Allowable compressive load on the saddle

$$\begin{aligned} b_e &= d_i * t_s / (d_i * t_s + 2 * t_w * (b - 1)) \\ &= 21.4869 * 0.375 / (21.4869 * 0.375 + 2 * 0.375 * (8 - 1)) \\ &= 0.6055 \end{aligned}$$

$$\begin{aligned} F_b &= n * (A_s + 2 * b_e * t_s) * S_c \\ &= 4 * (2.8594 + 2 * 0.6055 * 0.375) * 10,219 \\ &= 135,439.26 \text{ lb}_f \end{aligned}$$

Saddle loading of 21,672.52 lb<sub>f</sub> is  $\leq F_b$ ; satisfactory.

#### Primary bending + axial stress in the saddle due to end loads (assumes one saddle slotted)

$$\begin{aligned} \sigma_b &= V * (H_s - x_o) * y / I + Q / A \\ &= 1,318.94 * (68.625 - 30.2886) * 5.2168 / 119.73 + 6,764.76 / 35.2261 \\ &= 2,395 \text{ psi} \end{aligned}$$

The primary bending + axial stress in the saddle  $\leq 16,600$  psi; satisfactory.

#### Secondary bending + axial stress in the saddle due to end loads (includes thermal expansion, assumes one saddle slotted)

$$\begin{aligned} \sigma_b &= V * (H_s - x_o) * y / I + Q / A \\ &= 3,772.79 * (68.625 - 30.2886) * 5.2168 / 119.73 + 6,764.76 / 35.2261 \\ &= 6,494 \text{ psi} \end{aligned}$$

The secondary bending + axial stress in the saddle  $< 2 * S_y = 72,000$  psi; satisfactory.

#### Saddle base plate thickness check (Roark sixth edition, Table 26, case 7a)

where  $a = 21.4869$ ,  $b = 11.625$  in

$$\begin{aligned} t_b &= (\beta_1 * q * b^2 / (1.5 * S_a))^{0.5} \\ &= (1.6457 * 27 * 11.625^2 / (1.5 * 16,600))^{0.5} \\ &= 0.4907 \text{ in} \end{aligned}$$

The base plate thickness of 0.5 in is adequate.

#### Foundation bearing check



$$\begin{aligned} S_f &= Q_{\max} / (F * E) \\ &= 21,672.52 / (12 * 67) \\ &= 27 \text{ psi} \end{aligned}$$

Concrete bearing stress  $\leq 1,658$  psi ; satisfactory.

**Wind Code**

| Building Code: ASCE 7-10                             |              |
|------------------------------------------------------|--------------|
| Elevation of base above grade                        | 32.00 ft     |
| Increase effective outer diameter by                 | 0.00 ft      |
| Wind Force Coefficient, Cf                           | 0.5300       |
| Risk Category (Table 1.5-1)                          | II           |
| Basic Wind Speed, V                                  | 115.0000 mph |
| Exposure category                                    | B            |
| Wind Directionality Factor, Kd                       | 0.9500       |
| Topographic Factor, Kzt                              | 1.0000       |
| Enforce minimum design load of 16 psf per ASCE 29.8: | Yes          |

**Wind Pressure (WP) Calculations**

$$\begin{aligned}K_z &= 2.01 * (Z/z_g)^{2/\alpha} \\&= 2.01 * (40.77 / 1,200.00)^{0.2857} \\&= 0.7648\end{aligned}$$

$$\begin{aligned}q_z &= 0.00256 * K_z * K_{zt} * K_d * V^2 \\&= 0.00256 * 0.7648 * 1.0000 * 0.9500 * 115.0000^2 \\&= 24.5974 \text{ psf}\end{aligned}$$

$$\begin{aligned}q_z &= 0.6 * \max ( 24.5974, 16.0000 ) \\&= 14.7584 \text{ psf}\end{aligned}$$

Note: The 0.6 factor is the wind load combination factor from Section 2.4.1.

| Table Lookup Values                          |                          |
|----------------------------------------------|--------------------------|
| $\alpha = 7.0000, z_g = 1,200.00 \text{ ft}$ | [Table 26.9-1, page 256] |

Shear calculations are reported in the saddle report.



### Seismic Code

Seismic calculations are reported in the saddle report.



DAVIT ARM NOT SHOWN FOR CLARITY



- |                      |           |
|----------------------|-----------|
| HEADS: -----         | SA 516-70 |
| SHELLS: -----        | SA 516-70 |
| FLANGES: -----       | SA-105    |
| COUPLINGS:-----      | SA-105    |
| PIPES: -----         | SA-106 B  |
| WEAR PADS: -----     | SA 516-70 |
| SADDLES:-----        | SA-36     |
| INLET DIVERTER:----- | SA 516-70 |
| WEIR PLATE:-----     | SA 516-70 |

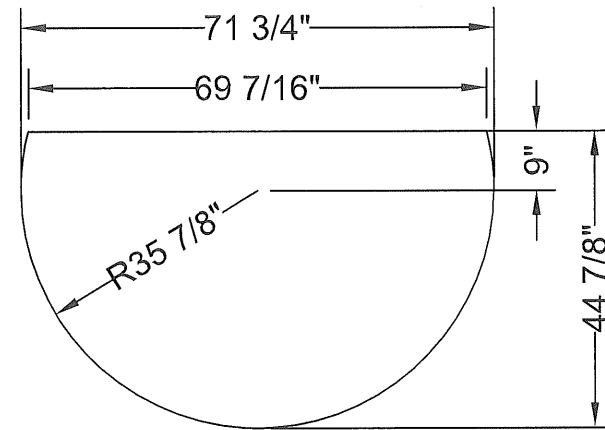


|         |
|---------|
| JOB NO. |
| J2465   |

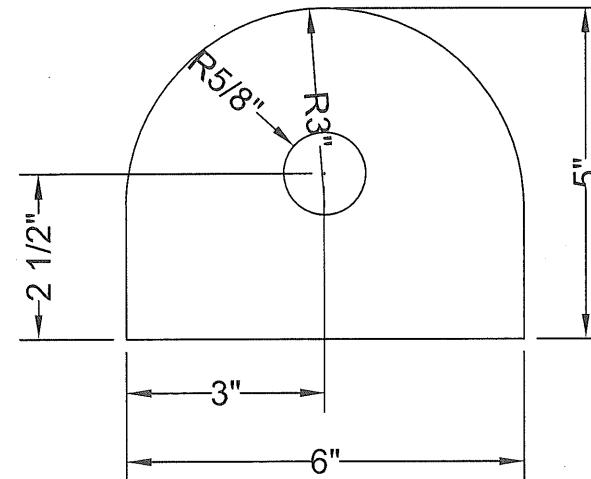
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|               |  |                       |                 |
|---------------|--|-----------------------|-----------------|
| DRAWN BY: JGF |  | CHECKED BY: JR        | APPROVED BY: GM |
| SCALE NTS     |  | PART NUMBER: 00002465 | QUANTITY: Rev.  |
| DATE 1-14-16  |  | MATERIAL:             | SHEET 1 OF 1 1  |

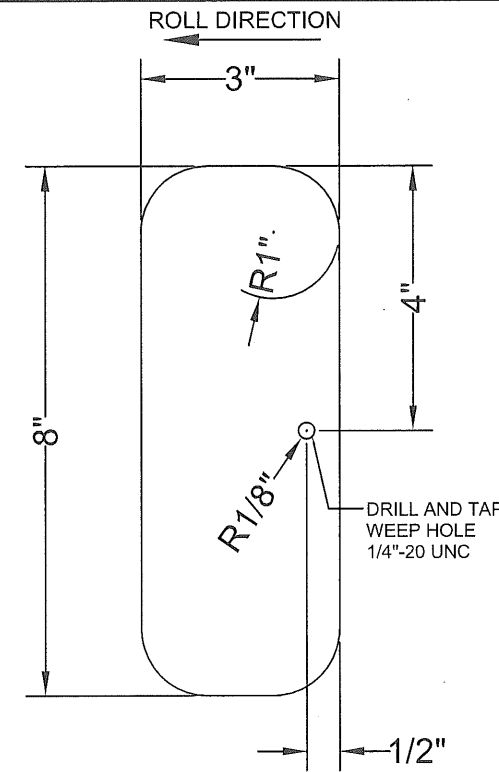




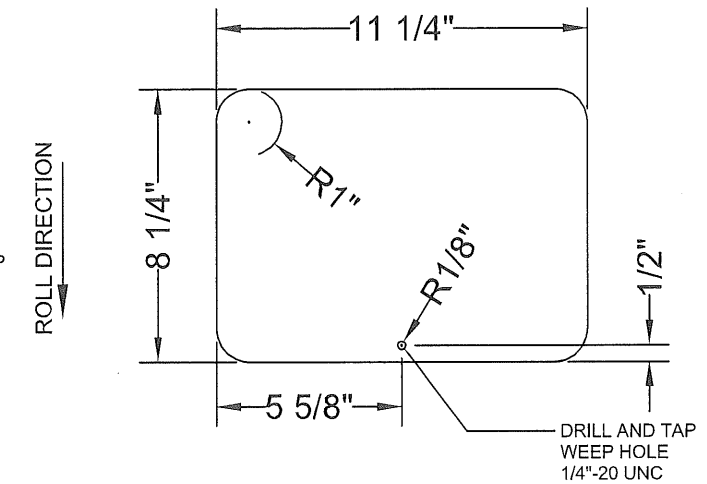
WEIR PLATE  
ITEM 7



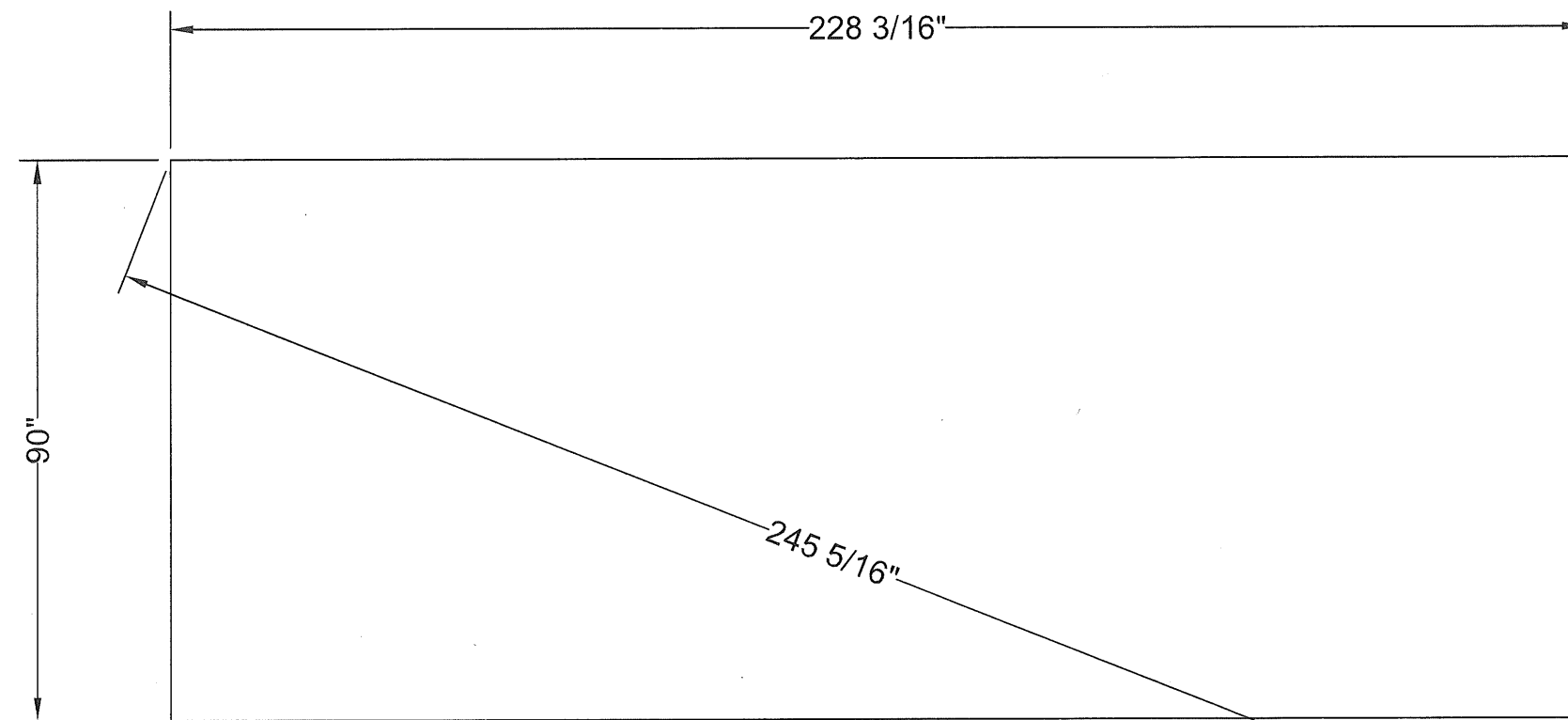
LIFTING LUG  
ITEM 10  
SCALE: 10:1



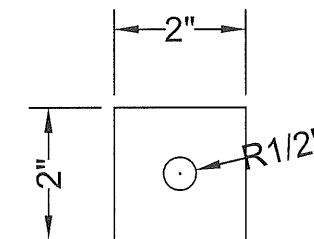
LIFTING LUG PAD  
ITEM 9  
SCALE: 10:1



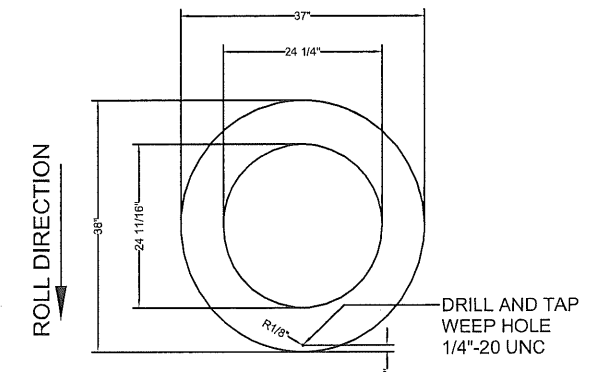
NAMEPLATE PAD  
ITEM 11  
SCALE: 5:1



SHELL RING  
ITEM 2  
SCALE: 1:1



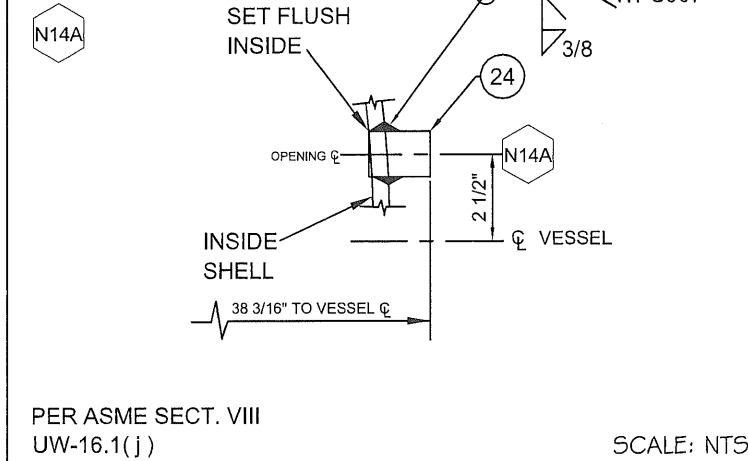
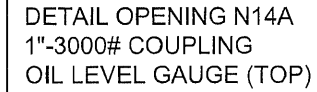
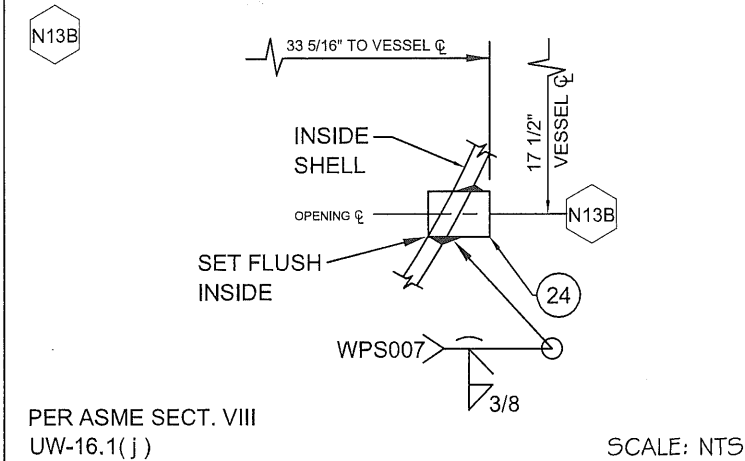
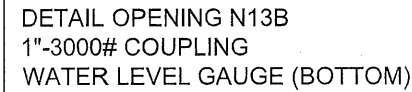
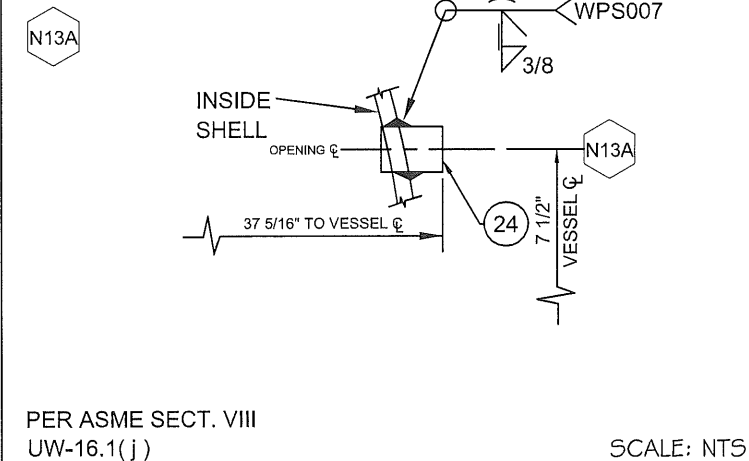
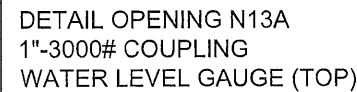
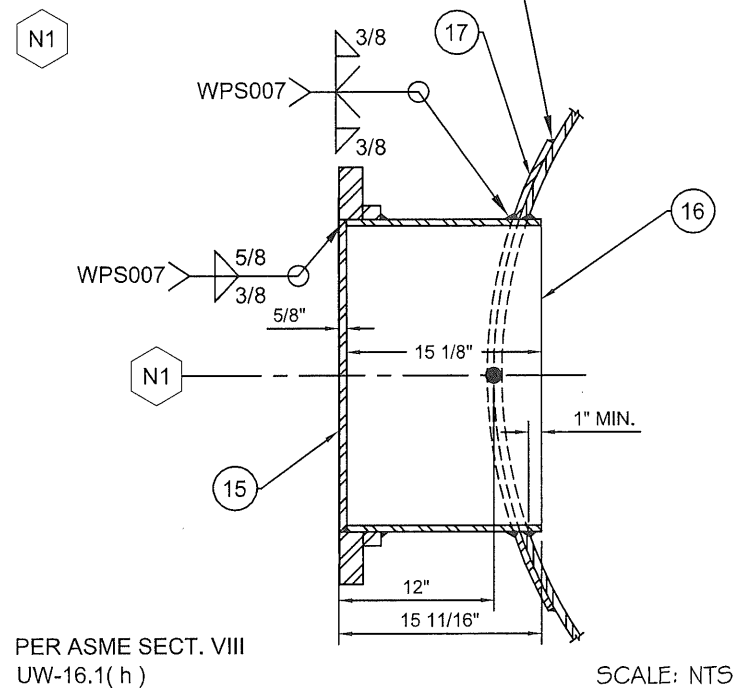
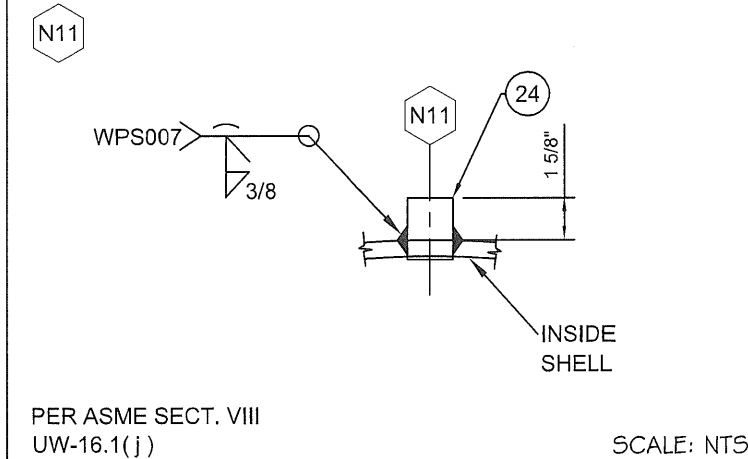
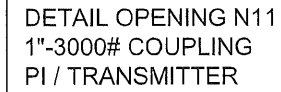
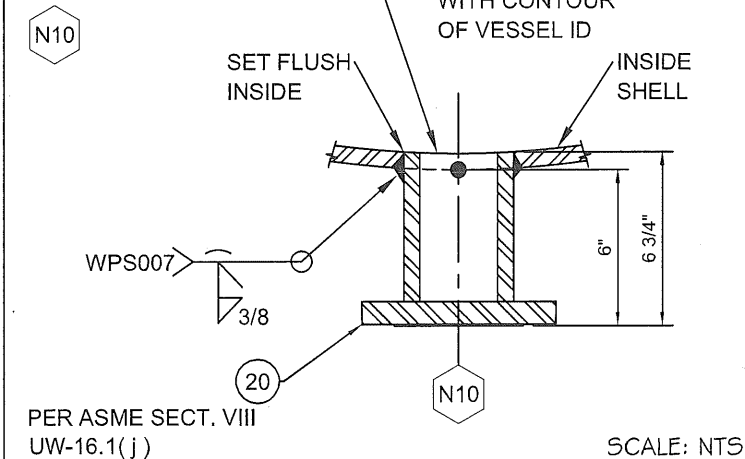
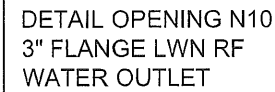
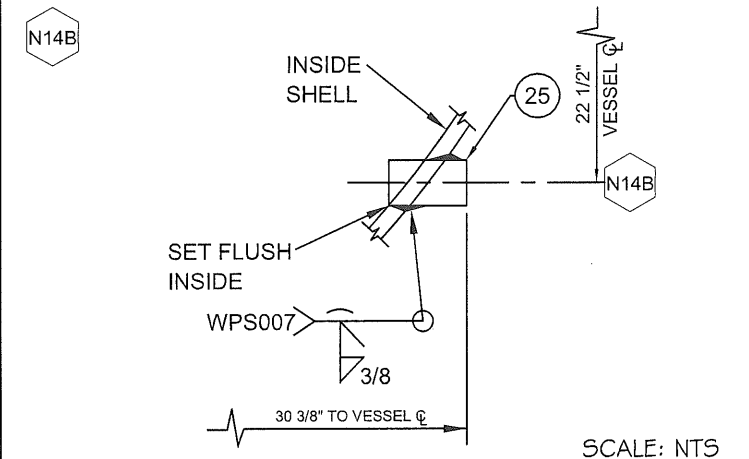
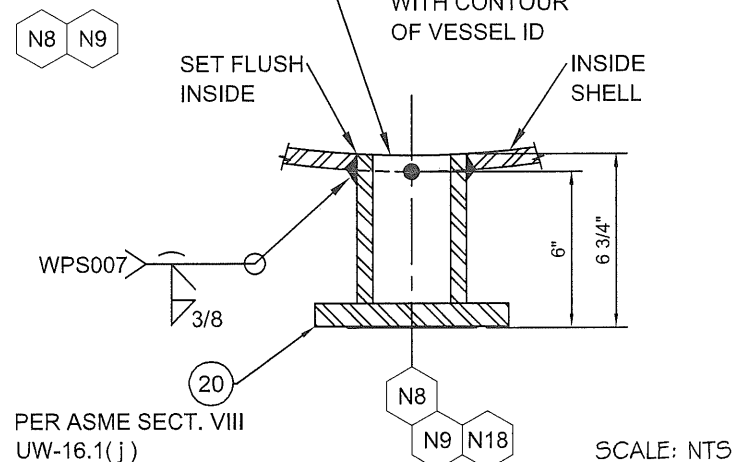
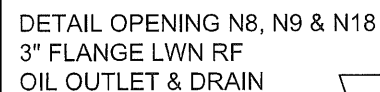
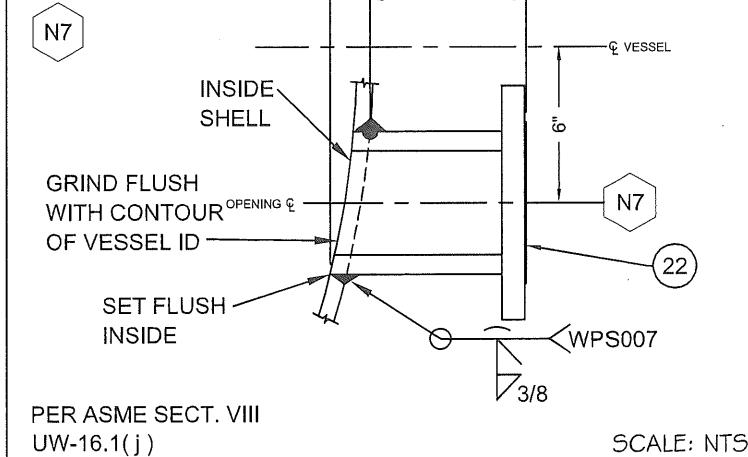
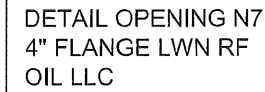
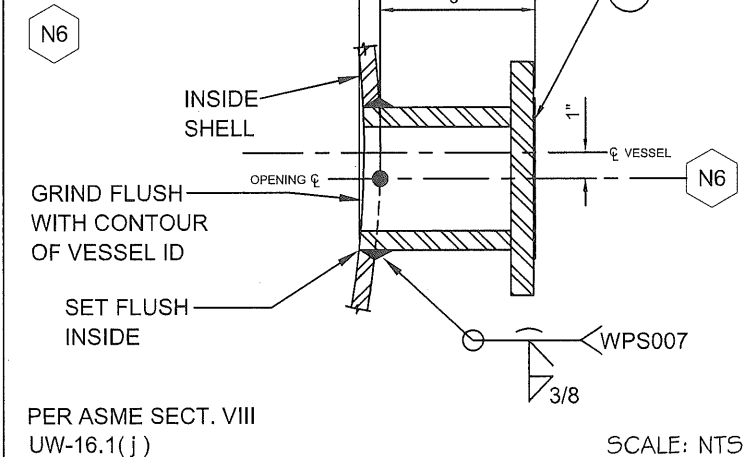
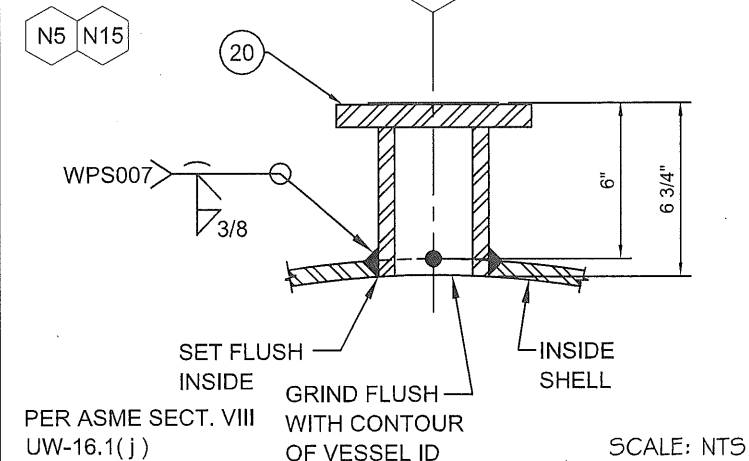
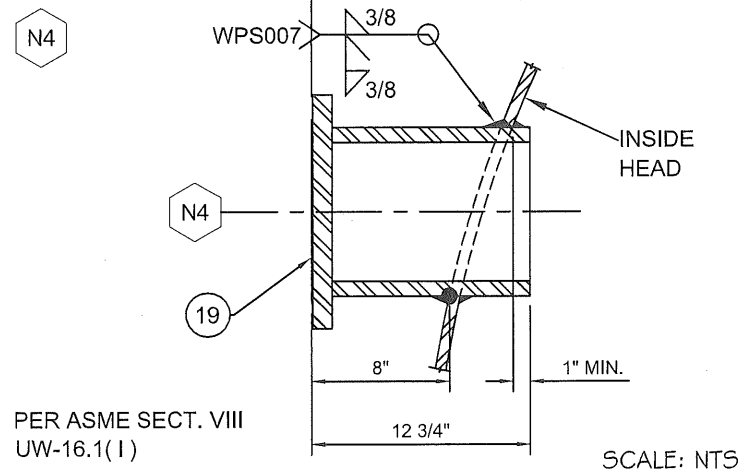
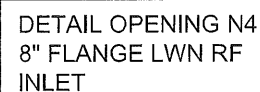
GROUNDING LUG  
ITEM 13  
SCALE: 10:1



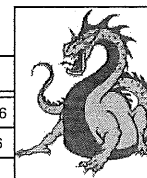
MANWAY REPAD  
ITEM 17  
SCALE: 1:1

| REV. | DESCRIPTION            | BY  | APPR. | DATE    |
|------|------------------------|-----|-------|---------|
| 0    | ISSUED FOR FABRICATION | JGF | JR    | 4-22-16 |
| 1    | ADDED PACKAGING BOM    | JGF | JR    | 6-7-16  |

|                                                                                       |                                                                            |  |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--|
|  | <b>72" ID x 180" 3-PHASE SEPARATOR</b><br>250 PSI @ 200 DEGREE F<br>V-1010 |  |
|                                                                                       | DRAWN BY: JGF    CHECKED BY: JR    APPROVED BY: GM                         |  |
|                                                                                       | SCALE: NTS    PART NUMBER: 00002465    QUANTITY: 1                         |  |
|                                                                                       | DATE: 1-14-16    MATERIAL:    SHEET 2 OF 4                                 |  |



| REV. | DESCRIPTION            | BY  | APPR. | DATE    |
|------|------------------------|-----|-------|---------|
| 0    | ISSUED FOR FABRICATION | JGF | JR    | 4-22-16 |
| 1    | ADDED PACKAGING BOM    | JGF | JR    | 6-7-16  |
|      |                        |     |       |         |



DRAGON PRODUCTS, LTD.

|         |
|---------|
| JOB NO. |
| J2465   |

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72" ID x 180" 3-PHASE SEPARATOR

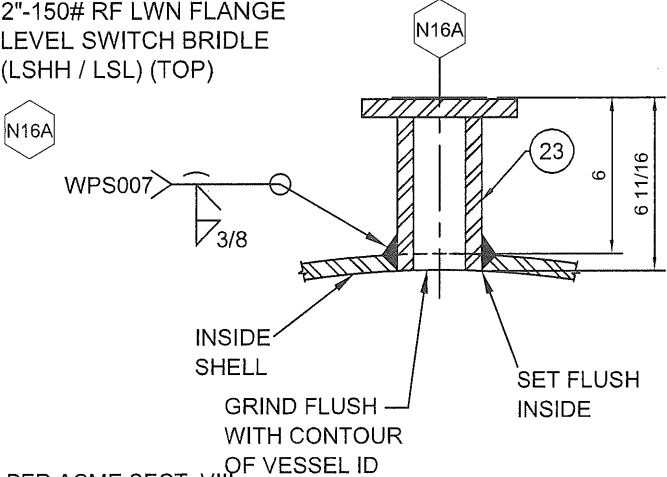
250 PSI @ 200 DEGREE F

V-101C

|               |         |                          |                 |
|---------------|---------|--------------------------|-----------------|
| DRAWN BY: JGF |         | CHECKED BY: JR           | APPROVED BY: GM |
| SCALE         | NTS     | PART NUMBER:<br>00002465 | QUANTITY:       |
| DATE          | 1-14-16 | MATERIAL:                | SHEET 3 OF 4    |

| BILL OF MATERIAL                   |           |                                                                |                     |      |
|------------------------------------|-----------|----------------------------------------------------------------|---------------------|------|
| ITEM NO.                           | Part No.  | Description                                                    | Materials           | Qty. |
| 1                                  | 2465-1000 | HEAD, 2:1 ELLIP., 72" ID, W/ 2" S.F., 0.513" MIN., 0.625" NOM. | SA-516-70           | 2    |
| 2                                  |           | SHELL, CUT AND ROLL, 0.625" X 90" X 228 3/16"                  | SA-516-70           | 2    |
| 3                                  | 2465-4000 | SADDLE ASSEMBLY, FIXED (SEE BELOW)                             | SEE DRAWING         | 1    |
| 4                                  | 2465-4000 | SADDLE ASSEMBLY, SLIDING (SEE BELOW)                           | SEE DRAWING         | 1    |
| 5                                  | 2465-3000 | DAVIT ASSEMBLY (SEE BELOW)                                     | SEE DRAWING         | 1    |
| 6                                  | 2465-2000 | INLET DIVERTER ASSEMBLY (SEE BELOW) (N4)                       | SA 516-70           | 1    |
| 7                                  |           | PLATE, WEIR, 72" X 45" X 3/8" THK.                             | SA 516-70           | 1    |
| 8                                  | 2465-5000 | MIST EXTRACTOR, 18" SCH 40 PIPE w/ INSERT (N5)                 | SEE DRAWING         | 1    |
| 9                                  |           | PLATE, 8" X 3" X 1/2" THK.                                     | SA 516-70           | 2    |
| 10                                 |           | PLATE, 8" X 5" X 1" THK.                                       | SA-36               | 2    |
| 11                                 |           | PLATE, 11 1/4" X 8 1/4" X 3/8" THK                             | SA-36               | 1    |
| 12                                 |           | PLATE, DATA, ASME                                              | SA-312 TP 304       | 1    |
| 13                                 |           | PLATE, GROUNDING LUG, 2" X 2" X 1/4" THK.                      | SA-36               | 2    |
| 14                                 | 2465-6000 | VORTEX BREAKER, 3" OPNGS (N8 & N10)                            | C.S. SA-312 TP 316  | 2    |
| 15                                 |           | FLANGE, 24"-150# RFSD (N1)                                     | SA-105              | 1    |
| 16                                 |           | PIPE, 24" SCH XS X 15 1/8" LG. (N1)                            | SA-106 B            | 1    |
| 17                                 |           | PLATE, REINFORCING PAD, 38" X 37" X 1/2" THK. (N1)             | SA-516 70           | 1    |
| 18                                 |           | FLANGE, 24"-150# RF, BLIND (N1)                                | SA-105              | 1    |
| 19                                 |           | FLANGE, 8"-150# LWN X 12 3/4" LG. (N4)                         | SA-105              | 1    |
| 20                                 |           | FLANGE, 3"-150# LWN X 6 3/4" LG. (N5, N8, N9, N10, N15 & N18)  | SA-105              | 6    |
| 21                                 |           | FLANGE, 4"-150# LWN X 6 13/16" LG. (N6)                        | SA-105              | 1    |
| 22                                 |           | FLANGE, 4"-150# LWN X 7 5/8" LG. (N7)                          | SA-105              | 1    |
| 23                                 |           | FLANGE, 2"-150# LWN X 6 11/16" LG. (N16A & N16B)               | SA-105              | 2    |
| 24                                 |           | COUPLING, 1"-3000# (N11, N13A, N13B, N14A)                     | SA-106 B            | 4    |
| 25                                 |           | COUPLING, SPECIAL, 1"-3000# X 3" LG. (N14B)                    | SA-106 B            | 1    |
| 26                                 |           | FLANGE, 2"-150# LWN X 12" LG. (N17A & N17B)                    | SA-105              | 2    |
| 2465-2000 INLET DIVERTER           |           |                                                                |                     |      |
| 1                                  |           | PLATE, 37 3/4" X 16" X 3/8" THK.                               | SA 516-70           | 1    |
| 2                                  |           | PLATE, 16" X 8" X 3/8" THK.                                    | SA 516-70           | 2    |
| 2465-3000 DAVIT ASSEMBLY           |           |                                                                |                     |      |
| 1                                  |           | BAR, 3/4" DIA X 11-1/2" LG.                                    | SA-105 OR A-105     | 1    |
| 2                                  |           | EYEBOLT 3/4" - 10 UNC X 6"                                     | S.S.                | 1    |
| 3                                  |           | WASHER 3/4" HVY                                                | C.S.                | 1    |
| 4                                  |           | NUT 3/4" HVY HEX                                               | A-194-2H            | 1    |
| 5                                  |           | COTTER KEY PIN, 1-1/2" LG.                                     | S.S.                | 1    |
| 6                                  |           | F.B., 3/8" X 2 1/2" X 19-5/8"                                  | A-36 OR EQ.         | 1    |
| 7                                  |           | PIPE, 2" SCH 40 X 47-3/8" LG.                                  | 2" SCH 40           | 2    |
| 8                                  |           | PLATE, 1/4" X 2 1/16" DIA                                      | SA-36 OR A-36       | 4    |
| 9                                  |           | PLATE, 1/4" X 3 1/2" OD X 2 1/2" ID                            | SA-36 OR A-36       | 2    |
| 10                                 |           | PIPE, 3" SCH XXH X 8" LG.                                      | 3" SCH XXH          | 2    |
| 11                                 |           | PLATE, 5/8" X 4" X 12"                                         | SA-36 OR A-36       | 2    |
| 12                                 |           | BAR, 3/4" DIA X 12 5/16"                                       | SA-105 OR A-105     | 2    |
| 2465-4000 SADDLE ASSEMBLY          |           |                                                                |                     |      |
| 1                                  |           | PLATE, WEAR PAD, SADDLE, 81" X 12" X 3/8" THK.                 | SA 516-70           | 2    |
| 2                                  |           | PLATE, WEB, SADDLE, 64 1/16" X 49 5/8" X 3/8" THK.             | SA-36               | 2    |
| 3                                  |           | PLATE, SIDE, SADDLE, 49 5/8" X 9 5/8" X 3/8" THK               | SA-36               | 4    |
| 4                                  |           | PLATE, GUSSET, SADDLE, 34 5/8" X 9 5/8" X 3/8" THK.            | SA-36               | 4    |
| 5                                  |           | PLATE, BASE, SADDLE, FIXED, 67" X 12" X 1/2" THK.              | SA-36               | 1    |
| 6                                  |           | PLATE, BASE, SADDLE, SLIDING, 67" X 12" X 1/2" THK.            | SA-36               | 1    |
| 2465-5000 MIST EXTRACTOR           |           |                                                                |                     |      |
| 1                                  |           | PIPE, 18" SCH 40 X 14" LG.                                     | SA-106 B            | 1    |
| 2465-6000 VORTEX BREAKER           |           |                                                                |                     |      |
| 3                                  |           | PLATE, 2" X 2" X 1/4" THK.                                     | SA-312 TP 316       | 1    |
| 2465 VESSEL PACKAGING              |           |                                                                |                     |      |
| 30                                 |           | GASKET, 24"-150#, FLEXITALLIC, CGI                             | S.S.                | 1    |
| 31                                 |           | NUT, HEAVY HEX, 1-1/4" - 8 UNC                                 | SA-312 TP 316       | 40   |
| 32                                 |           | STUD, 1-1/4" - 8 UNC X 7" LG.                                  | SA-312 TP 316       | 20   |
| 2465-2000 INLET DIVERTER           |           |                                                                |                     |      |
| 3                                  |           | BOLT, HEAVY HEX, 1/2"-13 UNC X 2 1/4" LG.                      | SA-193-B7M          | 6    |
| 4                                  |           | NUT, HEAVY HEX, 1/2"-13 UNC                                    | SA-194-2HM          | 12   |
| 5                                  |           | WASHER, FLAT, 1/2"                                             | C.S. CADNIUM PLATED | 12   |
| 2465-3000 DAVIT ASSEMBLY PACKAGING |           |                                                                |                     |      |
| 13                                 |           | GREASE ZERK                                                    |                     | 1    |
| 2465-5000 MIST EXTRACTOR           |           |                                                                |                     |      |
| 2                                  |           | BAR, ROUND, 1/2" DIA, X 22" LG.                                | SA-312 TP 316       | 1    |
| 3                                  |           | NUT, HEAVY HEX, 1/2"-13 UNC (CADNIUM PLATED)                   | SA-194-2HM          | 4    |
| 4                                  |           | WASHER, FLAT, 1/2" (CADNIUM PLATED)                            | A-36 OR EQ.         | 2    |
| 5                                  | 2465-5100 | PAD, MESH, 16 7/8" DIA, X 6" OAH                               | SA-312 TP 316       | 1    |
| 2465-6000 VORTEX BREAKER           |           |                                                                |                     |      |
| 1                                  |           | PLATE, 12 3/4" X 1 1/4" X 1/4" THK.                            | SA-312 TP 316       | 2    |
| 2                                  |           | PLATE, 7" X 1 1/4" X 1/4" THK.                                 | SA-312 TP 316       | 4    |
| 4                                  |           | WASHER, FLAT, 1/2" (CADNIUM PLATED)                            | C.S.                | 8    |
| 5                                  |           | NUT, HEAVY HEX, 1/2"-13 UNC                                    | SA-312 TP 316       | 8    |
| 6                                  |           | BOLT, 1/2"-13 UNC X 2" LG.                                     | SA-312 TP 316       | 4    |

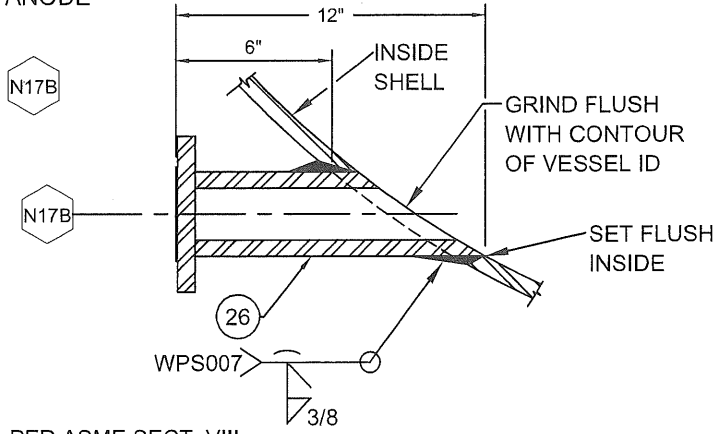
DETAIL OPENING N16A  
2"-150# RF LWN FLANGE  
LEVEL SWITCH BRIDLE  
(LSHH / LSL) (TOP)



PER ASME SECT. VIII  
UW-16.1(j)

SCALE: NTS

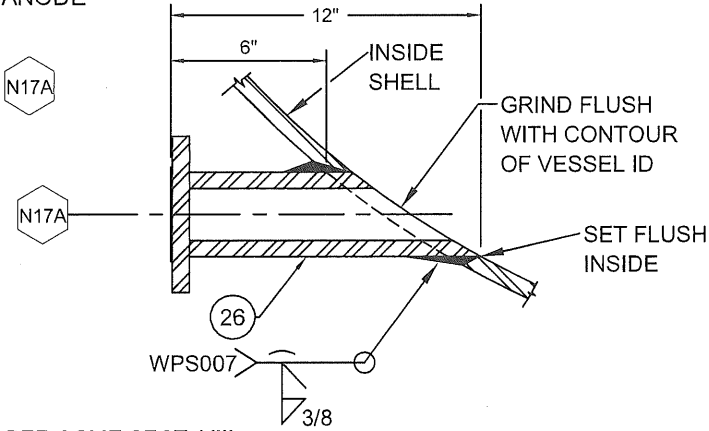
DETAIL OPENING N17B  
2"-150# RF LWN FLANGE  
ANODE



PER ASME SECT. VIII  
UW-16.1(j)

SCALE: NTS

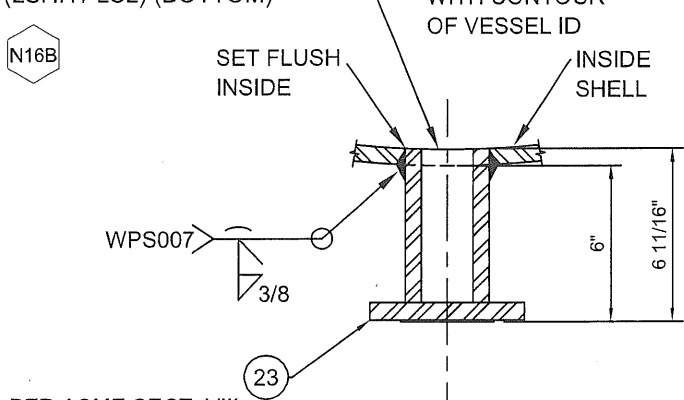
DETAIL OPENING N17A  
2"-150# RF LWN FLANGE  
ANODE



PER ASME SECT. VIII  
UW-16.1(j)

SCALE: NTS

DETAIL OPENING N16B  
2"-150# RF LWN FLANGE  
LEVEL SWITCH BRIDLE  
(LSHH / LSL) (BOTTOM)



PER ASME SECT. VIII  
UW-16.1(j)

SCALE: NTS

| REV. | DESCRIPTION            | BY  | APPR. | DATE    |
|------|------------------------|-----|-------|---------|
| 0    | ISSUED FOR FABRICATION | JGF | JR    | 4-22-16 |
| 1    | ADDED PACKAGING BOM    | JGF | JR    | 6-7-16  |



DRAGON PRODUCTS, LTD.

J2465

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72" ID x 180" 3-PHASE SEPARATOR

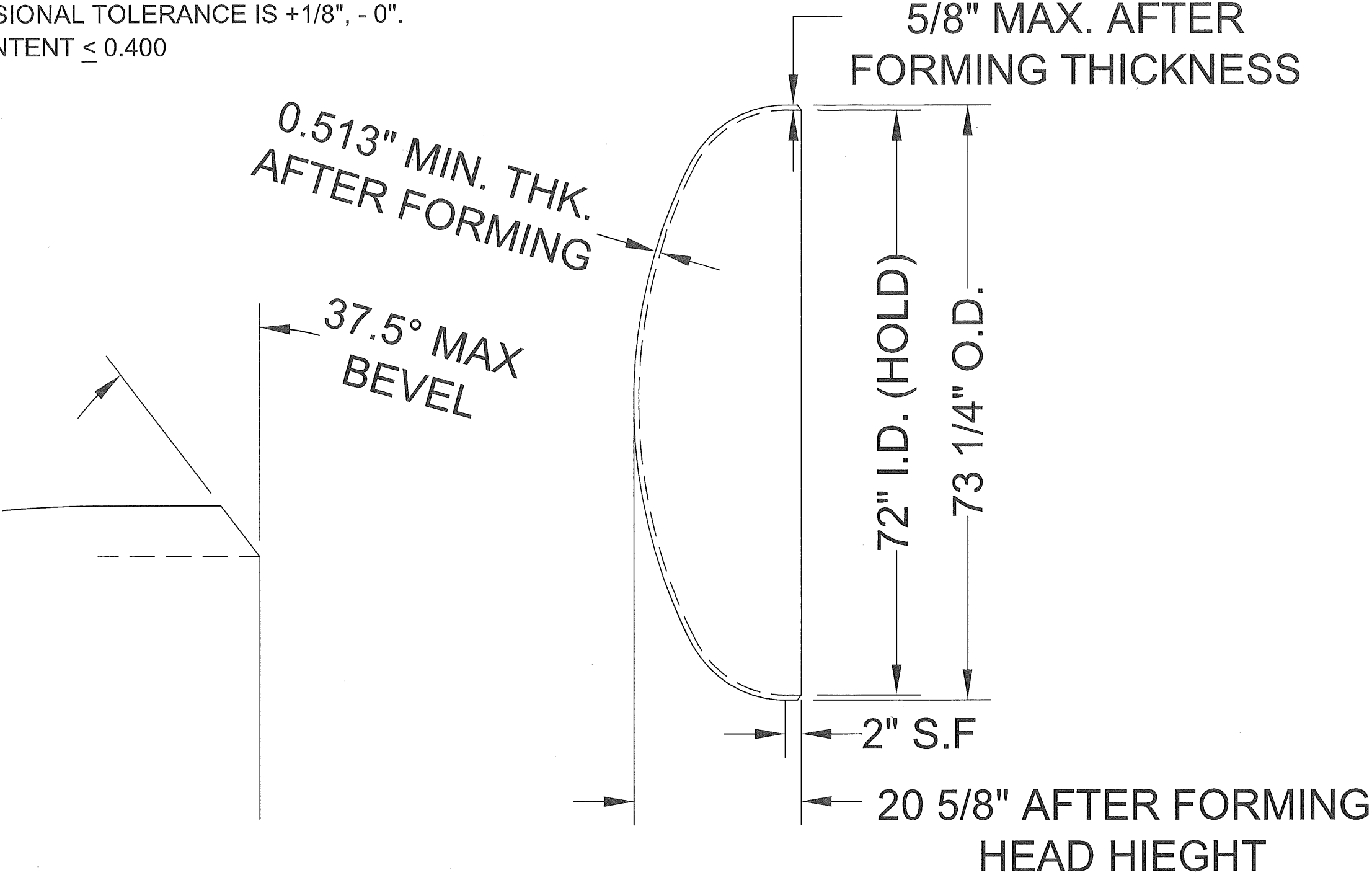
250 PSI @ 200 DEGREE F

V-1010

|           |         |              |          |              |        |
|-----------|---------|--------------|----------|--------------|--------|
| DRAWN BY: | JGF     | CHECKED BY:  | JR       | APPROVED BY: | GM     |
| SCALE     | NTS     | PART NUMBER: | 00002465 | QUANTITY:    | Rev.   |
| DATE      | 1-14-16 | MATERIAL:    |          | SHEET        | 4 of 4 |

1

THIS HEAD IS TO BE BUILT IN ACCORDANCE WITH ASME SECTION VIII, DIVISION I, LATEST EDITION.  
AND CONFORM TO PARAGRAPH UG-81 AND PARAGRAPH UCS-79 (d).  
MATERIAL TEST REPORTS REQUIRED FOR THIS HEAD.  
ALL DIMENSIONS STATED ON THE DRAWING ARE MINIMUM.  
DIMENSIONAL TOLERANCE IS +1/8", - 0".  
CE CONTENT  $\leq$  0.400



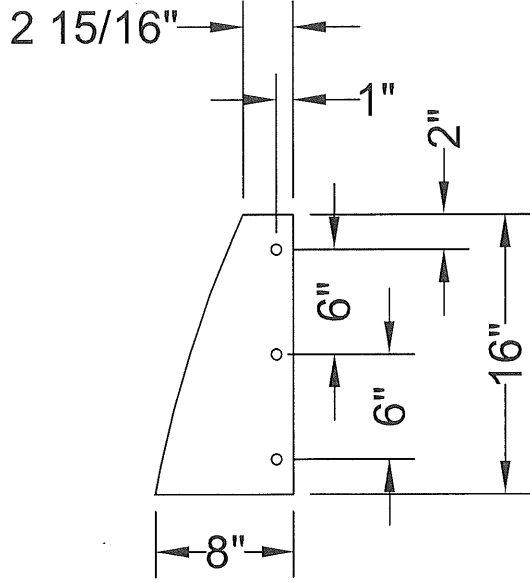
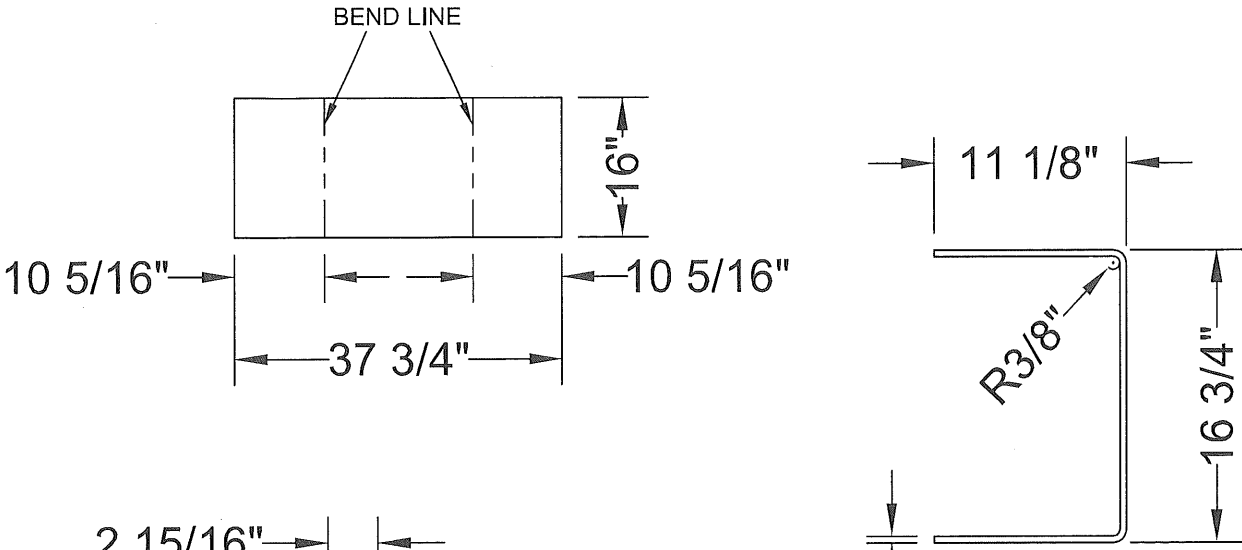
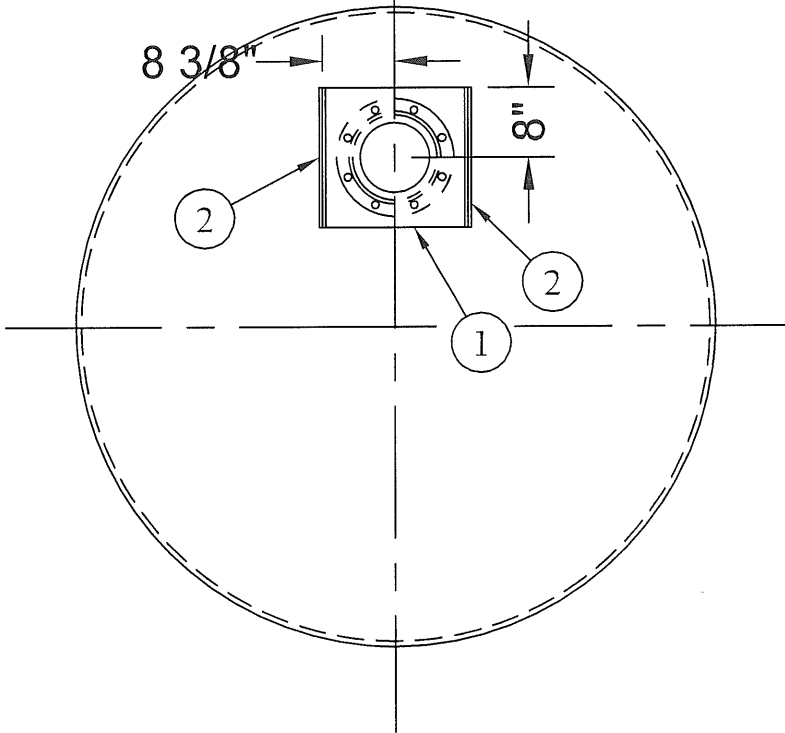
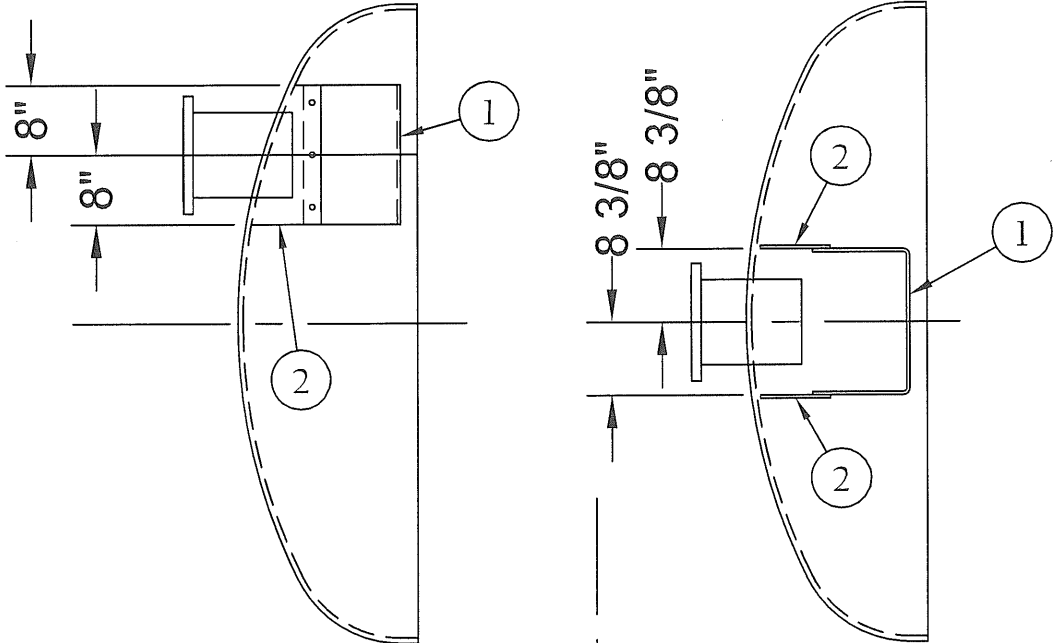
WELDING NOTE (UNLESS OTHERWISE NOTED)  
1) ALL WELDS SHALL BE CONTINUOUS.  
2) ALL FILLET WELDS SHALL HAVE EQUAL LEGS.  
3) FILLET WELD SIZE SHALL EQUAL BASE METAL WHEN BASE METAL IS LESS THAN OR EQUAL TO 3/16".  
4) WHEN THE THINNEST METAL IS EQUAL TO 1/4" OR GREATER, THE FILLET WELD SIZE SHALL BE 1/16" LESS THAN THE THINNEST METAL.



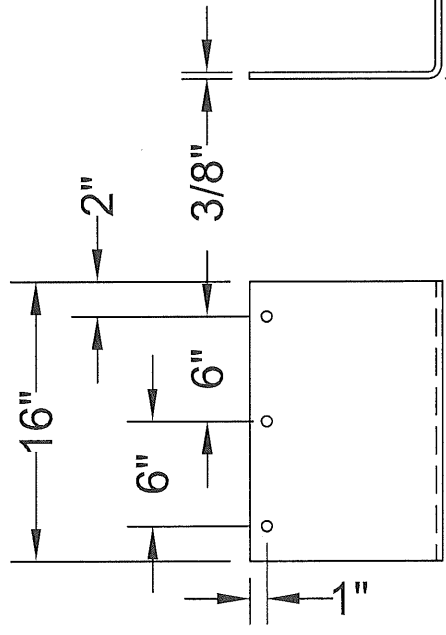
|               |       |                                                                                                                                                                                |                    |         |                        |
|---------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------|------------------------|
| LIBERTY TEXAS |       | HEAD, 2:1 ELLIP, 73 1/4" OD<br>w/ 2" S.F.<br>0.625" NOM, 0.513" MIN.                                                                                                           |                    |         |                        |
| JOB NO.       | J2465 | THIS DRAWING AND INFORMATION CONTAINED HEREIN IS THE PROPERTY OF DRAGON PRODUCTS, LTD. AND CANNOT BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF DRAGON PRODUCTS, LTD. | DRAWN BY:          | JGF     | CHECKED BY: JR         |
|               |       |                                                                                                                                                                                | SCALE              | NTS     | APPROVED BY: GM        |
|               |       |                                                                                                                                                                                | DATE               | 1-19-16 | PART NUMBER: 2465-1000 |
|               |       |                                                                                                                                                                                | MATERIAL: SA516-70 |         | QUANTITY: 1            |
|               |       |                                                                                                                                                                                | SHEET 1 OF 1       |         | Rev. 0                 |

SHOP NOTE:  
SHOP TO DOUBLE NUT EACH BOLT  
WHEN INSTALLING INLET DIVERTER.

| BILL OF MATERIAL |     |                                             |
|------------------|-----|---------------------------------------------|
| ITEM NO.         | QTY | DESCRIPTION                                 |
| 1                | 1   | PLATE, 37 3/4" X 16" X 3/8" THK.            |
| 2                | 2   | PLATE, 16" X 8" X 3/8" THK.                 |
| 3                | 6   | BOLT, 1/2"-13 UNC X 2 1/4" LG. (SA-193-B7M) |
| 4                | 12  | NUT, HEAVY HEX, 1/2"-13 UNC (SA-194-2HM)    |
| 5                | 12  | WASHER, FLAT, 1/2"                          |



DIVERTER CLIP  
ITEM 2



DIVERTER PLATE  
ITEM 1

WELDING NOTE (UNLESS OTHERWISE NOTED)  
1) ALL WELDS SHALL BE CONTINUOUS.  
2) ALL FILLET WELDS SHALL HAVE EQUAL LEGS.  
3) FILLET WELD SIZE SHALL EQUAL BASE METAL WHEN BASE METAL IS LESS THAN OR EQUAL TO 3/16".  
4) WHEN THE THINNEST METAL IS EQUAL TO 1/4" OR GREATER, THE FILLET WELD SIZE SHALL BE 1/16" LESS THAN THE THINNEST METAL.

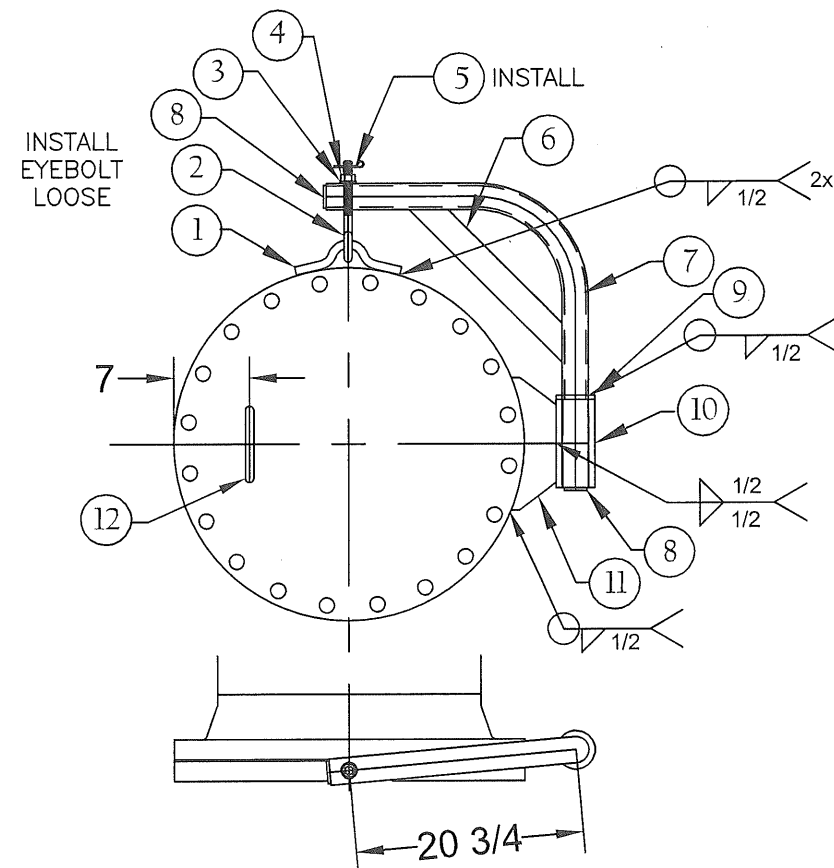


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DIVERTER, INLET  
3/8" PLATE  
(FOR OPENING N4)  
DRAWN BY: JGF  
CHECKED BY: JR  
APPROVED BY: GM  
SCALE: NTS  
PART NUMBER: 2465-2000  
DATE: 1-15-16  
MATERIAL: SA516-70  
QUANTITY: 1  
Rev. 0

# BILL OF MATERIAL

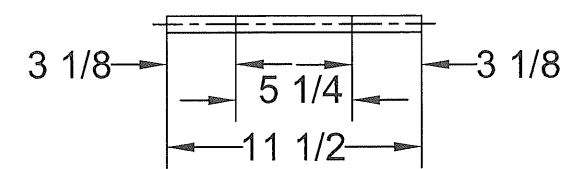
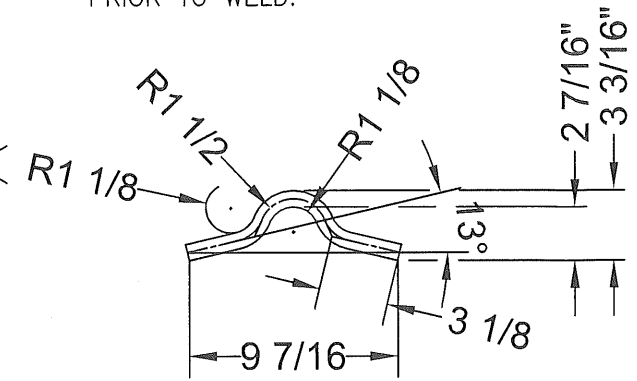
| ITEM | QTY. | DESCRIPTION                            |
|------|------|----------------------------------------|
| 1    | 1    | BAR, 3/4" DIA. x 11-1/2" LG.           |
| 2    | 1    | EYEBOLT 3/4" -10 UNC. x 6"             |
| 3    | 1    | WASHER 3/4" HVY.                       |
| 4    | 1    | NUT 3/4" HVY. HEX                      |
| 5    | 1    | COTTER KEY PIN, 1-1/2" LG.             |
| 6    | 1    | F. P., 3/8" x 2 1/2" x 19 -5/8"        |
| 7    | 1    | PIPE, 2" SCH. XH x 47-3/8" LG.         |
| 8    | 2    | PLATE, 1/4" x 2 -1/16" DIA.            |
| 9    | 1    | PLATE, 1/4" x 3-1/2" O.D.x 2-1/2" I.D. |
| 10   | 1    | PIPE, 3" DIA. SCH. XXH x 8" LG.        |
| 11   | 1    | PLATE, 5/8" x 4" x 12"                 |
| 12   | 1    | BAR, 3/4" DIA. x 12-5/16" LG.          |



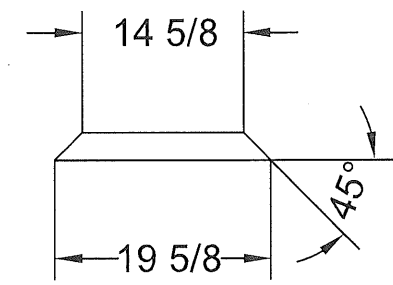
INSTALL EYEBOLT PRIOR TO WELD.

DRILL THRU 5/32"

② EYE BOLT

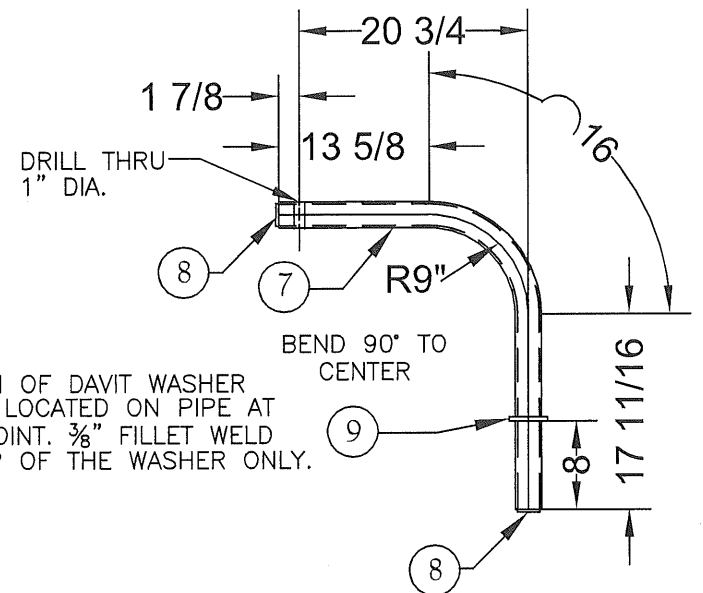


① MANWAY COVER DAVIT BRACKET



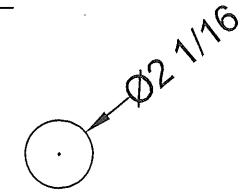
⑥ DAVIT ARM SUPPORT

BOTTOM OF DAVIT WASHER TO BE LOCATED ON PIPE AT THIS POINT. 3/8" FILLET WELD ON TOP OF THE WASHER ONLY.

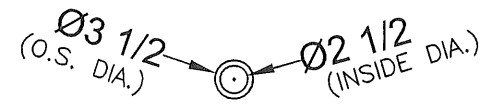


⑦ PIPE DAVIT

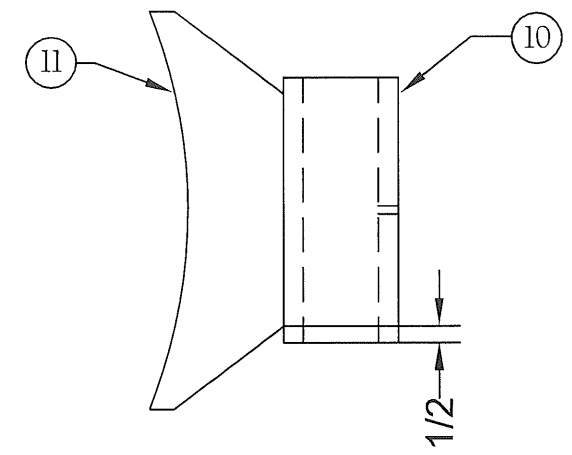
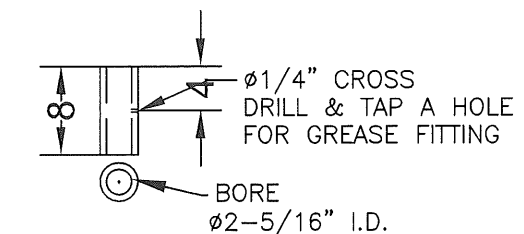
⑧ DAVIT END CAP



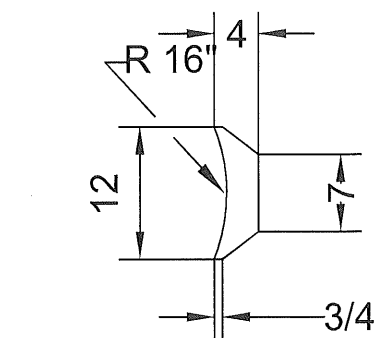
⑨ DAVIT WASHER



⑩ DAVIT HINGE



⑫ MANWAY COVER HANDLE



⑪ FLANGE WELD PL

MATERIAL GRADE  
PIPE - SA-106 B OR A-106 B  
PLATE - SA-36 OR A36  
BAR - SA-105 OR A-105

WELDING NOTE (UNLESS OTHERWISE NOTED)  
1) ALL WELDS SHALL BE CONTINUOUS.  
2) ALL FILLET WELDS SHALL HAVE EQUAL LEGS.  
3) FILLET WELD SIZE SHALL EQUAL BASE METAL WHEN BASE METAL IS LESS THAN OR EQUAL TO 3/16".  
4) WHEN THE THINNEST BASE METAL IS EQUAL TO 1/4" OR GREATER THE FILLET WELD SIZE SHALL BE 1/16" LESS.

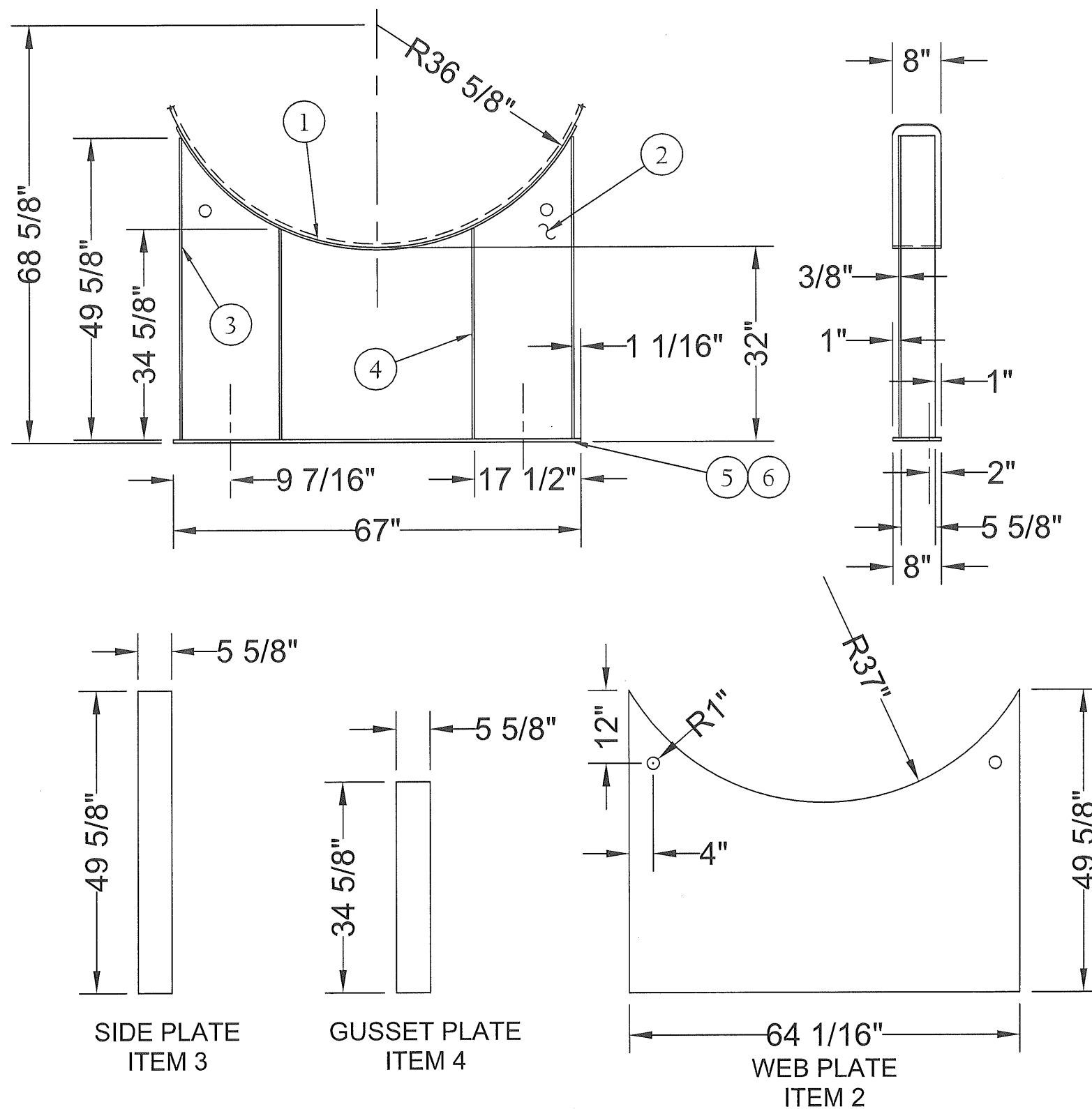


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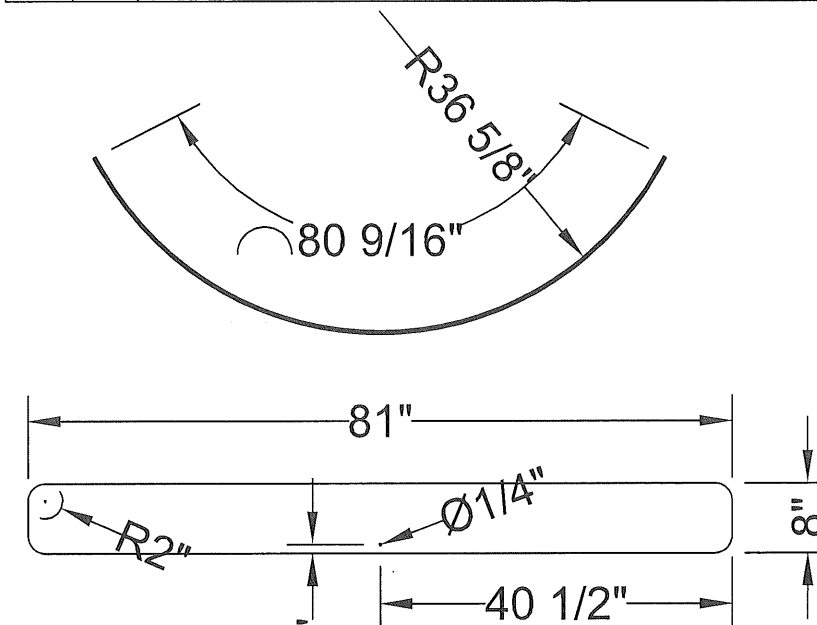
24" 150# MANWAY SIDE MOUNT

|                 |                        |                  |
|-----------------|------------------------|------------------|
| DRAWN BY: GGG   | CHECKED BY: JF         | APPROVED BY: JGF |
| SCALE: NTS      | PART NUMBER: 2465-3000 | QUANTITY: Rev.   |
| DATE: 6/29/2015 | MATERIAL:              | SHEET 1 of 1     |

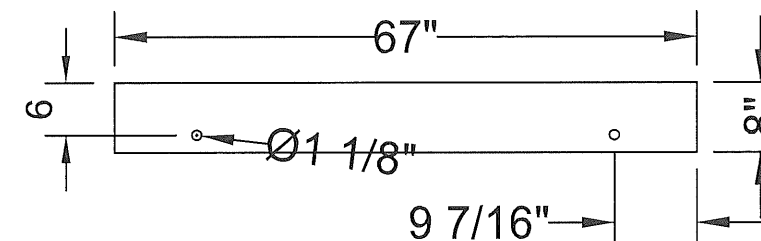




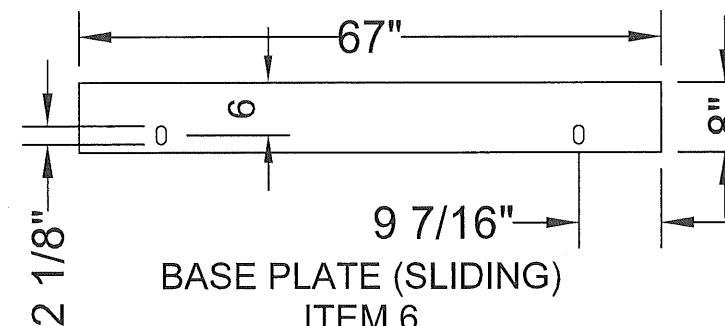
| BILL OF MATERIAL |     |                                                     |
|------------------|-----|-----------------------------------------------------|
| ITEM NO.         | QTY | DESCRIPTION                                         |
| 1                | 2   | PLATE, WEAR, 81" X 8" X 3/8" THK. (SA 516-70)       |
| 2                | 2   | PLATE, WEB, 64 1/16" X 49 5/8" X 3/8" THK. (SA-36)  |
| 3                | 4   | PLATE, SIDE, 49 5/8" X 5 5/8" X 3/8" THK. (SA-36)   |
| 4                | 4   | PLATE, GUSSET, 34 5/8" X 5 5/8" X 3/8" THK. (SA-36) |
| 5                | 2   | PLATE, BASE, FIXED, 67" X 8" X 1/2" THK. (SA-36)    |
| 6                | 2   | PLATE, BASE, SLIDING, 67" X 8" X 1/2" THK. (SA-36)  |



WEAR PLATE  
ITEM 1



BASE PLATE (FIXED)  
ITEM 5

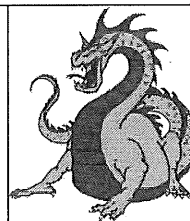


BASE PLATE (SLIDING)  
ITEM 6

WEIGHT PER SADDLE: 638.69 LBS.

WELDING NOTE (UNLESS OTHERWISE NOTED)

- 1) ALL WELDS SHALL BE CONTINUOUS.
- 2) ALL FILLET WELDS SHALL HAVE EQUAL LEGS.
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- 4) WHEN THE THINNEST METAL IS EQUAL TO 1/4" OR GREATER, THE FILLET WELD SIZE SHALL BE 1/16" LESS THAN THE THINNEST METAL.



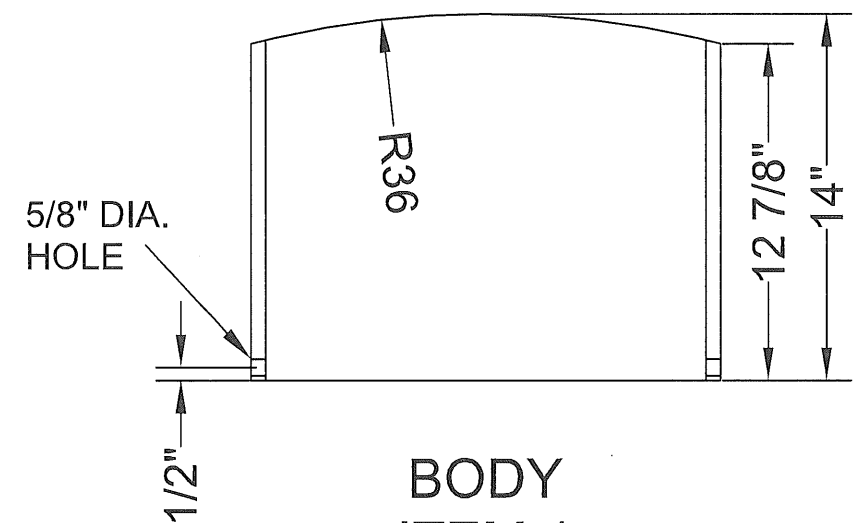
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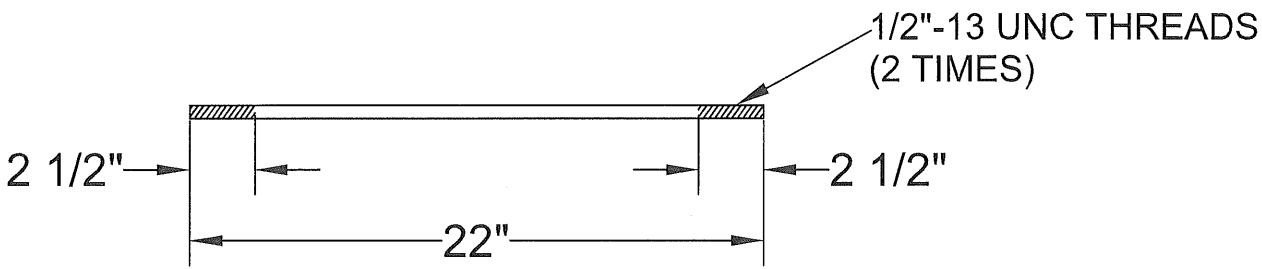
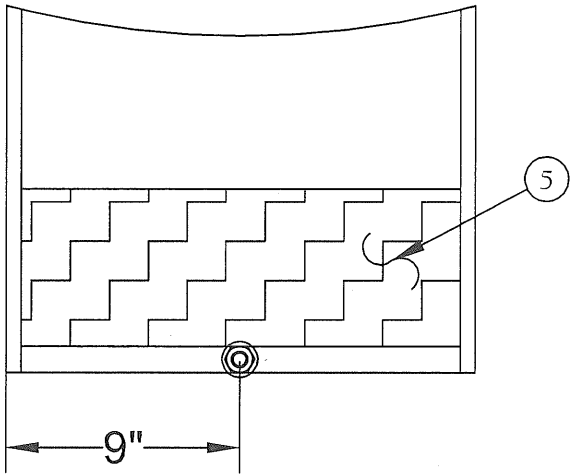
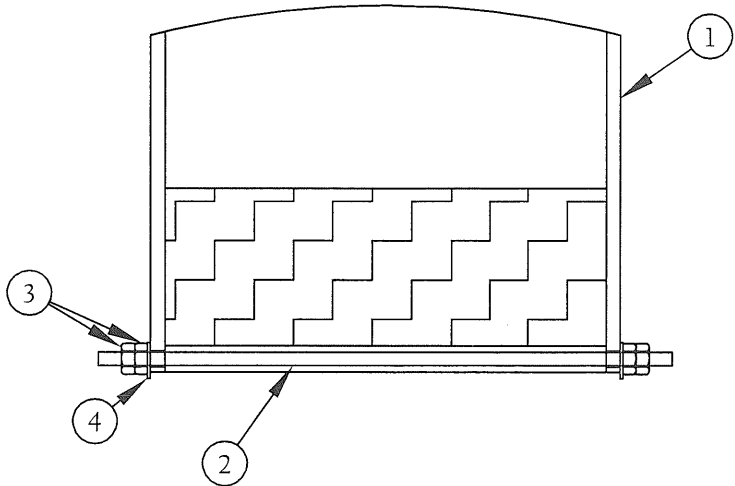
SADDLE ASSEMBLY  
 3/8" PLATE  
 (SLIDING & FIXED)

|               |                               |                 |
|---------------|-------------------------------|-----------------|
| DRAWN BY: JGF | CHECKED BY: JR                | APPROVED BY: GM |
| SCALE: NTS    | PART NUMBER: 2465-4000        | QUANTITY: 0     |
| DATE: 1-19-16 | MATERIAL: SA516-70 (WEAR PLT) | SHEET 1 of 1    |

| BILL OF MATERIAL |     |                                                 |
|------------------|-----|-------------------------------------------------|
| ITEM NO.         | QTY | DESCRIPTION                                     |
| 1                | 1   | PIPE, 18" SCH 40 X 14" LG. (SA-106 B)           |
| 2                | 1   | BAR, ROUND, 1/2" DIA. X 22" LG. (SA 312 TP 316) |
| 3                | 4   | NUT, HEAVY HEX, 1/2"-13 UNC (CADNIUM PLATED)    |
| 4                | 2   | WASHER, FLAT, 1/2" (CADNIUM PLATED)             |
| 5                | 1   | PAD, MESH, 16 7/8" DIA.                         |



BODY  
ITEM 1  
SA-106 B



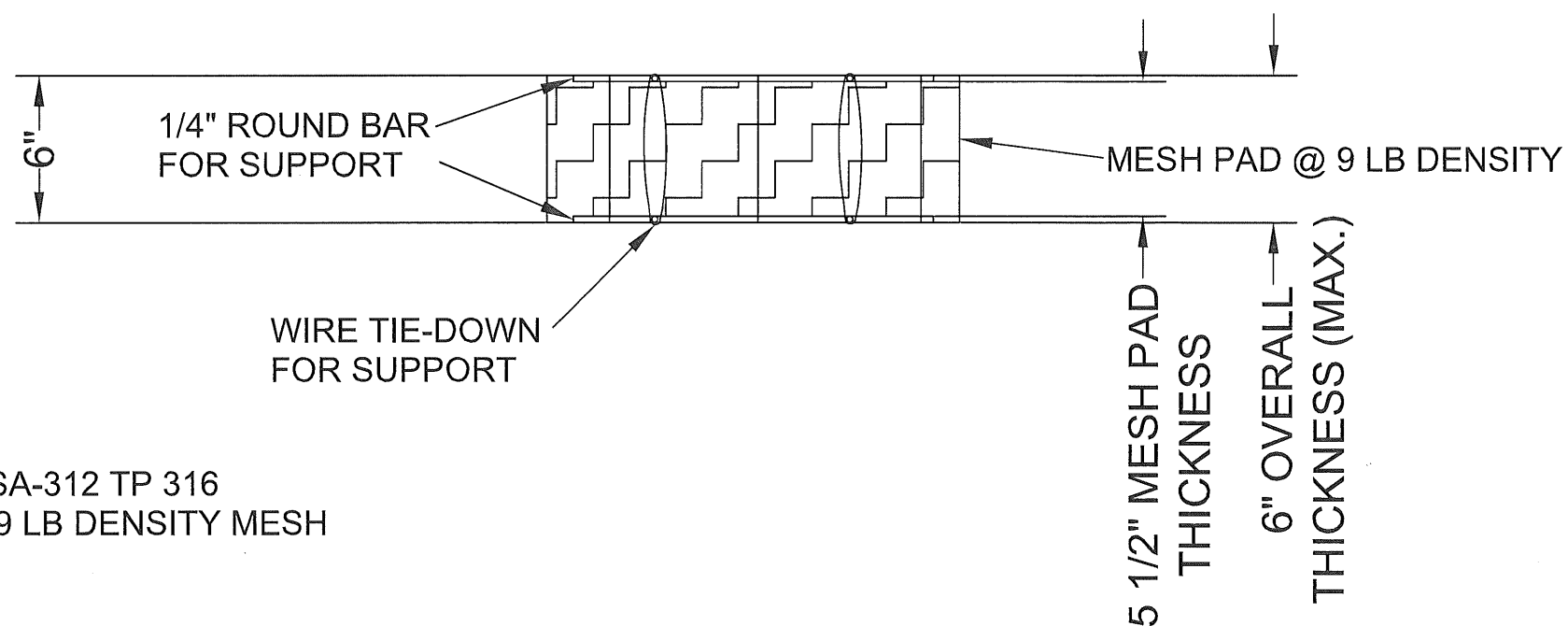
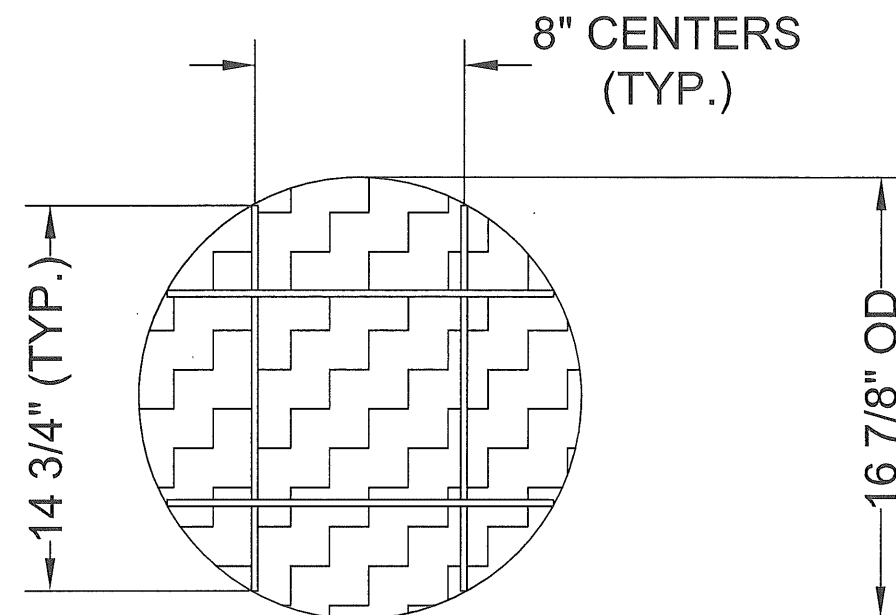
SECURING ROD  
ITEM 2  
A-312 TP 316

WELDING NOTE (UNLESS OTHERWISE NOTED)  
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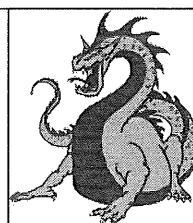
| LIBERTY TEXAS |                                                                                                                                                                                | MIST EXTRACTOR<br>ASSEMBLY DRAWING<br>PRODUCTION |         |              |           |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------|--------------|-----------|
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| J2465         |                                                                                                                                                                                | SCALE                                            | NTS     | PART NUMBER: | 2465-5000 |
|               |                                                                                                                                                                                | DATE                                             | 1-19-16 | MATERIAL:    | VARIES    |
|               |                                                                                                                                                                                |                                                  |         | QUANTITY:    | Rev.      |
|               |                                                                                                                                                                                |                                                  |         | SHEET 1 of 1 | 0         |





MATERIAL: SA-312 TP 316  
MESH PAD: 9 LB DENSITY MESH

WELDING NOTE (UNLESS OTHERWISE NOTED)  
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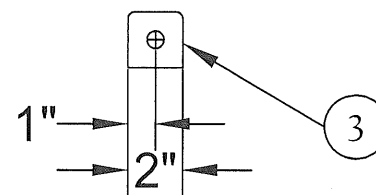
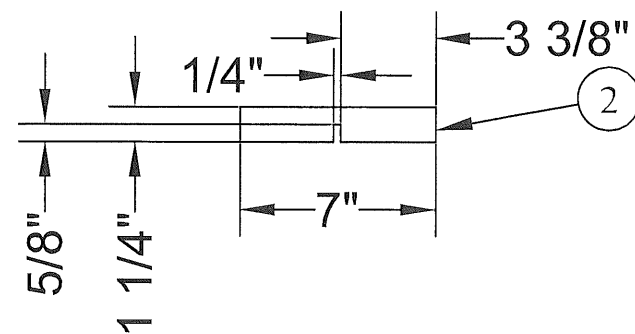
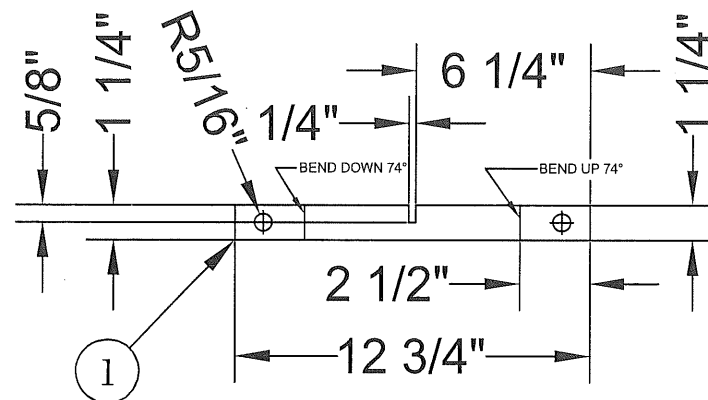
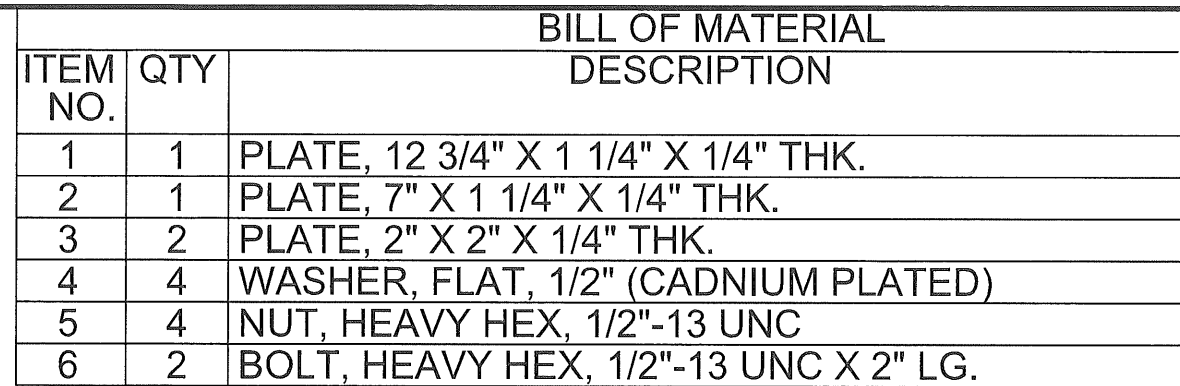


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JOB NO. J2465

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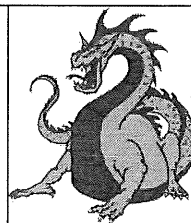
MIST EXTRACTOR  
MESH PAD DIMENSIONS  
VENDOR DRAWING

|               |                         |                 |
|---------------|-------------------------|-----------------|
| DRAWN BY: JGF | CHECKED BY: JR          | APPROVED BY: GM |
| SCALE: NTS    | PART NUMBER: 2465-5100  | QUANTITY: Rev.  |
| DATE: 1-19-16 | MATERIAL: SA-312 TP 316 | SHEET 1 OF 1 0  |



WELDING NOTE (UNLESS OTHERWISE NOTED)

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DRAGON PRODUCTS, LTD.

|         |                                                                                                                                                                                |      |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| LIBERTY |                                                                                                                                                                                | TEXA |
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| J2465   |                                                                                                                                                                                |      |

VORTEX BREAKER  
FITS 3"-150# OPENING  
FOR OPNGS N8 & N10

|               |  |                            |                 |
|---------------|--|----------------------------|-----------------|
| DRAWN BY: JGF |  | CHECKED BY: JR             | APPROVED BY: GM |
| SCALE NTS     |  | PART NUMBER:<br>2465-6000  | QUANTITY:       |
| DATE 1-22-16  |  | MATERIAL:<br>SA-312 TP 316 | SHEET 1 of 1    |

CUSTOMER: ENCANA  
DESCRIPTION.: 72" x 180" 250PSI 3-PHASE SEPARATOR  
DWG NO.: 00002465  
W/O: -  
BY: JGF

DRAGON PRODUCTS, LTD  
BILL OF MATERIALS

10/20/2016  
REV. 1

SR 10/20/16

| BILL OF MATERIAL         |           |                                                                |                    |      |              |          |        |               |              |              |     |                |
|--------------------------|-----------|----------------------------------------------------------------|--------------------|------|--------------|----------|--------|---------------|--------------|--------------|-----|----------------|
| ITEM NO.                 | Part No.  | Description                                                    | Materials          | Qty. | Cut Size     | Cut From | Pieces | Raw Steel No. | Piece Weight | Total Weight | M/C | Purchase price |
| 1                        | 2465-1000 | HEAD, 2:1 ELLIP., 72" ID. W/ 2" S.F., 0.513" MIN., 0.625" NOM. | SA-516-70          | 2    | PURCHASED    |          |        |               | 952.35       | 1904.70      |     |                |
| 2                        |           | SHELL, CUT AND ROLL, 0.625" X 90" X 228 3/16"                  | SA-516-70          | 2    | 90X228 3/16  | 120X480  |        |               | 3627.90      | 7255.80      |     |                |
| 3                        | 2465-4000 | SADDLE ASSEMBLY, FIXED (SEE BELOW)                             | SEE DRAWING        | 1    |              |          |        |               | 638.69       | 638.69       |     |                |
| 4                        | 2465-4000 | SADDLE ASSEMBLY, SLIDING (SEE BELOW)                           | SEE DRAWING        | 1    |              |          |        |               | 638.69       | 638.69       |     |                |
| 5                        | 2465-3000 | DAVIT ASSEMBLY (SEE BELOW)                                     | SEE DRAWING        | 1    |              |          |        |               | 85.00        | 85.00        |     |                |
| 6                        | 2465-2000 | INLET DIVERTER ASSEMBLY (SEE BELOW) (N4)                       | SA 516-70          | 1    |              |          |        |               | 94.00        | 94.00        |     |                |
| 7                        |           | PLATE, WEIR, 72" X 45" X 3/8" THK.                             | SA 516-70          | 1    | 72X45        |          |        |               | 282.95       | 282.95       |     |                |
| 8                        | 2465-5000 | MIST EXTRACTOR, 18" SCH 40 PIPE w/ INSERT (N5)                 | SEE DRAWING        | 1    |              |          |        |               | 130.81       | 130.81       |     |                |
| 9                        |           | PLATE, 8" X 3" X 1/2" THK.                                     | SA 516-70          | 2    | 8X3          |          |        |               | 3.41         | 6.82         |     |                |
| 10                       |           | PLATE, 6" X 5" X 1" THK.                                       | SA-36              | 2    | 6X5          |          |        |               | 8.51         | 17.02        |     |                |
| 11                       |           | PLATE, 11 1/4" X 8 1/4" X 3/8" THK                             | SA-36              | 1    | 11 1/4X8 1/4 |          |        |               | 9.88         | 9.88         |     |                |
| 12                       |           | PLATE, DATA, ASME                                              | SA-312 TP 304      | 1    | PURCHASED    |          |        |               | 28.98        | 28.98        |     |                |
| 13                       |           | PLATE, GROUNDING LUG, 2" X 2" X 1/4" THK.                      | SA-36              | 2    | 2X2          |          |        |               | 0.29         | 0.58         |     |                |
| 14                       | 2465-6000 | VORTEX BREAKER, 3" OPNGS (N8 & N10)                            | C.S. SA-312 TP 316 | 2    |              |          |        |               | 3.10         | 6.20         |     |                |
| 15                       |           | FLANGE, 24"-150# RFSO (N1)                                     | SA-105             | 1    | PURCHASED    |          |        |               | 204.00       | 204.00       |     |                |
| 16                       |           | PIPE, 24" SCH XS X 15 1/8" LG. (N1)                            | SA-106 B           | 1    | 15 1/8       |          |        |               | 158.19       | 158.19       |     |                |
| 17                       |           | PLATE, REINFORCING PAD, 38" X 37" X 1/2" THK. (N1)             | SA-516 70          | 1    | 38X37        |          |        |               | 96.80        | 96.80        |     |                |
| 18                       |           | FLANGE, 24"-150# RF, BLIND (N1)                                | SA-105             | 1    | PURCHASED    |          |        |               | 415.00       | 415.00       |     |                |
| 19                       |           | FLANGE, 8"-150# LWN X 12 3/4" LG. (N4)                         | SA-105             | 1    | 12 3/4       |          |        |               | 103.00       | 103.00       |     |                |
| 20                       |           | FLANGE, 3"-150# LWN X 6 3/4" LG. (N5, N8, N9, N10, N15 & N18)  | SA-105             | 6    | 6 3/4        |          |        |               | 24.00        | 144.00       |     |                |
| 21                       |           | FLANGE, 4"-150# LWN X 6 13/16" LG. (N6)                        | SA-105             | 1    | 6 13/16      |          |        |               | 47.00        | 47.00        |     |                |
| 22                       |           | FLANGE, 4"-150# LWN X 7 5/8" LG. (N7)                          | SA-105             | 1    | 7 5/8        |          |        |               | 47.00        | 47.00        |     |                |
| 23                       |           | FLANGE, 2"-150# LWN X 6 11/16" LG. (N16A & N16B)               | SA-105             | 2    | 6 11/16      |          |        |               | 16.00        | 32.00        |     |                |
| 24                       |           | COUPLING, 1"-3000# (N11, N13A, N13B, N14A)                     | SA-106 B           | 4    | PURCHASED    |          |        |               | 1.59         | 6.36         |     |                |
| 25                       |           | COUPLING, SPECIAL, 1"-3000# X 3" LG. (N14B)                    | SA-106 B           | 1    | 3            |          |        |               | 1.66         | 1.66         |     |                |
| 26                       |           | FLANGE, 2"-150# LWN X 12" LG. (N17A & N17B)                    | SA-105             | 2    | 12           |          |        |               | 16.00        | 32.00        |     |                |
|                          |           |                                                                |                    |      |              |          |        |               |              | 0.00         |     |                |
|                          |           |                                                                |                    |      |              |          |        |               |              | 0.00         |     |                |
|                          |           |                                                                |                    |      |              |          |        |               |              | 0.00         |     |                |
| 2465-2000 INLET DIVERTER |           |                                                                |                    |      |              |          |        |               |              |              |     |                |
| 1                        |           | PLATE, 37 3/4" X 16" X 3/8" THK.                               | SA 516-70          | 1    | 37 3/4X16    |          |        |               |              |              |     |                |
| 2                        |           | PLATE, 16" X 8" X 3/8" THK.                                    | SA 516-70          | 2    | 16X8         |          |        |               |              |              |     |                |
|                          |           |                                                                |                    |      |              |          |        |               |              |              |     |                |
| 2465-3000 DAVIT ASSEMBLY |           |                                                                |                    |      |              |          |        |               |              |              |     |                |
| 1                        |           | BAR, 3/4" DIA X 11-1/2" LG.                                    | SA-105 OR A-105    | 1    | 11 1/2"      | 240      |        |               |              |              |     |                |
| 2                        |           | EYEBOLT 3/4" - 10 UNC X 6"                                     | S.S.               | 1    | PURCHASED    |          |        |               |              |              |     |                |
| 3                        |           | WASHER 3/4" HVY                                                | C.S.               | 1    | PURCHASED    |          |        |               |              |              |     |                |
| 4                        |           | NUT 3/4" HVY HEX                                               | A-194-2H           | 1    | PURCHASED    |          |        |               |              |              |     |                |
| 5                        |           | COTTER KEY PIN, 1-1/2" LG.                                     | S.S.               | 1    | PURCHASED    |          |        |               |              |              |     |                |
| 6                        |           | F.B., 3/8" X 2 1/2" X 19-5/8"                                  | A-36 OR EQ.        | 1    | 16 3/8       | 240      |        |               |              |              |     |                |

APPROVAL:  
ENG MNGR \_\_\_\_\_  
QC MNGR \_\_\_\_\_

CUSTOMER: ENCANA  
DESCRIPTION.: 72" x 180" 250PSI 3-PHASE SEPARATOR  
DWG NO.: 00002465  
W/O: -  
BY: JGF

DRAGON PRODUCTS, LTD  
BILL OF MATERIALS

10/20/2016  
REV. 1

|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
|------------------------------------|-----------|-----------------------------------------------------|---------------------|----|-----------------|----------|--|--|------|-------|--|--|
| 7                                  |           | PIPE, 2" SCH 40 X 47-3/8" LG.                       | 2" SCH 40           | 2  | 39 9/16         | 252      |  |  |      |       |  |  |
| 8                                  |           | PLATE, 1/4" X 2 1/16" DIA                           | SA-36 OR A-36       | 4  | 2 1/16" DIA     | 120 X480 |  |  |      |       |  |  |
| 9                                  |           | PLATE, 1/4" X 3 1/2" OD X 2 1/2" ID                 | SA-36 OR A-36       | 2  | 2 1/2" X 3 1/2" | 120 X480 |  |  |      |       |  |  |
| 10                                 |           | PIPE, 3" SCH XXH X 8" LG.                           | 3" SCH XXH          | 2  | 8"              | 252      |  |  |      |       |  |  |
| 11                                 |           | PLATE, 5/8" X 4" X 12"                              | SA-36 OR A-36       | 2  | 4" X 12"        | 48 X96   |  |  |      |       |  |  |
| 12                                 |           | BAR, 3/4" DIA X 12 5/16"                            | SA-105 OR A-105     | 2  | 12 5/16"        | 240      |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2465-4000 SADDLE ASSEMBLY          |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 1                                  |           | PLATE, WEAR PAD, SADDLE, 81" X 12" X 3/8" THK.      | SA 516-70           | 2  | 81X12           |          |  |  |      |       |  |  |
| 2                                  |           | PLATE, WEB, SADDLE, 64 1/16" X 49 5/8" X 3/8" THK.  | SA-36               | 2  | 64 1/16X49 5/8  |          |  |  |      |       |  |  |
| 3                                  |           | PLATE, SIDE, SADDLE, 49 5/8" X 9 5/8" X 3/8" THK    | SA-36               | 4  | 49 5/8X9 5/8    |          |  |  |      |       |  |  |
| 4                                  |           | PLATE, GUSSET, SADDLE, 34 5/8" X 9 5/8" X 3/8" THK. | SA-36               | 4  | 34 5/8X9 5/8    |          |  |  |      |       |  |  |
| 5                                  |           | PLATE, BASE, SADDLE, FIXED, 67" X 12" X 1/2" THK.   | SA-36               | 1  | 67X12           |          |  |  |      |       |  |  |
| 6                                  |           | PLATE, BASE, SADDLE, SLIDING, 67" X 12" X 1/2" THK. | SA-36               | 1  | 67X12           |          |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2465-5000 MIST EXTRACTOR           |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 1                                  |           | PIPE, 18" SCH 40 X 14" LG.                          | SA-106 B            | 1  | 14              |          |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2465-6000 VORTEX BREAKER           |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 3                                  |           | PLATE, 2" X 2" X 1/4" THK.                          | SA-312 TP 316       | 1  |                 |          |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2465 VESSEL PACKAGING              |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 30                                 |           | GASKET, 24"-150#, FLEXITALLIC, CGI                  | S.S.                | 1  | PURCHASE        |          |  |  | 2.00 | 2.00  |  |  |
| 31                                 |           | NUT, HEAVY HEX, 1-1/4" - 8 UNC                      | SA-312 TP 316       | 40 |                 |          |  |  | 0.79 | 31.60 |  |  |
| 32                                 |           | STUD, 1-1/4" - 8 UNC X 7" LG.                       | SA-312 TP 316       | 20 |                 |          |  |  | 2.44 | 48.80 |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      | 82.40 |  |  |
| 2465-2000 INLET DIVERTER           |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 3                                  |           | BOLT, HEAVY HEX, 1/2"-13 UNC X 2 1/4" LG.           | SA-193-B7M          | 6  | PURCHASED       |          |  |  |      |       |  |  |
| 4                                  |           | NUT, HEAVY HEX, 1/2"-13 UNC                         | SA-194-2HM          | 12 | PURCHASED       |          |  |  |      |       |  |  |
| 5                                  |           | WASHER, FLAT, 1/2"                                  | C.S. CADNIUM PLATED | 12 | PURCHASED       |          |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2465-3000 DAVIT ASSEMBLY PACKAGING |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 13                                 |           | GREASE ZERK                                         |                     | 1  | PURCHASED       |          |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2465-5000 MIST EXTRACTOR           |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2                                  |           | BAR, ROUND, 1/2" DIA. X 22" LG.                     | SA-312 TP 316       | 1  | 22              |          |  |  |      |       |  |  |
| 3                                  |           | NUT, HEAVY HEX, 1/2"-13 UNC (CADNIUM PLATED)        | SA-194-2HM          | 4  | PURCHASE        |          |  |  |      |       |  |  |
| 4                                  |           | WASHER, FLAT, 1/2" (CADNIUM PLATED)                 | A-36 OR EQ.         | 2  | PURCHASE        |          |  |  |      |       |  |  |
| 5                                  | 2465-5100 | PAD, MESH, 16 7/8" DIA. X 6" OAH                    | SA-312 TP 316       | 1  | PURCHASE        |          |  |  |      |       |  |  |
|                                    |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 2465-6000 VORTEX BREAKER           |           |                                                     |                     |    |                 |          |  |  |      |       |  |  |
| 1                                  |           | PLATE, 12 3/4" X 1 1/4" X 1/4" THK.                 | SA-312 TP 316       | 2  | 37 3/4X16       |          |  |  |      |       |  |  |

APPROVAL:  
ENG MNGR \_\_\_\_\_  
QC MNGR \_\_\_\_\_

|   |  |                                     |               |   |          |  |  |  |  |  |  |  |
|---|--|-------------------------------------|---------------|---|----------|--|--|--|--|--|--|--|
| 2 |  | PLATE, 7" X 1 1/4" X 1/4" THK.      | SA-312 TP 316 | 4 | 16X8     |  |  |  |  |  |  |  |
| 4 |  | WASHER, FLAT, 1/2" (CADNIUM PLATED) | C.S.          | 8 | PURCHASE |  |  |  |  |  |  |  |
| 5 |  | NUT, HEAVY HEX, 1/2"-13 UNC         | SA-312 TP 316 | 8 | PURCHASE |  |  |  |  |  |  |  |
| 6 |  | BOLT, 1/2"-13 UNC X 2" LG.          | SA-312 TP 316 | 4 | PURCHASE |  |  |  |  |  |  |  |
|   |  |                                     |               |   |          |  |  |  |  |  |  |  |

#REF!

REFERENCE SPREADSHEET FOR CARBON CONTENT LIMITS FOR ALL MATERIAL.  
SPREADSHEET IS TO BE COMPLETED WITH MATERIAL MTR INFORMATION.  
ENGINEERING TO REVIEW PRIOR TO START OF FABRICATION.

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: Plates 5/8x96x480 S&S 16 GR-70

DATE DELIVERED: 10-25-16

VENDER NAME: Ranger STEEL

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178802

QUANTITY DELIVERED: 4

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

HEAT NO: A6U2837-02

COLOR ASSIGNED: Safety Purple Dark Ford Blue

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME STEEL Yard

RECEIVED BY: Michael Fawcett



# MILL TEST CERTIFICATE

1700 HOLT RD N.E.  
Tuscaloosa, AL 35404-1000  
800 800-8204  
customerservice@nucorsteel.com

|                                                                                                                                                                        |                                                                                           |                   |       |         |             |                    |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------|-------|---------|-------------|--------------------|------------------|
| Load Number                                                                                                                                                            | Tally                                                                                     | Mill Order Number | PO NO | Line NO | Part Number | Certificate Number | Prepared         |
| T131657                                                                                                                                                                | 0000000684731                                                                             | N-148961-001      | 13706 | 1       |             | S68473101-1        | 08/18/2016 16:20 |
| Grade                                                                                                                                                                  | Customer:                                                                                 |                   |       |         |             |                    |                  |
| Order Description:                                                                                                                                                     | Sold TO:<br>RANGER STEEL HOUSTON TX<br>Ship TO:<br>RANGER STEEL Fort Worth TX<br>Sent TO: |                   |       |         |             |                    |                  |
| Hot Roll Plate From Coil<br>A516 70, 0.6250 IN x 96.000 IN x 480.000 IN<br>Quality Plan Description:<br>A51670 NORM 15CU: A516-70/ASME SA516-70AR-15 LOW CU NORM TESTS |                                                                                           |                   |       |         |             |                    |                  |

| Shipped Item | Heat/Slab Number | Certified By | C       | Mn   | P    | S     | Si    | Cu   | Ni   | Cr   | Mo   | Co    | V     | Al    | Ti    | N2    | B     | Ca     | Sn     | CEV   | ACI  |  |
|--------------|------------------|--------------|---------|------|------|-------|-------|------|------|------|------|-------|-------|-------|-------|-------|-------|--------|--------|-------|------|--|
| 6H1272E      | A6U2837-02       | ***          | A6U2837 | 0.21 | 1.04 | 0.009 | 0.004 | 0.20 | 0.11 | 0.05 | 0.07 | 0.015 | 0.001 | 0.003 | 0.033 | 0.001 | 0.012 | 0.0000 | 0.0021 | 0.004 | 0.42 |  |

| Shipped Item | Certified By | Heat/Slab Number | Yield ksi | Tensile ksi | Y/T % | ELONGATION % |      | Bend OK? | Hard HB | Charpy Impacts (ft-lbs) |   |   |     |   | Shear % |   |     | Test Temp |  |  |  |  |
|--------------|--------------|------------------|-----------|-------------|-------|--------------|------|----------|---------|-------------------------|---|---|-----|---|---------|---|-----|-----------|--|--|--|--|
|              |              |                  |           |             |       | 2" 8"        | %    |          |         | 1                       | 2 | 3 | Avg | 1 | 2       | 3 | Avg |           |  |  |  |  |
| 6H1272E      | SGH1272BTT   | A6U2837-02       | ***       | 51.6        | 72.8  | 70.9         | 37.9 |          |         |                         |   |   |     |   |         |   |     |           |  |  |  |  |
| 6H1272E      | SGH1272FTT   | A6U2837-02       | ***       | 50.5        | 77.1  | 65.5         | 32.8 |          |         |                         |   |   |     |   |         |   |     |           |  |  |  |  |
| 6H1272E      | SGH1272MTT   | A6U2837-02       | ***       | 48.5        | 70.7  | 68.6         | 36.4 |          |         |                         |   |   |     |   |         |   |     |           |  |  |  |  |
| 6H1272E      | SGH1272NBT   | A6U2837-02       | ***       | 53.1        | 74.3  | 71.5         | 25.0 |          |         |                         |   |   |     |   |         |   |     |           |  |  |  |  |
| 6H1272E      | SGH1272NFT   | A6U2837-02       | ***       | 52.4        | 75.5  | 69.4         | 37.1 |          |         |                         |   |   |     |   |         |   |     |           |  |  |  |  |
| 6H1272E      | SGH1272NMT   | A6U2837-02       | ***       | 52.7        | 74.4  | 70.8         | 39.5 |          |         |                         |   |   |     |   |         |   |     |           |  |  |  |  |

Items: 1 PCS: 5 Weight: 40838 LBS

Mercury has not come in contact with this product during the manufacturing process nor has any mercury been used by the manufacturing process. Certified in accordance with EN 10204 3.1. No weld repair has been performed on this material. Normalized test coupons at 1650F for at least 30 minutes per inch of thickness. Material is compliant with NACE MR0175 Annex 2.1.2, and MR0103. Manufactured to a fully killed fine grain practice. NUTEMPER TEMPER PASSED plate from coil ISO 9001:2008 Registered, PED Certified

Ranger Steel  
QC Approved

We hereby certify that the product described above passed all of the tests required by the specifications.

Dr. Quilin Yu - Metallurgist

\*\*\* Indicates Heats melted and Manufactured in the U.S.A.

*Michael* 10-25-16



# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: 73-1/4 OD ELLIP Head 2.1 5/8" x 2" sf

DATE DELIVERED: 11-10-16

VENDER NAME: COMMERCIAL METAL

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178801

QUANTITY DELIVERED: 4

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

HEAT NO: HUW

COLOR ASSIGNED: Dark Ford Blue / Banner red

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME STEEL yard

RECEIVED BY: Michael Fant



10/25/2016 From: AMERICAN ALLOY STEEL, INC.

To: COMMERCIAL METAL FORMING

P.O.#: PO63559-01

S.O.#: 556405

AA PL#: 5178549

Item: 4 (1 PC) 5/8" X 96" X 480"

## ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE  
REPORT OF TEST AND ANALYSES

US HWY 12 Burns Harbor, Indiana

|                                                                   |                                                                                                                                 |                                     |            |        |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------|--------|
| SHIPMENT NO.<br>804-04330                                         | DATE SHIPPED<br>07-29-16                                                                                                        | CAR OR VEHICLE NO.<br>CSS-CHGO-BNSF | ATW 164006 | PAGE 5 |
| AMERICAN ALLOY STEEL INC<br>PO BOX 40469<br>HOUSTON TX 77240-0469 | SHIP TO<br>AMERICAN ALLOY STEEL INC<br>BNSF TR# 7226 MILE 66.4 LN SEG 492<br>6230 N HOUSTON ROSSLYN RD<br>HOUSTON TX 77091-3410 |                                     |            |        |

| SERIAL NUMBER | PAT NO. | HEAT NUMBER | NO. PCS. | THICKNESS | WIDTH OR DIA. | LENGTH | WEIGHT | YIELD POINT | TENSILE STRENGTH | AF FRAC. BLOOM. | RED. |
|---------------|---------|-------------|----------|-----------|---------------|--------|--------|-------------|------------------|-----------------|------|
|               |         |             |          | INCHES    | INCHES        | INCHES | POUNDS | PSI         | PSI              | IN              | %    |

QUALITY STEEL MELTED &amp; MANUFACTURED IN THE U. S. A.

PLATES-ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC

A516-06 GR 65 PVQ, ASTM A516-06 GR 60 PVQ, ASME SA516 GR 70 PVQ 2015

EDITION, ASME SA516 GR 65 PVQ 2015 EDITION, ASME SA516 GR 60 PVQ 2015

EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT

MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL

TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN

10204:2004 TYPE 3.1

NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# 108833 GH 354-5218G

|         |           |   |      |    |     |      |       |       |   |    |
|---------|-----------|---|------|----|-----|------|-------|-------|---|----|
| C544041 | 822U31470 | 1 | .625 | 96 | 480 | 8168 | 48900 | 76600 | 8 | 23 |
|         |           |   |      |    |     |      | 52300 | 74700 | 8 | 25 |

(M55)MFST REF#:8

HUY

|         |           |   |      |    |     |       |       |       |   |    |
|---------|-----------|---|------|----|-----|-------|-------|-------|---|----|
| C544042 | 822U31470 | 3 | .625 | 96 | 480 | 24504 | 54100 | 78500 | 8 | 22 |
|         |           |   |      |    |     |       | 52200 | 73800 | 8 | 25 |

(M55)MFST REF#:8

|         |           |   |      |    |     |       |       |       |   |    |
|---------|-----------|---|------|----|-----|-------|-------|-------|---|----|
| C544043 | 822U31470 | 3 | .625 | 96 | 480 | 24504 | 49700 | 76800 | 8 | 21 |
|         |           |   |      |    |     |       | 52400 | 75400 | 8 | 23 |

(M55)MFST REF#:8

All heads made from steel covered by the

attached test reports were cold formed,

meet the requirements of paragraphs

UG-77(c), UG-79(c), UCS-79(d) for carbon

steel heads, UHA-44(a)(1)(a) for stainless

steel heads per Sect. VIII Div.1 2015, and

WERE NOT HEAT TREATED UNLESS NOTED.

In addition, per UG-96, these heads meet

the requirements of UG-16, UG-40, and UG-81

of Sect. VIII Div.1 2015.

| SERIAL<br>NUMBER                                                                                                | PAT<br>NO. | HEAT<br>NUMBER | HARD<br>BHN | BEND | CHARPY IMPACT       |                 |                 |                |                   |   |       |   |   |          |   |   |      |   |
|-----------------------------------------------------------------------------------------------------------------|------------|----------------|-------------|------|---------------------|-----------------|-----------------|----------------|-------------------|---|-------|---|---|----------|---|---|------|---|
|                                                                                                                 |            |                |             |      | TEMPERATURE         |                 |                 | FT-LBS         |                   |   | SHARP |   |   | LAT. EXP |   |   | RILE |   |
|                                                                                                                 |            |                |             |      | THICKNESS<br>INCHES | NO. OF<br>TESTS | NO. OF<br>FAILS | NO. OF<br>DIPS | TEMPERATURE<br>°F | 1 | 2     | 3 | 1 | 2        | 3 | 1 | 2    | 3 |
| In addition, per UG-96, these heads meet the requirements of UG-10, UG-60 and UG-81 of Sect. VIII Div. 1, 2015. |            |                |             |      |                     |                 |                 |                |                   |   |       |   |   |          |   |   |      |   |

COMMERCIAL METAL FORMING

Youngstown Stamping Division

Certified a true copy of the  
original retained in our file.  
AMERICAN ALLOY STEEL, INC.

Reviewed By

JP 9/26/2016

| HEAT NUMBER | C   | Mn   | P    | S    | Si   | Co   | Ni  | Cr  | Mo   | V    | Ti   | Al   | B     | Cu   | N    | As   | MOLDED GRAIN SIZE |
|-------------|-----|------|------|------|------|------|-----|-----|------|------|------|------|-------|------|------|------|-------------------|
| 822U31470   | .17 | 1.09 | .008 | .006 | .330 | .024 | .01 | .12 | .082 | .002 | .002 | .033 | .0002 | .002 | .005 | .006 |                   |

I certify that the above results are a true and correct copy of actual results contained in records maintained by ArcelorMittal Burns Harbor and are in full compliance with the requirements of the specification cited above. This test report cannot be altered and must be transmitted intact with any subsequent third party test reports, if required.

BHPLRPT.TIF

SUPPLY QUALITY ASSURANCE

R. SPANGLER II PER LSS

Michael 11-10-16

AMERICAN ALLOY  
PLATE # 5178549

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: 73-1/4 OD ELLIP Head 2.1 5/8" 2" SF

DATE DELIVERED: 11-10-16

VENDER NAME: COMMERCIAL METAL

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178801

QUANTITY DELIVERED: 11

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

HEAT NO: HUY

COLOR ASSIGNED: Dark Ford Blue / U Haul orange

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME STEEL yard

RECEIVED BY: Michael Fant

10/25/2016 From: AMERICAN ALLOY STEEL, INC.

To: COMMERCIAL METAL FORMING

P.O.#: PO63559-01

S.O.#: 556405

AA PL#: 5178549

Item: 4 (1 PC) 5/8" X 96" X 480"

## ArcelorMittal Burns Harbor Plate

QUALITY ASSURANCE  
REPORT OF TEST AND ANALYSES

US HWY 12 Burns Harbor, Indiana

|                                                                   |                                                                                                                                 |                                     |            |        |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------|--------|
| SHIPMENT NO.<br>804-04330                                         | DATE SHIPPED<br>07-29-16                                                                                                        | CAR OR VEHICLE NO.<br>CSS-CHGO-BNSF | ATW 164006 | PAGE 5 |
| AMERICAN ALLOY STEEL INC<br>PO BOX 40469<br>HOUSTON TX 77240-0469 | SHIP TO<br>AMERICAN ALLOY STEEL INC<br>BNSF TR# 7226 MILE 66.4 LN SEG 492<br>6230 N HOUSTON ROSSLYN RD<br>HOUSTON TX 77091-3410 |                                     |            |        |

| S<br>E<br>R<br>I<br>A<br>L<br>N<br>O. | P<br>A<br>T<br>N<br>O. | H<br>E<br>A<br>T<br>N<br>O. | N<br>O.<br>P<br>C<br>S. | S<br>I<br>Z<br>E<br>A<br>N<br>D<br>Q<br>U<br>A<br>N<br>T<br>I<br>T<br>Y |                                                          |                            |                            | Y<br>I<br>E<br>L<br>D<br>P<br>O<br>I<br>N<br>T | T<br>E<br>N<br>S<br>I<br>L<br>E<br>S<br>T<br>R<br>E<br>N<br>G<br>T<br>H | A<br>F<br>F<br>R<br>A<br>C<br>E<br>L<br>O<br>N<br>G. | R<br>E<br>D. |
|---------------------------------------|------------------------|-----------------------------|-------------------------|-------------------------------------------------------------------------|----------------------------------------------------------|----------------------------|----------------------------|------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------|--------------|
|                                       |                        |                             |                         | T<br>H<br>I<br>C<br>K<br>N<br>E<br>S<br>S                               | W<br>I<br>D<br>T<br>H<br>O<br>R<br>D<br>I<br>N<br>A<br>L | L<br>E<br>N<br>G<br>T<br>H | W<br>E<br>I<br>G<br>H<br>T |                                                |                                                                         |                                                      |              |

QUALITY STEEL MELTED &amp; MANUFACTURED IN THE U. S. A.

PLATES-ASTM A516-06 GR 70 PVQ MOD C.20 MAX CU.15 MAX KLD FINE GRAIN PRAC

A516-06 GR 65 PVQ, ASTM A516-06 GR 60 PVQ, ASME SA516 GR 70 PVQ 2015

EDITION, ASME SA516 GR 65 PVQ 2015 EDITION, ASME SA516 GR 60 PVQ 2015

EDITION, FIRST TST AS ROLLED-ADD'L TENSION PER TST PC HEAT TREATMENT

MILL TEST PCS NORM 1650+/-25F FOR 30MIN/IN (30 MINUTES MIN), AIRCOOL

TEST CERTS ARE PREPARED IN ACCORD WITH PROCEDURES OUTLINED IN EN

10204:2004 TYPE 3.1

NO WELD REPAIR WAS PERFORMED ON BELOW PLATE(S)

CO# 108833 GH 354-5218G

| CO#              | HEAT NO.  | QTY | THICKNESS | WIDTH | LENGTH | WEIGHT | YIELD | TENSILE | AFRAC | RED. |
|------------------|-----------|-----|-----------|-------|--------|--------|-------|---------|-------|------|
| C544041          | 822U31470 | 1   | .625      | 96    | 480    | 8168   | 48900 | 76600   | 8     | 23   |
| (M55)MFST REF#:8 |           |     |           |       |        |        | 52300 | 74700   | 8     | 25   |

HUY

|                  |           |   |      |    |     |       |       |       |   |    |
|------------------|-----------|---|------|----|-----|-------|-------|-------|---|----|
| C544042          | 822U31470 | 3 | .625 | 96 | 480 | 24504 | 54100 | 78500 | 8 | 22 |
| (M55)MFST REF#:8 |           |   |      |    |     |       | 52200 | 73800 | 8 | 25 |

HUW →

|                  |           |   |      |    |     |       |       |       |   |    |
|------------------|-----------|---|------|----|-----|-------|-------|-------|---|----|
| C544043          | 822U31470 | 3 | .625 | 96 | 480 | 24504 | 49700 | 76800 | 8 | 21 |
| (M55)MFST REF#:8 |           |   |      |    |     |       | 52400 | 75400 | 8 | 23 |

All heads made from steel covered by the

attached test reports were cold formed,

meet the requirements of paragraphs

UG-77(c), UG-79(c), UCS-79(d) for carbon

steel heads, UHA-44(a)(1)(a) for stainless

steel heads per Sect. VIII Div.1 2015, and

WERE NOT HEAT TREATED UNLESS NOTED.

In addition, per UG-96 these heads meet

the requirements of PG-16, PG-40, and UG-81

of Sect. VIII Div.1 2015.

Q-QUENCH TEMPERATURE

TEMPERATURE

N-NORMALIZE TEMPERATURE

| SERIAL<br>NUMBER | PAT<br>NO. | HEAT<br>NUMBER | HARD<br>BRIN | BEND | CHARPY IMPACT       |           |           |                 |        |             |               |   |   |           |   |   |          |   |   |      |
|------------------|------------|----------------|--------------|------|---------------------|-----------|-----------|-----------------|--------|-------------|---------------|---|---|-----------|---|---|----------|---|---|------|
|                  |            |                |              |      | THICKNESS<br>INCHES | TEMP<br>F | TEMP<br>C | SPEED<br>FT/SEC | INCHES | TEST<br>JUL | ENERGY FT-LBS |   |   | SHEAR (%) |   |   | LAT. EXP |   |   | MILS |
|                  |            |                |              |      |                     |           |           |                 |        |             |               | 1 | 2 | 3         | 1 | 2 | 3        | 1 | 2 | 3    |

COMMERCIAL METAL FORMING

Youngstown Stamping Division

Certified a true copy of the  
original, retained in our file.

AMERICAN ALLOY STEEL, INC.

Reviewed By:

JP 9/26/2016

| H<br>E<br>A<br>T<br>N<br>O. | C<br>H<br>E<br>M<br>I<br>C<br>A<br>L<br>A<br>N<br>A<br>L<br>Y<br>S<br>I<br>S |    |   |   |    |    |    |    |    |   |    |    |   |    |    |    | M<br>E<br>L<br>L<br>I<br>N<br>D<br>G<br>R<br>A<br>I<br>N<br>S<br>I<br>Z<br>E |
|-----------------------------|------------------------------------------------------------------------------|----|---|---|----|----|----|----|----|---|----|----|---|----|----|----|------------------------------------------------------------------------------|
|                             | C                                                                            | Mn | P | S | Si | Co | Ni | Cr | Mo | V | Ti | Al | B | Cu | Nb | Sn |                                                                              |

822U31470 .17 1.09 .008 .006 .330.024 .01 .12.082.002.002.033.0002 .002.005.006

I certify that the above results are a true and correct copy of actual results contained in records maintained by ArcelorMittal Burns Harbor and are in full compliance with the requirements of the specification cited above. This test report cannot be altered and must be transmitted intact with any subsequent third party test reports, if required.

BMLTSP.TTF

SUPPLY, QUALITY ASSURANCE

R. SPANGLER II PER LSS

Michael Jan 11-10-16

AMERICAN ALLOY  
STEEL  
PLATE # 5178549

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: FLG 2 LONG WLDNk RF 150 LB X 12" L

DATE DELIVERED: 11-1-16

VENDER NAME: FORGED COMPONENTS

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178836

QUANTITY DELIVERED: 40

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

\_\_\_\_\_  
SIGNATURE REQUIRED

NUMBER REJECTED: \_\_\_\_\_

NCR ISSUED: ☐ YES. ☐ NO.

NCR #: \_\_\_\_\_

HEAT NO: A6146

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME Warehouse

RECEIVED BY: Michael Chapman



14527 Smith Rd.  
Humble, Texas 77396  
TEL: (281) 441-4088  
FAX: (281) 441-8899

PAGE: 1 of 1  
REPORT # 16-023376  
DATE: 10/31/2016

**FCI ORDER # 75372**

I.A.W. ASME 2015 ED.  
I.A.W. NACE MR 0175

CUSTOMER ORDER # DP178836

SOLD / SHIPPED TO: DRAGON PRODUCTS (THE MODERN GROUP)

**Item Quantity Description**

1 40 PART HARDNESS (HBW): 156  
2" X 150 X 12" LG RF LWN

TAG: JOB# J2465

Heat Number: A6146

Material Type: SA105N

CHEMICAL ANALYSIS

PHYSICAL PROPERTIES

C .172  
Mn 1.210  
P .0250  
S .0100  
Si .250  
Cr .170  
Mo .010  
V .002  
Cu .025  
Ni .050  
Cb(Nb) .003

Yield PSI 50,000  
Tensile PSI 76,300  
Elongation 37.5  
Reduction of Area 73.7  
Hardness 156 HBW

Sn  
As

Ti  
Al .039

C E .415

Heat Treatment NORMALIZED  
Temperature 1688 °F  
Time at Temperature 3 HRS  
Cooling Media AIR

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by:

*Erika Marquez*

Name: Erika Marquez

Title: QA Representative

*Michael 11-1-16*

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: FLG 8 Long WLDNK RF 150LB X 14" L

DATE DELIVERED: 11-1-16

VENDER NAME: FORGED COMPONENTS

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178836

QUANTITY DELIVERED: 10

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: \_\_\_\_\_

NCR ISSUED: ☐ YES. ☐ NO.

NCR #: \_\_\_\_\_

HEAT NO: W354

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME Warehouse

RECEIVED BY: Michael Chapman



14527 Smith Rd.  
Humble, Texas 77396  
TEL: (281) 441-4088  
FAX: (281) 441-8899

PAGE: 1 of 1  
REPORT # 16-023379  
DATE: 10/31/2016

**FCI ORDER # 75372**

I.A.W. ASME 2015 ED.  
I.A.W. NACE MR 0175

**CUSTOMER ORDER # DP178836**

**SOLD / SHIPPED TO: DRAGON PRODUCTS (THE MODERN GROUP)**

**Item Quantity Description**

PART HARDNESS (HBW): 149/149

4 10 8" X 150 X 14" LG RF LWN,

TAG: JOB# J2465

**Heat Number: W354**

**Material Type: SA105N**

**CHEMICAL ANALYSIS**

**PHYSICAL PROPERTIES**

C .170  
Mn 1.090  
P .0110  
S .0020  
Si .200  
Cr .160  
Mo .030  
V .009  
Cu .250  
Ni .120  
Cb(Nb) .001

Yield PSI 47,000  
Tensile PSI 72,500  
Elongation 34.4  
Reduction of Area 73.1  
Hardness 149/149 HBW

Sn .011  
As .005  
Sb .001  
Ti .0030  
Al .021  
B .0001

C E .416

Heat Treatment **NORMALIZED**  
Temperature 1650 °F  
Time at Temperature 1/2 HR/IN THK MIN  
Cooling Media AIR

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by: Erika Marquez

Name: Erika Marquez

Title: QA Representative

*Michael J. [Signature]* 11-1-16

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: FLG 3 Long WLDNK RF 150LB X 9" L

DATE DELIVERED: 11-1-16

VENDER NAME: FORGED COMPONENTS

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178836

QUANTITY DELIVERED: 60

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: \_\_\_\_\_

NCR ISSUED: ☐ YES. ☐ NO.

NCR #: \_\_\_\_\_

HEAT NO: E55038

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME Warehouse

RECEIVED BY: Michael Chapman



**CUSTOMER ORDER #** DP178836  
**SOLD / SHIPPED TO:** DRAGON PRODUCTS (THE MODERN GROUP)

**Item Quantity Description**

2 60 PART HARDNESS (HBW): 149/149  
3" X 150 X 9" LG RF LWN

TAG: JOB# J2465

**Heat Number:** E55038

**Material Type:** SA105N

**CHEMICAL ANALYSIS**

**PHYSICAL PROPERTIES**

C .180  
Mn 1.220  
P .0190  
S .0020  
Si .230  
Cr .050  
Mo .006  
V .004  
Cu .016  
Ni .015  
Cb(Nb) .000

Yield PSI 47,900  
Tensile PSI 76,600  
Elongation 36.2  
Reduction of Area 70.6  
Hardness 156/156 HBW

Al .030

C E .397

**Heat Treatment** NORMALIZED  
**Temperature** 1688 °F  
**Time at Temperature** 3 HRS  
**Cooling Media** AIR

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by:

*Erika Marquez*

Name: Erika Marquez

Title: QA Representative

*Michael* 11-1-16

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: FLG 4, Long WLDNK, RF 150LBX 12"2

DATE DELIVERED: 8-16

VENDER NAME: FORGED COMPONENTS

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP176423

QUANTITY DELIVERED: 20

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

HEAT NO: 6748

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME Warehouse

RECEIVED BY: Michael Forbes



14527 Smith Rd.  
Humble, Texas 77396  
TEL: (281) 441-4088  
FAX: (281) 441-8899

PAGE: 1 of 1  
REPORT # 16-021236  
DATE: 8/12/2016  
FCI ORDER # 74674

CUSTOMER ORDER # DP176423  
SOLD / SHIPPED TO: DRAGON PRODUCTS (THE MODERN GROUP)

I.A.W. NACE MR 0175

Item Quantity Description

IAW ASME 2015 ED  
2 52 3" X 150 X 9" LG RF LWN,  
3 20 4" X 150 X 12" LG RF LWN

TAG: JOB # J2465

Heat Number: G748  
Material Type: SA105N

CHEMICAL ANALYSIS

PHYSICAL PROPERTIES

C  
Mn  
P  
S  
Si  
Cr  
Mo  
V  
Cu  
Ni  
Cb(Nb)

.194  
1.047  
.0100  
.0050  
.218  
.066  
.016  
.005  
.039  
.012  
.001

Yield PSI  
Tensile PSI  
Elongation  
Reduction of Area  
Hardness

54,000  
79,000  
26.1  
66.7  
179/163 HBW

C E

.390

Heat Treatment  
Temperature  
Time at Temperature  
Cooling Media

QUENCHED  
1650 °F  
4-1/2 HRS  
WATER

TEMPERED  
1150 °F  
2 HRS  
AIR

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by:

Name: Tanya Torres

Title: QA Representative

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: FLG 2 LONG WLDNK RF 150LBX12"long

DATE DELIVERED: 11-9-16

VENDER NAME: Forged Components

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP179780

QUANTITY DELIVERED: 3

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

HEAT NO: A6169

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME Warehouse

RECEIVED BY: James Cook



14527 Smith Rd.  
Humble, Texas 77396  
TEL: (281) 441-4088  
FAX: (281) 441-8899

PAGE: 1 of 1  
REPORT # 16-023647  
DATE: 11/8/2016  
**FCI ORDER # 75671**  
I.A.W. ASME 2015 ED.

CUSTOMER ORDER # DP179780

SOLD / SHIPPED TO: DRAGON PRODUCTS (THE MODERN GROUP)

**Item Quantity Description**

TAG: JOB# J2605

1 3 2" X 150 X 12" LG RF LWN,

Heat Number: A6169

Material Type: SA105N

CHEMICAL ANALYSIS

PHYSICAL PROPERTIES

C .175  
Mn 1.210  
P .0190  
S .0070  
Si .230  
Cr .050  
Mo .003  
V .003  
Cu .015  
Ni .020  
Cb(Nb) .008

Yield PSI 53,939  
Tensile PSI 77,740  
Elongation 33  
Reduction of Area 72  
Hardness 156/163 HBW

Al .036

C E .390

Heat Treatment NORMALIZED  
Temperature 1688 °F  
Time at Temperature 1/2 HR/IN THK MIN  
Cooling Media

We hereby certify that all test results and process information contained herein are correct and true as contained in the records of the company.

Prepared by:

*Erika Marquez*

Name: Erika Marquez

Title: QA Representative

*Michael 11-9-16*

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: CPLG CUSTOM 1X3 300# THD SA105

DATE DELIVERED: 10-31-16

VENDER NAME: LONE STAR STAINLESS

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178837

QUANTITY DELIVERED: 10

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

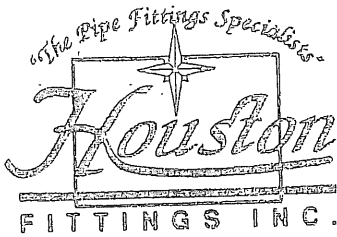
HEAT NO: SRZ D,

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME Warehouse

RECEIVED BY: Michael Chapman



6011 NUNN  
HOUSTON, TEXAS 77087  
(713) 649-4467 • FAX (713) 649-5080  
1-800-292-5726

## CERTIFICATE OF COMPLIANCE

WE CERTIFY TO THE BEST OF OUR KNOWLEDGE THAT THE FOLLOWING ITEMS MEET  
AND ARE IN ACCORDANCE WITH P.O.#47115 AND ALL OF THE REQUIREMENTS OF THE  
INDICATED SPECIFICATIONS.

DATE: 10/21/16

CUSTOMER P.O.#47115

CUSTOMER: LONESTAR

| ITEM# | QTY. | SIZE    | PRESSURE<br>CLASS | ASTM | MATERIAL |
|-------|------|---------|-------------------|------|----------|
| 1     | 10   | 1" x 3" | 3M                |      | SA105    |

DESCRIPTION: THREADED COUPLING

HEAT#A154410 HFI HEAT#SRZD

MANUFACTURED IN U.S.A.

  
QUALITY CONTROL DEPARTMENT

Heat Number

SR2D

A154410

8000 N. County Road 225 East  
Pittsboro, IN 46167  
Phone: (317) 882-7000  
Fax: (317) 892-7285



# Certified Material Test Report

Cort #: 209665

Work Order: 196924

Load #: 239509

Size: 1-3/4"

Grain Practice: Al Fine Grain (5-8) per ASTM A29

Mill Order: 1515435

Sales Order: 153441-1

Reference #:

Shape: Round

Heat #: A154410

Customer: Metalech Service Center, Inc.

Reference Desc:

Grade: A350/LF2 Chem

Reduction Ratio: 60.4 to 1

Issued: 11/18/2015 15:50:26

PO #: 89443-1

End Use:

Length: 20'

Disposition: Rolled Prime

## Ladle Chemistry Analysis (ASTM A29)

| C     | Mn    | P     | S     | Si    | Al    | Cu      | Ni      | Cr   | Mo       | Sn    | N      | V     | Cb    | B      | Ca     | W     | Ti    | DI   |
|-------|-------|-------|-------|-------|-------|---------|---------|------|----------|-------|--------|-------|-------|--------|--------|-------|-------|------|
| 0.19  | 1.11  | 0.010 | 0.004 | 0.26  | 0.033 | 0.12    | 0.09    | 0.11 | 0.03     | 0.008 | 0.0069 | 0.038 | 0.000 | 0.0002 | 0.0019 | 0.000 | 0.001 | 0.87 |
| Pb    | Co    | As    | Sb    | Zr    | Bi    | H (ppm) | O (ppm) | Ceq  | J-Factor |       |        |       |       |        |        |       |       |      |
| 0.000 | 0.006 | 0.004 | 0.003 | 0.000 | 0.000 | 1.5     |         | 0.42 | 247      |       |        |       |       |        |        |       |       |      |

## Product Check Analysis (ASTM A29)

| C     | Mn | P | S | Si | Al | Cu | Ni | Cr | Mo | Sn | N | V | Cb | Ti | B | Ca | O |
|-------|----|---|---|----|----|----|----|----|----|----|---|---|----|----|---|----|---|
| Front |    |   |   |    |    |    |    |    |    |    |   |   |    |    |   |    |   |
| Back  |    |   |   |    |    |    |    |    |    |    |   |   |    |    |   |    |   |

## Jominy (ASTM A255)

|                 | J1  | J2 | J3 | J4 | J5 | J6 | J7 | J8 | J9 | J10 | J12 | J14 | J16 | J18 | J20 | J24 | J28 | J32 |
|-----------------|-----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Calc'd Standard | 1.5 | 3  | 5  | 7  | 9  | 11 | 13 | 15 | 20 | 25  | 30  | 35  | 40  | 45  | 50  |     |     |     |
| Calc'd Metric   |     |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |
| Front           | J1  | J2 | J3 | J4 | J5 | J6 | J7 | J8 | J9 | J10 | J12 | J14 | J16 | J18 | J20 | J24 | J28 | J32 |
| Back            |     |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |

## Microcleanliness (ASTM E45)

| Method A |    |    |    |    |    | Method C |    | Method E |         |
|----------|----|----|----|----|----|----------|----|----------|---------|
| AT       | AH | BT | BH | CT | CH | DT       | DH | S        | O       |
|          |    |    |    |    |    |          |    | SAM "B"  | SAM "D" |

## Microcleanliness (DIN 50602)

| K   | M   |
|-----|-----|
| S   | O   |
| Tot | Tot |

## Decarb

| Depth | % of Diameter |
|-------|---------------|
|-------|---------------|

## Grain Size

| Austenitic | Ferritic |
|------------|----------|
|------------|----------|

## Macrostructure (ASTM E381)

| S | R | C |
|---|---|---|
|---|---|---|

## Magnetic Particle Inspection

| Frequency | Severity |
|-----------|----------|
|-----------|----------|

## Mechanical Properties (ASTM A370)

| Tensile Properties |                     |              |       |                          | Hardness |        |
|--------------------|---------------------|--------------|-------|--------------------------|----------|--------|
| Tensile Strength   | 0.2% Yield Strength | % Elong (2") | % ROA | 0.35% EUL Yield Strength | (MR)     | (Surf) |

Steel Dynamics - Engineered Bar Products has a quality system in place which has been certified ISO 9001:2008 compliant, including PED certification.

## Comments/Specs

Electric Arc Furnace Melted - Vacuum Tank Degassed --- Normalize and Machine Straighten --- NACE MR-01-75 / ISO 15156-2009 --- ASTM A696-90a Grade C --- ASTM A675-03 Grade 70 --- ASME SA350-04 LF-2 Class 1 --- ASME SA105-04 --- ASME SA675-04 Gr 70 --- DIN 3.1.B --- NACE MR0103-2007 --- UT Tested ASTM A388 & 100% Surface Scan 1mm FBH --- UT Tested ASTM A388 & 100% Surface Scan 1mm FBH --- ASTM A350/A350M-13 LF2 --- ASTM A105/A105M-13 --- Pres Equip Direct(PED) 97/23/EC/7/2 Annex I, Par 4.3

UT: Passed Ultrasonic Inspection

Condition: Normalize, Straighten, Chamfer, Immersion UT

I hereby certify that the content of this report is correct and accurate, and that all tests and operations performed on this material were in compliance with applicable material specifications and purchaser designated requirements.

Jonathan Vallosio - Rolling Mill Metallurgist

Any alteration to this report voids Steel Dynamic's warranting of results. No weld repair has been performed on this material. This material is not radioactive and has not been exposed to radioactivity while under the control of Steel Dynamics. This material has not been exposed to mercury while under the control of Steel Dynamics. Unless otherwise noted, this material was melted, continuously cast, and rolled in the USA; w/ all testing performed by Steel Dynamics.

Steel Dynamics Rev Level 1 [108] - 864

Retrieved on: 11/18/15 15:50:25



Heat Number

SRZD

A154410

8000 N. County Road 225 East  
Pittsboro, IN 46167  
Phone: (317) 892-7000  
Fax: (317) 892-7285



## Certified Material Test Report

### Heat Treatment Addendum

Cert #: 209685

Work Order #: 196924

Load #: 239509

Size: 1-3/4"

Mill Order: 1515435

Sales Order: 153441-1

Reference #:

Shape: Round

Heat #: A154410

Customer: Metatech Service Center, Inc PO #: 89443-1

Reference Desc:

Grade: A350/LF2 Chem

Issued: 11/18/2015 15:50:26

End Use:

Length: 20'

| Normalize |        | Austenitize |      | Quench Media |      |      | Temper |      | Stress Relieve |      |
|-----------|--------|-------------|------|--------------|------|------|--------|------|----------------|------|
| Time      | Temp   | Time        | Temp | Type         | Time | Temp | Time   | Temp | Time           | Temp |
| 3.5 hrs   | 1670 F |             |      |              |      |      |        |      |                |      |
|           |        | hrs         | °F   |              | min  | °F   | hrs    | °F   | hrs            | F    |

\* Furnaces are calibrated to API 6A Annex M, and use atmospheric thermocouples.  
 \*\* QTC is 12" protrusion from longitudinal orientation, machined to a 0.505" buttonhead for tensile.

**Charpy Impact (ASTM E23) (v-notch | 10mm x 10mm)**

| Charpy Impact (ASTM E23) (v-notch 1/16mm x 10mm) |              |            |         | Impact Energy (ft-lbs) |    |    |     | Lateral Expansion (0.001") |    |    |     | % Shear |    |    |     |    |
|--------------------------------------------------|--------------|------------|---------|------------------------|----|----|-----|----------------------------|----|----|-----|---------|----|----|-----|----|
| Sample ID                                        | Orientation  | Location   | Temp(F) | 1                      | 2  | 3  | Avg | 1                          | 2  | 3  | Avg | 1       | 2  | 3  | Avg |    |
| 65800                                            | Longitudinal | Mid-Radius | Q1      | -50                    | 54 | 56 | 66  | 58                         | 43 | 41 | 45  | 43      | 40 | 45 | 50  | 45 |

**Hardness (ASTM A370)**

| Sample ID | Location      | HB  |
|-----------|---------------|-----|
| 65800     | Mid-Radius Q1 | 145 |

**Tensile (ASTM A370)**

| Sample ID | Orientation  | Location      | Tensile    | 0.2% Yield | %E (2") | %ROA |
|-----------|--------------|---------------|------------|------------|---------|------|
| 65800     | Longitudinal | Mid-Radius Q1 | 73,700 psi | 46,700 psi | 32      | 87   |

I hereby certify that the content of this report is correct and accurate, and that all tests and operations performed on this material were in compliance with applicable material specifications and purchaser designated requirements.

*Garrett Bouyettl*  
Garrett Bouyettl - Bar Finishing Metallurgist

Any alteration to this report voids Steel Dynamic's warranting of results.

Steel Dynamics Rev Level 1 (115) - 351

Retrieved on: 11/18/15 15:50:18

*Michael 10-31-16*

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: CPLG 1 3000#

DATE DELIVERED: 9/30/16

VENDER NAME: LONESTAR STAINLESS

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP178029

QUANTITY DELIVERED: 1

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6) .

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

HEAT NO: 41105

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

YARD LOCATION: ASME Warehouse

RECEIVED BY: Michael Chapman

# MILL TEST & INSPECTION CERTIFICATE

ACCORDING TO EN 10204 : 2004 3.1

CUSTOMER

CERT. NO : 133629

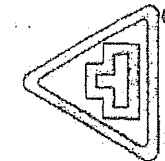
ORDER NO : 613/001621

INVOICE NO : BW01310209136

L/C NO :

DATE : 11/28/2013

PAGE : 4 ORIGIN : TAIWAN



**柏緯鐵工股份有限公司**  
**BOTH-WELL STEEL FITTINGS CO., LTD.**

高雄市中區武吉里仁心路303號  
 NO.303, REN-SIN ROAD, REN-WU DISTRICT, KAOHSIUNG CITY, TAIWAN R.O.C.(81480)  
 TEL: +886-7-3714536, 3710497, 3720260 FAX: +886-7-3713854, 3713882  
 Web site: <http://www.bothwell.com.tw> e-mail: [box@bothwell.com.tw](mailto:box@bothwell.com.tw)

| ITEM | BW<br>HT. CD. | RAW MATERIAL<br>HEAT NO. | DESCRIPTION               | CHEMICAL COMPOSITION (%) |               |                        |                            |       |           |            |      |       |       |            |                |    | QUANTITY                                                                                                    | SPECIFICATION FOR |    |                | INSPECTION         |         |         |
|------|---------------|--------------------------|---------------------------|--------------------------|---------------|------------------------|----------------------------|-------|-----------|------------|------|-------|-------|------------|----------------|----|-------------------------------------------------------------------------------------------------------------|-------------------|----|----------------|--------------------|---------|---------|
|      |               |                          |                           | C                        | Si            | Mn                     | P                          | S     | Cu        | Cr         | Ni   | Mo    | V     | Co(Nb)     | N              | Al |                                                                                                             | Ti                | Zr | CE             | MATERIAL           | FITTING | SURFACE |
| 001  | AB932         | 12511619                 | FULL CPLG 1/2" 3000# NPT  | -                        | 0.10          | 0.60                   | -                          | -     | -         | -          | 0.30 | 0.40  | 0.12  | -          | -              | -  | -                                                                                                           | -                 | -  | ASTM A105N -12 | ASME B16.11 - 2011 | GOOD    | GOOD    |
| 002  | AB896         | 12703762                 | FULL CPLG 3/4" 3000# NPT  | 0.35                     | 0.35          | 1.05                   | 0.035                      | 0.040 | 0.40      | 0.30       | 0.40 | 0.08  | -     | -          | -              | -  | -                                                                                                           | -                 | -  | ASTM A105N -12 | ASME B16.11 - 2011 | GOOD    | GOOD    |
| 003  | 4101          | 0093201                  | FULL CPLG 1" 3000# NPT    | 0.19                     | 0.27          | 0.95                   | 0.016                      | 0.008 | 0.03      | 0.10       | 0.05 | 0.01  | 0.005 | 0.003      | -              | -  | -                                                                                                           | -                 | -  | ASTM A105N -12 | ASME B16.11 - 2011 | GOOD    | GOOD    |
| 003  | 4105          | 0093200                  | FULL CPLG 1" 3000# NPT    | 0.19                     | 0.23          | 0.92                   | 0.013                      | 0.003 | 0.11      | 0.06       | 0.05 | 0.005 | 0.004 | 0.000      | -              | -  | -                                                                                                           | -                 | -  | ASTM A105N -12 | ASME B16.11 - 2011 | GOOD    | GOOD    |
| 004  | 4146          | 336787                   | HEX BUSHING 3/8"x1/4" NPT | 0.19                     | 0.18          | 0.93                   | 0.015                      | 0.008 | 0.17      | 0.09       | 0.06 | 0.01  | 0.001 | 0.000      | -              | -  | -                                                                                                           | -                 | -  | ASTM A105N -12 | ASME B16.11 - 2011 | GOOD    | GOOD    |
| 004  | 4146          | 336787                   | HEX BUSHING 3/8"x1/4" NPT | 0.19                     | 0.19          | 0.94                   | 0.017                      | 0.006 | 0.19      | 0.11       | 0.07 | 0.01  | 0.001 | 0.000      | -              | -  | -                                                                                                           | -                 | -  | ASTM A105N -12 | ASME B16.11 - 2011 | GOOD    | GOOD    |
| 004  | 4146          | 336787                   | HEX BUSHING 3/8"x1/4" NPT | 0.20                     | 0.20          | 0.85                   | 0.017                      | 0.009 | 0.14      | 0.09       | 0.06 | 0.02  | 0.003 | 0.001      | -              | -  | -                                                                                                           | -                 | -  | ASTM A105N -12 | ASME B16.11 - 2011 | GOOD    | GOOD    |
| ITEM | BW<br>HT. CD. | MECHANICAL PROPERTIES    |                           |                          |               |                        |                            |       |           |            |      |       |       |            | HEAT TREATMENT |    | ADDITIONAL TEST/REMARKS<br>STEEL MAKING PROCESS : ELECTRIC FURNACE<br>CONFORMS TO NACE MR0175-09 /MR0103-10 |                   |    |                |                    |         |         |
|      |               | T. S.<br>(KSI)           | Y. S.<br>(KSI)            | EL.<br>(%)               | R of A<br>(%) | Hardness<br>(HFW)(AVG) | Charpy Impact<br>"F / 0 °C |       |           | NORMALIZED |      |       |       |            |                |    |                                                                                                             |                   |    |                |                    |         |         |
| Min  |               | 70                       | 36                        | 22                       | 30            | -                      | 187                        |       | WTN./AVG. | 1          | 2    | 3     | AVG.  | 900°C A.C. |                |    |                                                                                                             |                   |    |                |                    |         |         |
| Max  |               |                          |                           |                          |               |                        |                            |       |           |            |      |       |       |            |                |    |                                                                                                             |                   |    |                |                    |         |         |
| 001  | AB932         | 76.1                     | 45.3                      | 33.0                     | 66.8          | 145                    | 146                        |       |           |            |      |       |       |            |                |    |                                                                                                             |                   |    |                |                    |         |         |
| 002  | AB896         | 77.4                     | 45.7                      | 34.2                     | 68.6          | 145                    | 142                        |       |           |            |      |       |       |            |                |    |                                                                                                             |                   |    |                |                    |         |         |
| 003  | 4101          | 75.9                     | 51.7                      | 35.8                     | 65.5          | 144                    | 146                        |       |           |            |      |       |       |            |                |    |                                                                                                             |                   |    |                |                    |         |         |
| 003  | 4105          | 75.3                     | 52.9                      | 34.4                     | 67.2          | 144                    | 148                        |       |           |            |      |       |       |            |                |    |                                                                                                             |                   |    |                |                    |         |         |
| 004  | 4146          | 76.6                     | 56.9                      | 62.6                     | 63.6          | 145                    | 146                        |       |           |            |      |       |       |            |                |    |                                                                                                             |                   |    |                |                    |         |         |

| ITEM | BW HT. CD. | MECHANICAL PROPERTIES |             |         |            |                     |                         |   |   |             |      | HEAT TREATMENT |            | ADDITIONAL TEST/REMARKS                                                         |  |
|------|------------|-----------------------|-------------|---------|------------|---------------------|-------------------------|---|---|-------------|------|----------------|------------|---------------------------------------------------------------------------------|--|
|      |            | T. S. (KSI)           | Y. S. (KSI) | EL. (%) | R of A (%) | Hardness (HBS)(AVG) | Charpy Impact °F / 0 °C |   |   | MIN. / AVG. |      | NORMALIZED     | 900°C A.C. | STEEEL MAKING PROCESS : ELECTRIC FURNACE CONFORMS TO NACE MR0175-09 / MR0103-10 |  |
| 001  | AB932      | 76.1                  | 45.3        | 33.0    | 66.8       | 145                 | 187                     | 1 | 2 | 3           | AVG. |                |            |                                                                                 |  |
| 002  | AB896      | 77.4                  | 45.7        | 34.2    | 68.6       | 145                 | 142                     |   |   |             |      |                |            |                                                                                 |  |
| 003  | 4101       | 75.9                  | 51.7        | 35.8    | 65.5       | 144                 | 146                     |   |   |             |      |                |            |                                                                                 |  |
| 003  | 4105       | 75.3                  | 52.9        | 34.4    | 67.2       | 144                 | 148                     |   |   |             |      |                |            |                                                                                 |  |
| 004  | 4146       | 76.6                  | 56.9        | 62.6    | 63.6       | 145                 | 146                     |   |   |             |      |                |            |                                                                                 |  |

WE HEREBY CERTIFY, THAT THE MATERIAL DESCRIBED ABOVE HAS BEEN TESTED AND COMPLIES WITH THE TERMS OF THE ORDER CONTRACT.

C.C. Huang  
 Q.C. MANAGER  
 CHEN CHI HUANG

Y.Y. Chang  
 INSPECTOR  
 YUAN YAO CHANG

EW-D0839 REV: 2

*Signature* 9.30/6

# MATERIAL AND VENDORS LOG

LOCATION: LIBERTY, TX

MATERIAL/ITEM: CPLG 1 3000 #

DATE DELIVERED: 9-30-16

VENDER NAME: LONE STAR STAINLESS

ADDRESS: \_\_\_\_\_

PURCHASE ORDER NO: DP 178029

QUANTITY DELIVERED: 5

CONDITION OF DELIVERY: Good

MATERIAL INSPECTED IN ACCORDANCE WITH UG 90 GENERAL (6).

SIGNATURE REQUIRED

NUMBER REJECTED: 0

NCR ISSUED: ☐ YES. ☒ NO.

NCR #: \_\_\_\_\_

HEAT NO: 41101

COLOR ASSIGNED: \_\_\_\_\_

SERIAL #: \_\_\_\_\_

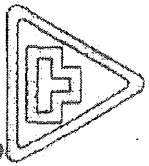
YARD LOCATION: ASME Warehouse

RECEIVED BY: Michael Chapman

# MILL TEST & INSPECTION CERTIFICATE

ACCORDING TO EN 10204 : 2004 3.1

CUSTOMER : 133629  
 CERT. NO : 613/001621  
 ORDER NO : 613/001621  
 INVOICE NO : BWO1310209136  
 L/C NO :  
 DATE : 11/28/2013  
 PAGE : 4  
 ORIGIN : TAIWAN



**柏緯鋼鐵股份有限公司**  
**BOTHWELL STEEL FITTINGS CO., LTD.**  
 台灣桃園市仁武區松柏里仁心路303號  
 NO.303, REN-SIN ROAD, REN-WU DISTRICT, KAOHSIUNG CITY, TAIWAN R.O.C. 814501  
 TEL: +886-7-3711538, 3710497, 3720260 FAX: +886-7-3713864, 3713882  
 Web site: <http://www.bothwell.com.tw> e-mail: [box@bothwell.com.tw](mailto:box@bothwell.com.tw)

| ITEM | BW HT. CD. | RAW MATERIAL | DESCRIPTION               | QUANTITY | SPECIFICATION FOR  | INSPECTION |
|------|------------|--------------|---------------------------|----------|--------------------|------------|
| 001  | AB932      | 12511619     | FULL CP/G 1/2" 3000# NPT  | 500 PC   | MATERIAL           | SURFACE    |
| 002  | AB896      | 12703762     | FULL CP/G 3/4" 3000# NPT  | 400 PC   | FITTING            | DIM.       |
| 003  | 4101       | 0093201      | FULL CP/G 1" 3000# NPT    | 470 PC   | ASME SA105N - 12   | GOOD       |
| 003  | 4105       | 0093200      | FULL CP/G 1" 3000# NPT    | 530 PC   | ASME SA105N-2013RD | GOOD       |
| 004  | 4146       | 336787       | HEX BUSHING 3/8"x1/4" NPT | 1500 PC  | ASME B16.11 - 2011 | GOOD       |

| ITEM | BW HT. CD. | C    | Si   | Mn   | P     | S     | Cu   | Cr   | Ni   | Mo   | V    | Co(Nb) | N | Al | Ti | Zr | CE | MATERIAL SUPPLIER |
|------|------------|------|------|------|-------|-------|------|------|------|------|------|--------|---|----|----|----|----|-------------------|
| Min  |            | 0.35 | 0.10 | 0.60 | 0.035 | 0.040 | 0.40 | 0.30 | 0.40 | 0.12 | 0.08 | -      | - | -  | -  | -  | -  |                   |
| Max  |            | 0.35 | 0.35 | 1.05 | 0.035 | 0.040 | 0.40 | 0.30 | 0.40 | 0.12 | 0.08 | -      | - | -  | -  | -  | -  |                   |

| ITEM | BW HT. CD. | T. S. (KSI) | Y. S. (KSI) | EL. (%) | R of A (%) | Hardness (HBM)(AVG) | Charpy Impact (Joule) °C | HEAT TREATMENT | ADDITIONAL TEST/REMARKS                 |
|------|------------|-------------|-------------|---------|------------|---------------------|--------------------------|----------------|-----------------------------------------|
| Min  |            | 70          | 36          | 22      | 30         | 187                 | 1                        |                | STEEL MAKING PROCESS : ELECTRIC FURNACE |
| Max  |            | 70          | 36          | 22      | 30         | 187                 | 2                        |                | CONFORMS TO NACE MR0175-09 / MR0103-10  |

WE HEREBY CERTIFY, THAT THE MATERIAL DESCRIBED ABOVE HAS BEEN TESTED AND COMPLIES WITH THE TERMS OF THE ORDER CONTRACT.

REV. 2

C.C. Huang  
 Q.C. MANAGER  
 CHEN CHU HUANG  
 Y.Y. Chang  
 INSPECTOR  
 YUAN YAO CHANG

93066



# TRAVELER

JOB NO.: J2465 DATE: 11/15/16 SER #: 129959 REV #: 0 A.I. REV #: 0

ITEM: 72" OD X 180" 3-PHASE SEPARATOR DWG #: 00002465 REV #: 1 NB#: 401

MAWP: 250PSI EXT PSI: 0 MAX TEMP: 200°F MDMT: -20°F

SPECIAL SERVICE (L,UB,LT) YES ☐ NO ☒ IMPACT TESTS REQ'D YES ☐ NO ☒

TRAVELER REVIEWED BY: [Signature] DATE: 11-16-16

QUALITY CONTROL MANAGER: [Signature] DATE: 11/16/16

AUTHORIZED INSPECTOR: [Signature] DATE: 11/16/16

| #                      | MATERIAL INSPECTION                                                                                                                                                                                                                  |                                                                                                                                                 | QUALITY CONTROL | DATE     | AUTHORIZED INSPECTOR | DATE        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------------------|-------------|
| 1                      | Mill Test Reports Reviewed By:                                                                                                                                                                                                       |                                                                                                                                                 |                 |          |                      |             |
| 2                      | Shell                                                                                                                                                                                                                                | Plate <input checked="" type="checkbox"/> Material Spec.: <b>SA-516-70</b><br>Pipe <input type="checkbox"/> Thickness, Surface & Edge Condition | EW              | 11-9-16  | [Signature]          | 11/20/16    |
| 3                      | Heads                                                                                                                                                                                                                                | Material Spec.: <b>SA-516-70</b><br>Thickness, Surface & Edge Condition<br>UCS-79(d) Requirements Met                                           | EW              | 11-11-16 | [Signature]          | [Signature] |
| 4                      | Pipe                                                                                                                                                                                                                                 | Spec. & Grade: <b>SA-106B</b><br>Edge Condition: <b>BEVELED</b>                                                                                 | EW              | 11-21-16 |                      |             |
| 5                      | Reinforcement Pads: <input checked="" type="checkbox"/>                                                                                                                                                                              | Mat'l Spec.: <b>SA-516-70</b><br>Size: <b>38"X37"</b><br>Thickness: <b>1/2"</b>                                                                 | EW              | 11-21-16 |                      |             |
| 6                      | Flanges: <input checked="" type="checkbox"/>                                                                                                                                                                                         | Mat'l Spec.: <b>SA-105</b><br>Rating: <b>150#</b><br>Bore: <b>SEE DWG</b><br>Slip-on Flange Gap: <b>5/8"</b>                                    | EW              | 11-21-16 |                      |             |
| FABRICATION INSPECTION |                                                                                                                                                                                                                                      |                                                                                                                                                 |                 |          |                      |             |
| 7                      | Shell Size (Match Heads) (Bevels)                                                                                                                                                                                                    |                                                                                                                                                 | EW              | 11-9-16  | [Signature]          | 11/22/16    |
| 8                      | Out of Roundness                                                                                                                                                                                                                     |                                                                                                                                                 | EW              | 11-9-16  | [Signature]          | [Signature] |
| 9                      | Edge Off-Set Longitudinal and Girth Seams                                                                                                                                                                                            |                                                                                                                                                 | EW              | 11-9-16  |                      |             |
| 10                     | Nozzle Fit-Ups                                                                                                                                                                                                                       |                                                                                                                                                 | EW              | 11-21-16 |                      |             |
| 11                     | Qualified Weld Procedure's / Welder's I.D.                                                                                                                                                                                           |                                                                                                                                                 | EW              | 11-21-16 |                      |             |
| 12                     | Internal Welds - Size and Appearance                                                                                                                                                                                                 |                                                                                                                                                 | EW              | 11-21-16 | [Signature]          | [Signature] |
| 13                     | External Welds - Size and Appearance                                                                                                                                                                                                 |                                                                                                                                                 | EW              | 11-21-16 |                      |             |
| 14                     | Pre-Heat Required? <input type="checkbox"/> Chk'd By: <u>[Signature]</u>                                                                                                                                                             |                                                                                                                                                 |                 |          |                      |             |
| 15                     | Post Weld Heat Treat Required (PWHT)? <input type="checkbox"/> Chart Rcv'd: <u>[Signature]</u> Chk'd By: <u>[Signature]</u>                                                                                                          |                                                                                                                                                 |                 |          |                      |             |
| 16                     | PT <input type="checkbox"/> MT <input type="checkbox"/> Test Req'd? Chk'd By: <u>[Signature]</u>                                                                                                                                     |                                                                                                                                                 |                 |          |                      |             |
| 17                     | Radiography Required? <input checked="" type="checkbox"/> RT Level: <u>2</u> Number of Films: <u>[Signature]</u><br>Interpreted By: <u>[Signature]</u> Chk'd By: <u>[Signature]</u>                                                  |                                                                                                                                                 |                 |          |                      |             |
| 18                     | Hydro-Test <input checked="" type="checkbox"/> Pneu-Test <input type="checkbox"/><br>Chart Required? <input type="checkbox"/> Customer Witness? <input type="checkbox"/><br>Test Pressure: <u>325</u> PSI Hold Time: <u>AS REQ'D</u> |                                                                                                                                                 | SRF             | 11-29-16 | [Signature]          | 11/22/16    |
| 19                     | Hardness Test: <input type="checkbox"/>                                                                                                                                                                                              |                                                                                                                                                 |                 |          |                      |             |
| 20                     | Nameplate: Stamping / Application / Picture                                                                                                                                                                                          |                                                                                                                                                 | SRF             | 11-29-16 | [Signature]          | 11/22/16    |
| 21                     | Manufacturer's Data Report Certified:                                                                                                                                                                                                |                                                                                                                                                 |                 |          | [Signature]          | 11/22/16    |

NOTE: A.I. Hold Points Indicated Here →

\*\*SEE BACK FOR ADDITIONAL REMARKS, INSPECTION POINTS, AND/OR HEAT NO'S.

## A.I. HOLD POINTS INDICATED BY AN ( \* ) IN THE COURSE, HEAD, OR NOZZLE BLOCKS

| COURSE | MAT'L                          | HEAT #                          | LONG FIT-UP |          |      |      | LONG WELD |          |      |      |
|--------|--------------------------------|---------------------------------|-------------|----------|------|------|-----------|----------|------|------|
|        |                                |                                 | Q.C.        | DATE     | A.I. | DATE | Q.C.      | DATE     | A.I. | DATE |
| 1      | 5/8" SA-516-70<br>90"X224-1/4" | Safety Purple<br>Dark Ford Blue | EW          | 11-9-16  |      |      | EW        | 11-10-16 |      |      |
| 2      | 5/8" SA-516-70<br>90"X224-1/4" | Safety Purple<br>Dark Ford Blue | EW          | 11-10-16 |      |      | EW        | 11-10-16 |      |      |
|        |                                |                                 |             |          |      |      |           |          |      |      |
|        |                                |                                 |             |          |      |      |           |          |      |      |
|        |                                |                                 |             |          |      |      |           |          |      |      |
|        |                                |                                 |             |          |      |      |           |          |      |      |
|        |                                |                                 |             |          |      |      |           |          |      |      |

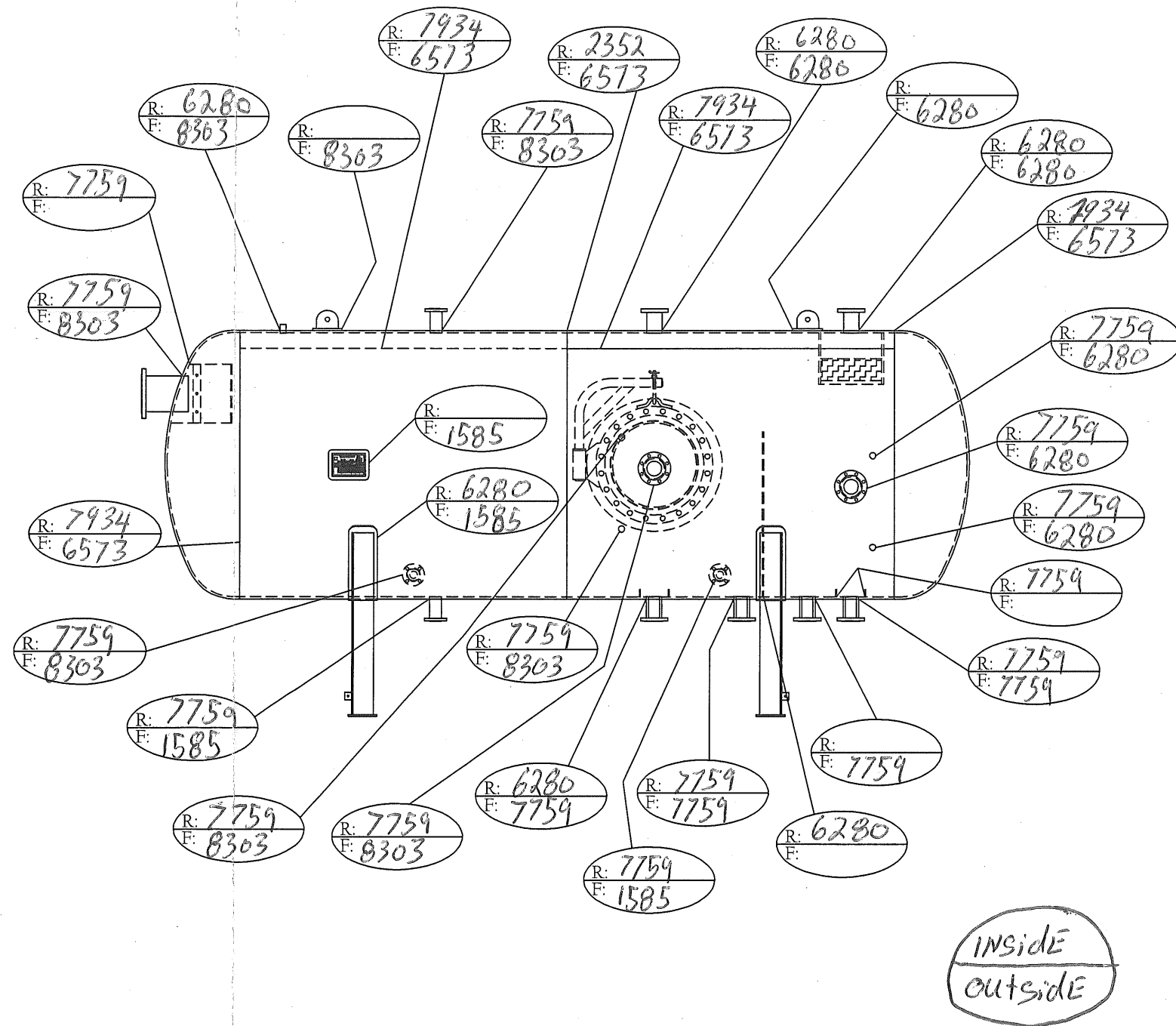
| COURSE | GIRTH FIT-UP |          |      |      | GIRTH WELD |          |      |      |
|--------|--------------|----------|------|------|------------|----------|------|------|
|        | Q.C.         | DATE     | A.I. | DATE | Q.C.       | DATE     | A.I. | DATE |
| 1-2    | EW           | 11-11-16 |      |      | EW         | 11-11-16 |      |      |
|        |              |          |      |      |            |          |      |      |
|        |              |          |      |      |            |          |      |      |
|        |              |          |      |      |            |          |      |      |
|        |              |          |      |      |            |          |      |      |
|        |              |          |      |      |            |          |      |      |

| HEAD      | MAT'L                                         | HEAT #                         | HEAD TO SHELL FIT-UP |          |      |      | HEAD TO SHELL WELD |          |      |      |
|-----------|-----------------------------------------------|--------------------------------|----------------------|----------|------|------|--------------------|----------|------|------|
|           |                                               |                                | Q.C.                 | DATE     | A.I. | DATE | Q.C.               | DATE     | A.I. | DATE |
| (1) LEFT  | 72"ID SA-516-70 (2)<br>0.513"MIN / 0.625" NOM | Dark Ford Blue<br>WHAUL ORANGE | EW                   | 11-11-16 |      |      | EW                 | 11-11-16 |      |      |
| (2) RIGHT | 72"ID SA-516-70 (3)<br>0.513"MIN / 0.625" NOM | BANNER RECK<br>Dark Ford Blue  | EW                   | 11-11-16 |      |      | EW                 | 11-11-16 |      |      |
|           |                                               |                                |                      |          |      |      |                    |          |      |      |
|           |                                               |                                |                      |          |      |      |                    |          |      |      |

| NOZZLE NO. | MATERIAL                   | HEAT # | NOZZLE FIT-UP |          |      |      | NOZZLE WELD |          |      |      |
|------------|----------------------------|--------|---------------|----------|------|------|-------------|----------|------|------|
|            |                            |        | Q.C.          | DATE     | A.I. | DATE | Q.C.        | DATE     | A.I. | DATE |
| N1         | MANWAY, 24" 150# RFSO      |        | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N4         | INLET, 8" 150# LWN         | W354   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N5         | GAS OUTLET, 3" 150# LWN    | CB248  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N6         | WATER LLC, 4" 150# LWN     | W421   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N7         | OIL LLC, 4" 150# LWN       | W421   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N8         | OIL OUTLET, 3" 150# LWN    | CB248  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N9         | DRAIN, 3" 150# LWN         | CB248  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N10        | WATER OUTLET, 3" 150# LWN  | CB248  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N11        | PI/TRANS 1" 3000# CPLG     | 4101   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N13A       | WTER LVL TOP 1" 3000# CPLG | 4105   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N13B       | WTER LVL BTM 1" 3000# CPLG | 4105   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N14A       | OIL LVL TOP 1"3000# CPLG   | 4105   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N14B       | OIL LVL BTM 1" 3000# CPLG  | SR20   | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N15        | PRESS RELF 3" 150# LWN     | CB248  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N16A       | LVL (LSHH/TOP) 2"150# LWN  | CB317  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N16B       | LVL (LSHH/BTM) 2" 150# LWN | CB317  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |
| N17A       | ANODE 2" 150# LWN          | CB317  | EW            | 11-21-16 |      |      | EW          | 11-29-16 |      |      |







|                                                                                       |                                             |                                                                                                                                                                                |                                        |                                 |                       |                        |
|---------------------------------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------|-----------------------|------------------------|
|  | <b>DRAGON PRODUCTS, LTD.</b>                |                                                                                                                                                                                | <b>72" ID x 180" 3-PHASE SEPARATOR</b> |                                 |                       |                        |
|                                                                                       |                                             |                                                                                                                                                                                | <b>WELD MAP</b><br><b>V-1010</b>       |                                 |                       |                        |
|                                                                                       | <b>JOB NO.</b><br><b>J2465</b>              | THIS DRAWING AND INFORMATION CONTAINED HEREIN IS THE PROPERTY OF DRAGON PRODUCTS, LTD. AND CANNOT BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF DRAGON PRODUCTS, LTD. |                                        | <b>DRAWN BY:</b> JGF            | <b>CHECKED BY:</b> JR | <b>APPROVED BY:</b> GM |
|                                                                                       | <b>SCALE</b> NTS<br><br><b>DATE</b> 1-14-16 |                                                                                                                                                                                |                                        | <b>PART NUMBER:</b><br>00002465 | <b>QUANTITY:</b><br>1 | <b>Rev.</b><br>1       |



DRAGON ESP, LTD.

FORMED HEAD INCOMING RECEIVING  
DIMENSIONAL CHECK

#3

A 614

DRAWING NO. J2465

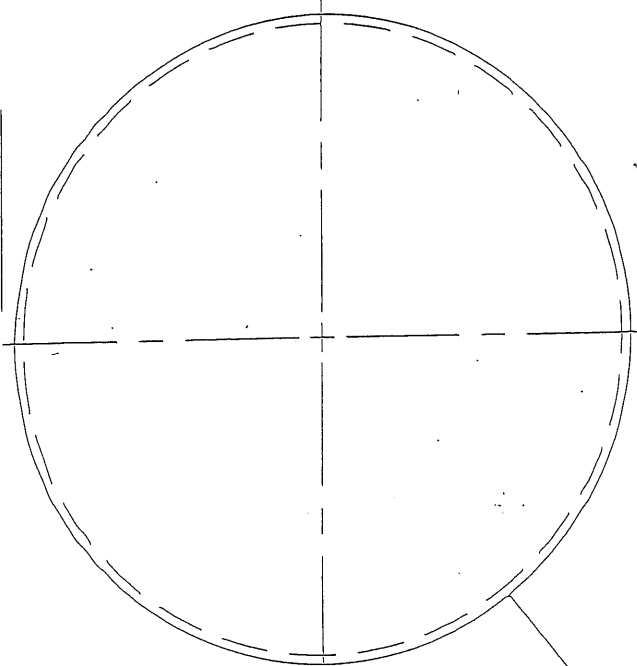
SERIAL NO. DP178801

P.O. NO.

COLOR CODE: FEB-UHO

HEAT NO. HUY

601 D 602



CIRCUMFERENCE  
OUTSIDE

C 606

TOP VIEW

THK. MIC. = 570

THK. MIC. = 532

THK. MIC. = 545

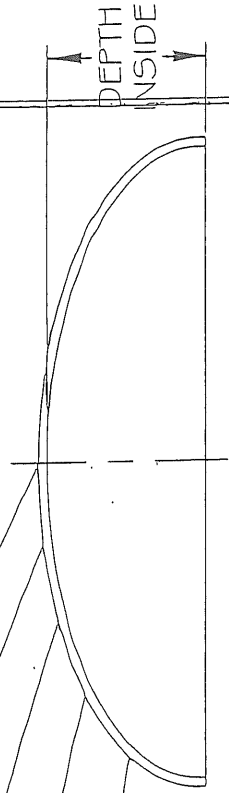
THK. MIC. = 552

THK. MIC. = 581

CIRCUMFERENCE = 19"

DIAMETER = 73"

DEPTH = 26 1/8



DEPTH  
INSIDE

NOTE: USE ULTRA-SONIC  
MATERIAL TEST UNIT.

ELEVATION VIEW

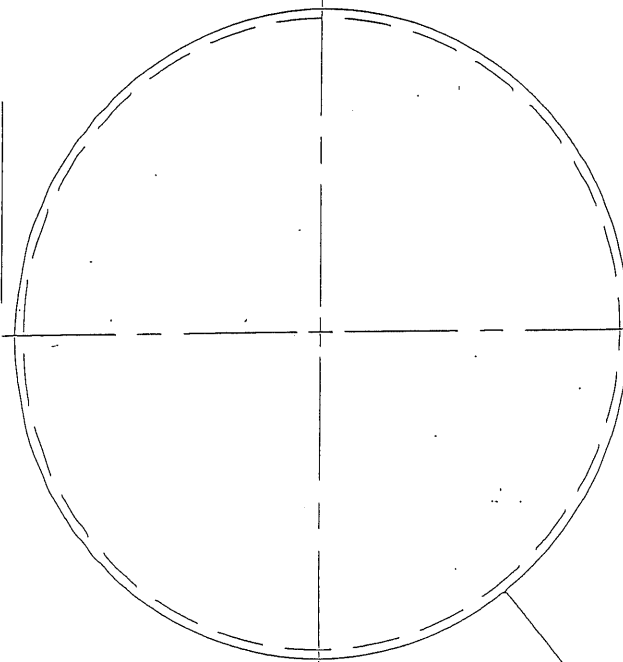


DRAGON ESP, LTD.

FORMED HEAD INCOMING RECEIVING  
DIMENSIONAL CHECK

(#2)

A 600



601 D

601

CIRCUMFERENCE  
OUTSIDE

C 615

TOP VIEW

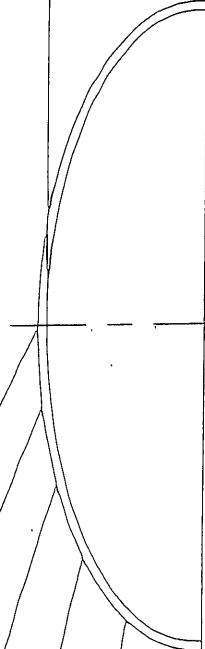
THK. MIC. = 564

THK. MIC. = 542

THK. MIC. = 562

THK. MIC. = 563

THK. MIC. = 554



DEPTH  
INSIDE

DRAWING NO. J2465

SERIAL NO. DP78801

P.O. NO.

COLOR CODE: DFB-BR

HEAT NO. HUN

CIRCUMFERENCE = 19 1/8

DIAMETER = 73"

DEPTH = 20 3/8

NOTE: USE ULTRA-SONIC  
MATERIAL TEST UNIT.

ELEVATION VIEW

# PAINT / BLAST INSPECTION REPORT



PROJECT: ENH/60A  
S/N: 129959

BLAST DATE: 12-1-16  
BLAST PROFILE: 3.1 3.8

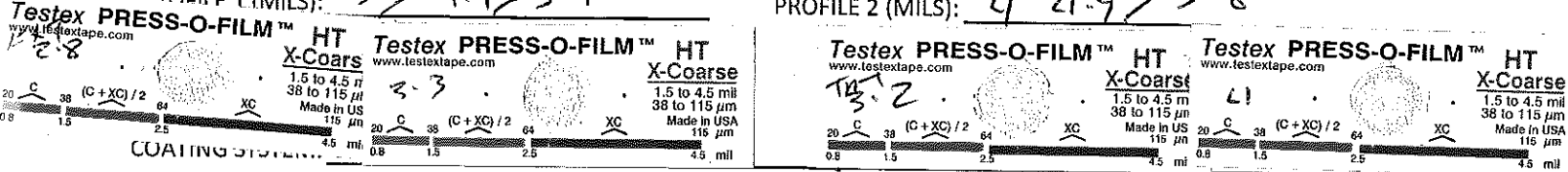
INSPECTOR: CHARLES SMITH  
DESCRIPTION: 6x15

## DAILY CONDITIONS LOG

| DATE    | TIME | AIR TEMP. | SURFACE | DEW PT. | HUMIDITY |
|---------|------|-----------|---------|---------|----------|
| 12-1-16 | 9:00 | 57        | 61      | 38      | 46       |

PROFILE 1 (MILS): 2.8 2.2 3.3 4.1 3.1

PROFILE 2 (MILS): 3.2 3.4 4 4.9 3.8



DATE: 12-1-16

INSPECTOR: CHARLES SMITH

COATING: ENVIROLINE 2405

BATCH NO. RESIN: SK0745UH

BATCH NO. CURE: SK0477UH

DFT NO.1: 

| MIL NO.1 | MIL NO.2 | MIL NO.3 | MIL NO.4 | MIL AVG. |
|----------|----------|----------|----------|----------|
| 15.8     | 22.4     | 27.4     | 29.7     | 24.8     |

## DAILY CONDITIONS LOG

| DATE    | TIME  | AIR TEMP. | SURFACE | DEW PT. | HUMIDITY |
|---------|-------|-----------|---------|---------|----------|
| 12-1-16 | 10:00 | 72        | 74      | 41      | 41       |

DATE: 12-2-16

INSPECTOR: CHARLES SMITH

COATING: MAGNAPOL 646

BATCH NO. RESIN: XM2286HK

BATCH NO. CURE: XM906CF

DFT NO.2: 

| MIL NO.1 | MIL NO.2 | MIL NO.3 | MIL NO.4 | MIL AVG. |
|----------|----------|----------|----------|----------|
| 5        | 6.1      | 6.4      | 7        | 6.1      |

## DAILY CONDITIONS LOG

| DATE    | TIME | AIR TEMP. | SURFACE | DEW PT. | HUMIDITY |
|---------|------|-----------|---------|---------|----------|
| 12-1-16 | 2:00 | 73        | 74      | 36      | 26       |

DATE: 12-2-16

INSPECTOR: CHARLES SMITH

COATING: Capitol Canyon

BATCH NO. RESIN: XM1806WF

BATCH NO. CURE: MA79165H

DFT NO.3: 

| MIL NO.1 | MIL NO.2 | MIL NO.3 | MIL NO.4 | MIL AVG. |
|----------|----------|----------|----------|----------|
| 9.1      | 9.3      | 12.2     | 12.7     | 10.8     |

## DAILY CONDITIONS LOG

| DATE | TIME | AIR TEMP. | SURFACE | DEW PT. | HUMIDITY |
|------|------|-----------|---------|---------|----------|
| 12-1 | 6:00 | 62        | 66      | 42      | 50       |

## VISUAL INSPECTION

|          | PASS                                | FAIL                     |
|----------|-------------------------------------|--------------------------|
| COLOR    | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| HOLIDAYS | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| DRIPS    | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| BLISTERS | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

## HOLIDAY DETECTION REPORT

| TIME/DATE | PASS                                | FAIL                     | TOUCH UP AREA |
|-----------|-------------------------------------|--------------------------|---------------|
| 12-3-16   | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |
|           | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |
|           | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |
|           | <input checked="" type="checkbox"/> | <input type="checkbox"/> |               |

PROJECT: ENCLOSURE  
S/N: 129959

COMPRESSED AIR, BLOT TEST, 1 MIN. DURATION

TIME 8:00 DATE 12-1-16

BLAST GOOD ✓ BAD            INITIALS JK

PAINT GOOD ✓ BAD            INITIALS JK

BLAST MEDIA CHECK YES ✓ NO            INITIALS JK

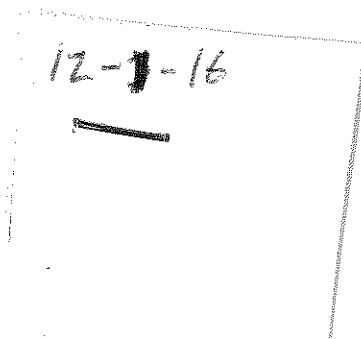
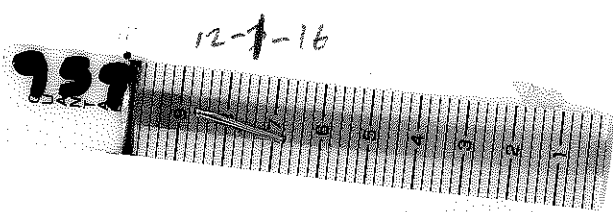
BLAST CLEANING YES ✓ NO            INITIALS JK

CHLORIDE TEST GOOD ✓ BAD            INITIALS JK

STRIPE COAT PAINT REQUIRED            INITIALS JK

YES ✓ NO            INITIALS JK

NOTES:





# PosiTector

## Batch 129959

### 129959 Information

Created: 2016-06-17 11:10:00  
Gage S/N: 746423  
Probe Type: SPG  
Probe S/N: 223692

### 129959 Notes

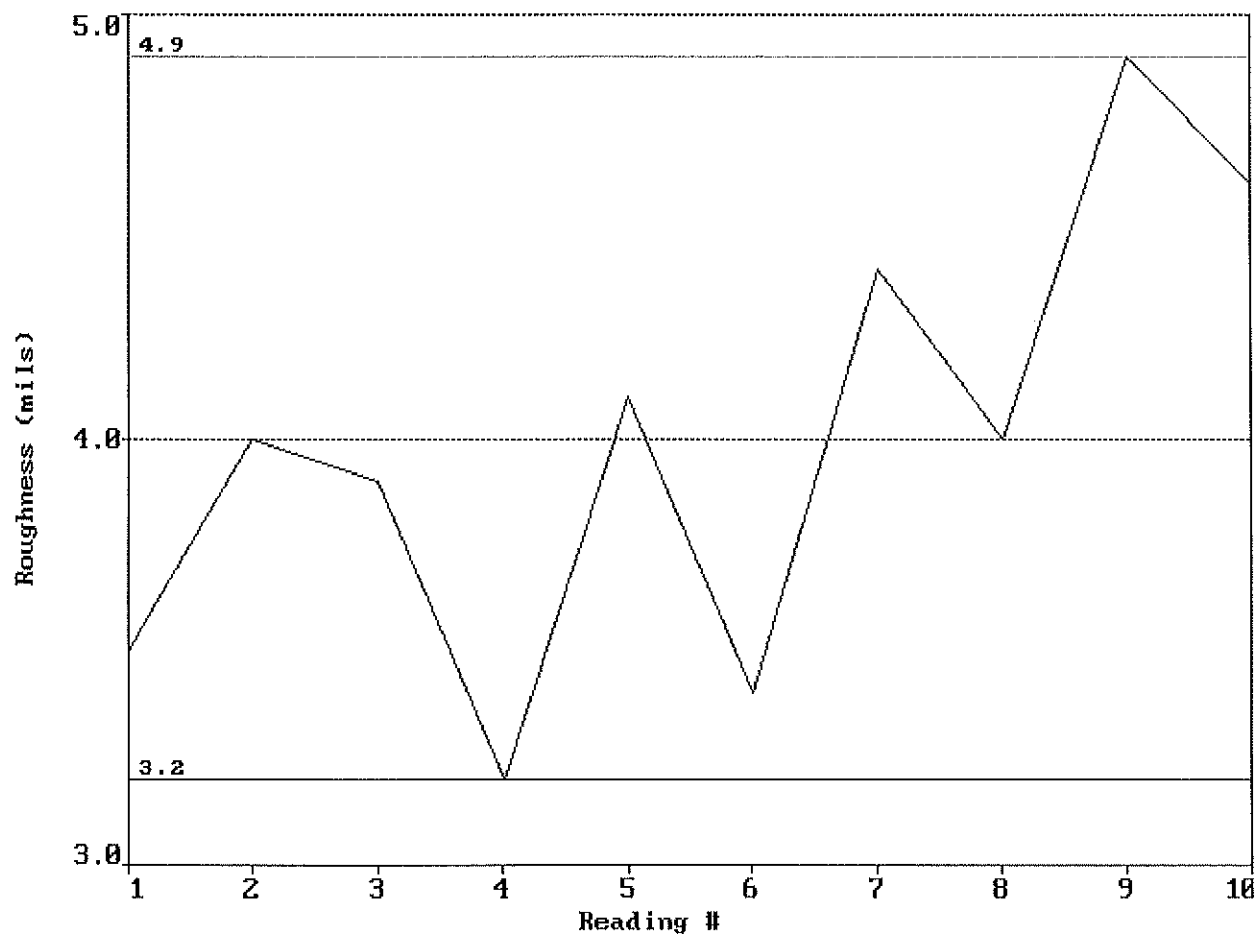
int blast

### 129959 Summary

| #  | Σ    | σ    | μ   | τ   |
|----|------|------|-----|-----|
| 10 | 4.00 | 0.54 | 3.2 | 4.9 |

### 129959 Readings

| #  |          |                     |
|----|----------|---------------------|
| 1  | 3.5 mils | 2016-06-17 11:10:02 |
| 2  | 4.0 mils | 11:10:19            |
| 3  | 3.9 mils | 11:10:40            |
| 4  | 3.2 mils | 11:10:41            |
| 5  | 4.1 mils | 11:10:46            |
| 6  | 3.4 mils | 11:10:48            |
| 7  | 4.4 mils | 11:10:55            |
| 8  | 4.0 mils | 11:10:57            |
| 9  | 4.9 mils | 11:10:59            |
| 10 | 4.6 mils | 11:11:03            |

**129959 Chart**[Home](#)



# PosiTector

## Batch 129959

### 129959 Information

Created: 2016-06-17 11:13:28  
Gage S/N: 746423  
Probe Type: SPG  
Probe S/N: 223692

### 129959 Notes

ext blast

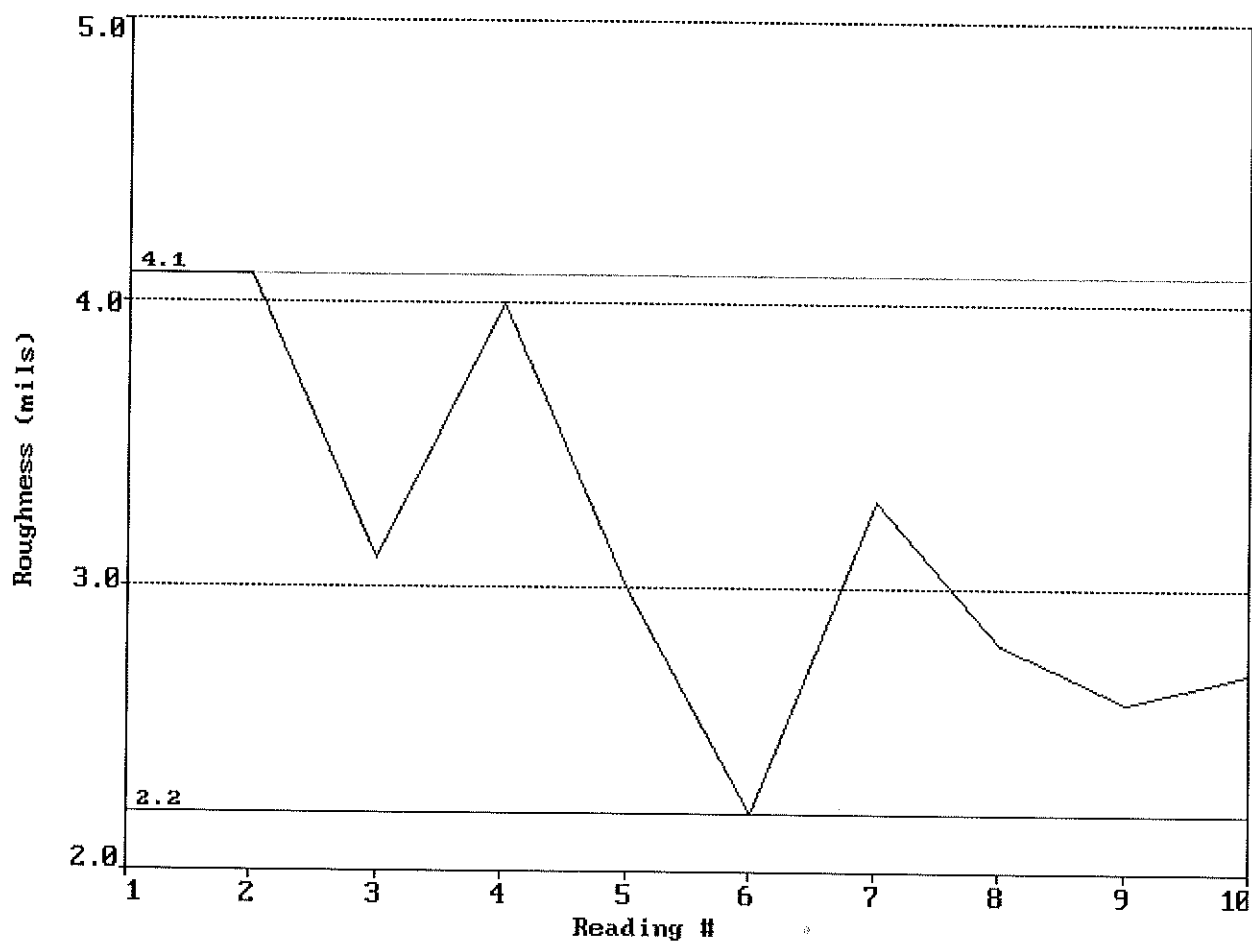
### 129959 Summary

| #  | Ȳ    | σ    | ȳ   | ȳ   |
|----|------|------|-----|-----|
| 10 | 3.19 | 0.67 | 2.2 | 4.1 |

### 129959 Readings

| #  |          |                     |
|----|----------|---------------------|
| 1  | 4.1 mils | 2016-06-17 11:13:41 |
| 2  | 4.1 mils | 11:13:46            |
| 3  | 3.1 mils | 11:13:48            |
| 4  | 4.0 mils | 11:13:52            |
| 5  | 3.0 mils | 11:13:53            |
| 6  | 2.2 mils | 11:13:55            |
| 7  | 3.3 mils | 11:13:57            |
| 8  | 2.8 mils | 11:13:59            |
| 9  | 2.6 mils | 11:14:00            |
| 10 | 2.7 mils | 11:14:02            |



**129959 Chart**[Home](#)



# PosiTector

## Batch 129959

### 129959 Information

Created: 2016-12-02 12:16:26  
Gage S/N: 771357  
Probe Type: FRS  
Probe S/N: 277317  
CAL: Cal 1

### 129959 Notes

Int finish

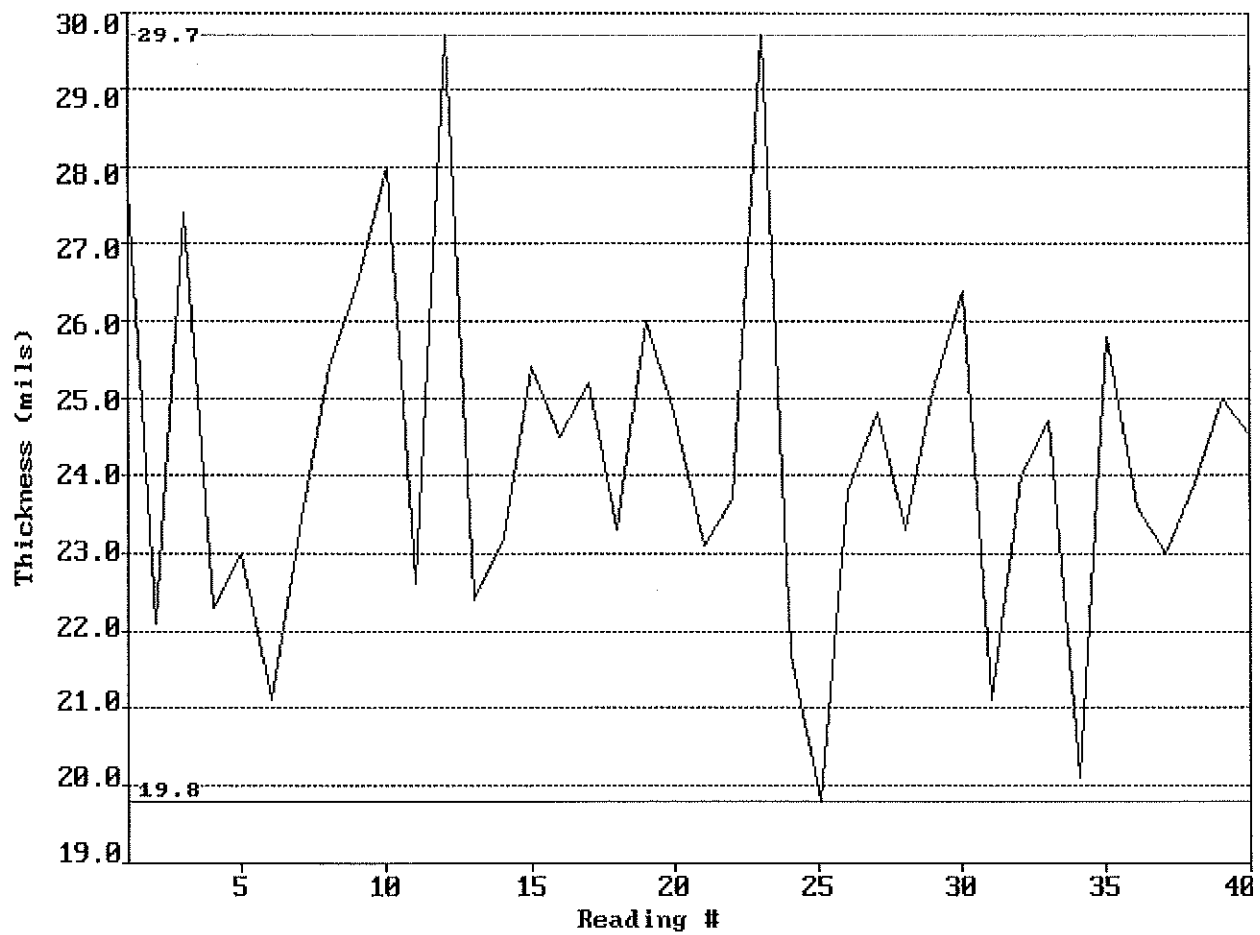
### 129959 Summary

| #  | $\bar{x}$ | $\sigma$ | $\bar{y}$ | $\bar{z}$ |
|----|-----------|----------|-----------|-----------|
| 40 | 24.27     | 2.28     | 19.8      | 29.7      |

### 129959 Readings

| #  |           |                     |
|----|-----------|---------------------|
| 1  | 27.7 mils | 2016-12-02 12:16:29 |
| 2  | 22.1 mils | 12:16:30            |
| 3  | 27.4 mils | 12:16:32            |
| 4  | 22.3 mils | 12:16:34            |
| 5  | 23.0 mils | 12:16:36            |
| 6  | 21.1 mils | 12:16:40            |
| 7  | 23.3 mils | 12:16:41            |
| 8  | 25.4 mils | 12:16:44            |
| 9  | 26.5 mils | 12:16:45            |
| 10 | 28.0 mils | 12:16:47            |
| 11 | 22.6 mils | 12:17:02            |
| 12 | 29.7 mils | 12:17:04            |
| 13 | 22.4 mils | 12:17:06            |
| 14 | 23.2 mils | 12:17:08            |
| 15 | 25.4 mils | 12:17:08            |
| 16 | 24.5 mils | 12:17:10            |

|    |           |          |
|----|-----------|----------|
| 17 | 25.2 mils | 12:17:10 |
| 18 | 23.3 mils | 12:17:11 |
| 19 | 26.0 mils | 12:17:16 |
| 20 | 24.8 mils | 12:17:17 |
| 21 | 23.1 mils | 12:17:19 |
| 22 | 23.7 mils | 12:17:20 |
| 23 | 29.7 mils | 12:17:21 |
| 24 | 21.7 mils | 12:17:22 |
| 25 | 19.8 mils | 12:17:23 |
| 26 | 23.8 mils | 12:17:24 |
| 27 | 24.8 mils | 12:17:25 |
| 28 | 23.3 mils | 12:17:26 |
| 29 | 25.1 mils | 12:17:27 |
| 30 | 26.4 mils | 12:17:28 |
| 31 | 21.1 mils | 12:17:30 |
| 32 | 24.0 mils | 12:17:32 |
| 33 | 24.7 mils | 12:17:33 |
| 34 | 20.1 mils | 12:17:34 |
| 35 | 25.8 mils | 12:17:36 |
| 36 | 23.6 mils | 12:17:39 |
| 37 | 23.0 mils | 12:17:40 |
| 38 | 23.9 mils | 12:17:41 |
| 39 | 25.0 mils | 12:17:42 |
| 40 | 24.5 mils | 12:17:43 |

**129959 Chart**[Home](#)



# PosiTector

## Batch 129959

### 129959 Information

|             |                     |
|-------------|---------------------|
| Created:    | 2016-12-03 08:49:44 |
| Gage S/N:   | 771357              |
| Probe Type: | FRS                 |
| Probe S/N:  | 277317              |
| CAL:        | Cal 1               |

### 129959 Notes

ext primer

### 129959 Summary

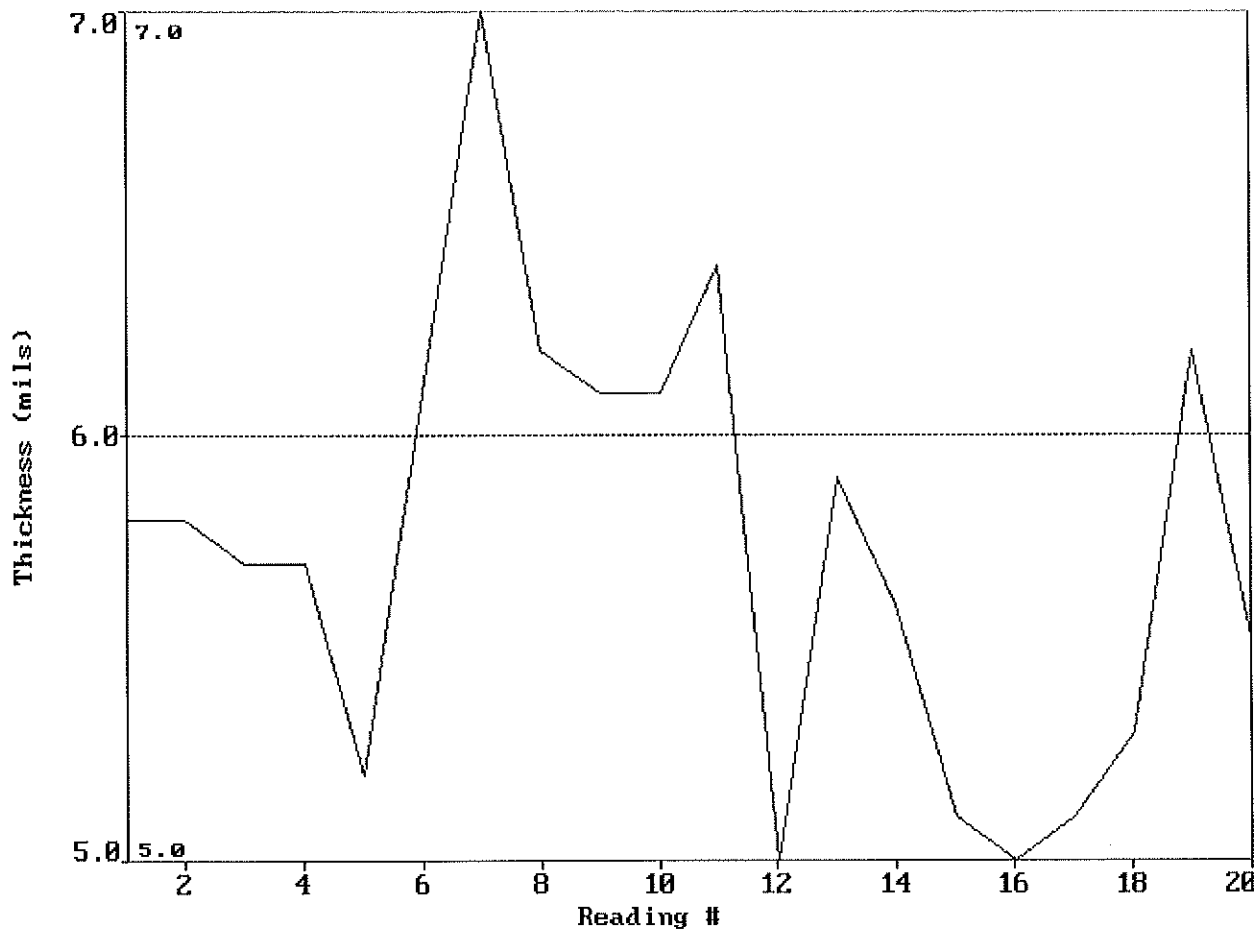
|    |           |          |              |            |
|----|-----------|----------|--------------|------------|
| #  | $\bar{x}$ | $\sigma$ | $\downarrow$ | $\uparrow$ |
| 20 | 5.74      | 0.53     | 5.0          | 7.0        |

### 129959 Readings

|    |          |                     |
|----|----------|---------------------|
| #  |          |                     |
| 1  | 5.8 mils | 2016-12-03 08:49:49 |
| 2  | 5.8 mils | 08:49:52            |
| 3  | 5.7 mils | 08:49:55            |
| 4  | 5.7 mils | 08:50:00            |
| 5  | 5.2 mils | 08:50:03            |
| 6  | 6.1 mils | 08:50:06            |
| 7  | 7.0 mils | 08:50:12            |
| 8  | 6.2 mils | 08:50:15            |
| 9  | 6.1 mils | 08:50:18            |
| 10 | 6.1 mils | 08:50:23            |
| 11 | 6.4 mils | 08:50:28            |
| 12 | 5.0 mils | 08:50:32            |
| 13 | 5.9 mils | 08:52:34            |
| 14 | 5.6 mils | 08:52:40            |
| 15 | 5.1 mils | 08:52:42            |
| 16 | 5.0 mils | 08:52:44            |

|    |          |          |
|----|----------|----------|
| 17 | 5.1 mils | 08:52:46 |
| 18 | 5.3 mils | 08:52:55 |
| 19 | 6.2 mils | 08:52:57 |
| 20 | 5.5 mils | 08:53:03 |

## 129959 Chart



[Home](#)



# PosiTector

## Batch 129959

### 129959 Information

Created: 2016-12-05 08:14:55  
Gage S/N: 771357  
Probe Type: FRS  
Probe S/N: 277317  
CAL: Cal 1

### 129959 Notes

ext finish

### 129959 Summary

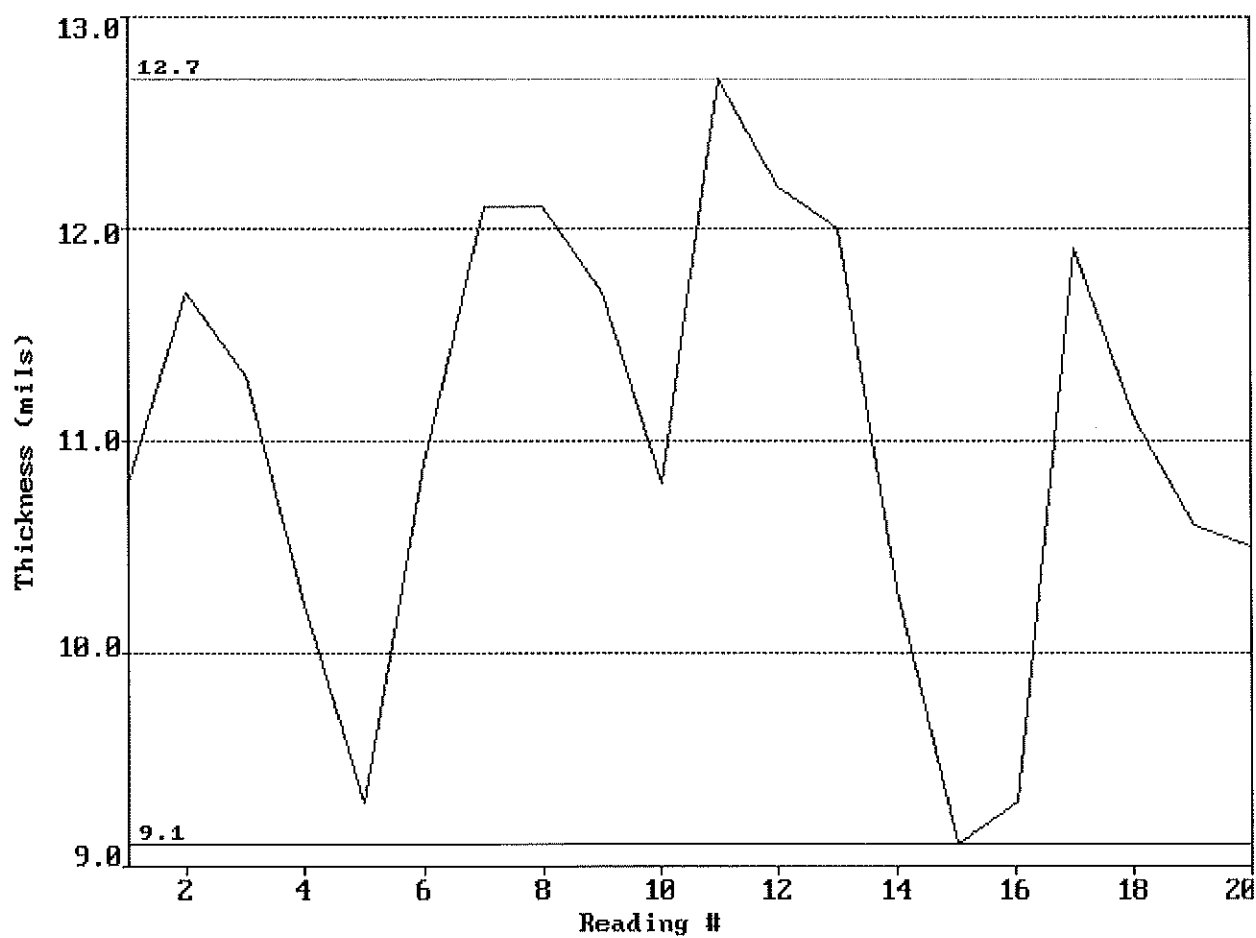
| #  | $\bar{x}$ | $\sigma$ | $\bar{y}$ | $\bar{z}$ |
|----|-----------|----------|-----------|-----------|
| 20 | 11.03     | 1.04     | 9.1       | 12.7      |

### 129959 Readings

| #  |           |                     |
|----|-----------|---------------------|
| 1  | 10.8 mils | 2016-12-05 08:15:08 |
| 2  | 11.7 mils | 08:15:10            |
| 3  | 11.3 mils | 08:15:12            |
| 4  | 10.2 mils | 08:15:17            |
| 5  | 9.3 mils  | 08:15:19            |
| 6  | 10.9 mils | 08:15:21            |
| 7  | 12.1 mils | 08:15:23            |
| 8  | 12.1 mils | 08:15:25            |
| 9  | 11.7 mils | 08:15:29            |
| 10 | 10.8 mils | 08:15:31            |
| 11 | 12.7 mils | 08:15:34            |
| 12 | 12.2 mils | 08:15:36            |
| 13 | 12.0 mils | 08:15:38            |
| 14 | 10.3 mils | 08:15:58            |
| 15 | 9.1 mils  | 08:16:01            |
| 16 | 9.3 mils  | 08:16:03            |

|    |           |          |
|----|-----------|----------|
| 17 | 11.9 mils | 08:16:18 |
| 18 | 11.1 mils | 08:16:20 |
| 19 | 10.6 mils | 08:16:23 |
| 20 | 10.5 mils | 08:16:26 |

## 129959 Chart



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Technician, Level &amp; Date

Customer's Signature (if applicable)

Reviewed By (if applicable)



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Date:

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Page: 4 of 4

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Mistras Job No:

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Purchase Order:

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Tested Item(s):

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Technician, Level &amp; Date

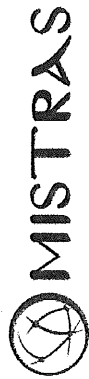
Customer's Signature (if applicable)

Reviewed By (if applicable)

Q: Snowdon Lull. II 11.5.16

Certificate of Inspection, Radiography [Welds]

100-RTFORM-001p2 | Rev 3



# Radiography Examination Report

27 Sawyer St. | Beaumont, TX 77702 | P: (409) 835-2600; F: (409) 835-1199 [www.mistrasgroup.com](http://www.mistrasgroup.com)

Client: DRACON Location: LB3000-IX Date: 11-14-16 Page: 2 of 3  
Part/Item No: 001 12999 Mistras Job No: 38041:3  
Description: LESSER Purchase Order: 32465

|                                                                                               |                                                                                                               |                                                                                                    |                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code/Specification<br><u>ASME SEC. II</u>                                                     | Acceptance Criteria<br><u>ASME SEC. II</u>                                                                    | Procedure (ID and Rev)<br><u>100.105-001 050.11</u>                                                | Technique<br><input checked="" type="checkbox"/> SWE/SWV <input type="checkbox"/> DWE/SWV <input type="checkbox"/> DWE/DWV                                  |
| Material Type<br><u>CS</u>                                                                    | Weld Joint Type<br><u>SEW</u>                                                                                 | Weld Reinforcement<br><u>.121</u>                                                                  | Radiation Source<br><input checked="" type="checkbox"/> Ir 192 <input type="checkbox"/> Co 60 <input type="checkbox"/> SE 75 <input type="checkbox"/> X-Ray |
| Location Markers<br><input type="checkbox"/> Source-Side <input type="checkbox"/> Film-Side   | IQI Type & ID<br><u>ASTM-1B</u>                                                                               | IQI Location<br><input checked="" type="checkbox"/> Source-Side <input type="checkbox"/> Film-Side | Focal Spot Size<br><u>.160</u>                                                                                                                              |
| Quality Level<br><u>1</u>                                                                     | Shim Thickness<br><u>1</u>                                                                                    | Min. Source-Object Distance<br><u>17"</u>                                                          | Max. Source Side of Object-Film Distance<br><u>26"</u>                                                                                                      |
| Exposure Time<br><u>7:10</u>                                                                  | Film Mfr. & Type<br><u>A08005</u>                                                                             | Screen Thickness<br>Front: <u>0.010</u> Back: <u>0.010</u>                                         | No. of Film & Size<br><u>45x10/17"</u>                                                                                                                      |
| Film Viewing<br><input checked="" type="checkbox"/> Single <input type="checkbox"/> Composite | Film Processing<br><input type="checkbox"/> Automatic <input checked="" type="checkbox"/> Manual: Time (min): | Comments:                                                                                          |                                                                                                                                                             |

| Tested Item(s):            |      |                    |                       |        |        |          |                 |                |                   |                        |       |                |                |          |          |              |               |          |             |              |
|----------------------------|------|--------------------|-----------------------|--------|--------|----------|-----------------|----------------|-------------------|------------------------|-------|----------------|----------------|----------|----------|--------------|---------------|----------|-------------|--------------|
| ID/Weld No.                | View | Original or Repair | Geometric Unsharpness | Accept | Reject | Porosity | Slag/Inclusions | Lack of Fusion | Linear Indication | Incomplete Penetration | Crack | Root Concavity | Root Convexity | Tungsten | Undercut | Weld Contour | Film Artifact | Comments | IQI Density | Weld Density |
| GS-1 7934-9859<br>8x72"    | 1-2  | 0                  |                       | X      | X      | ✓        | X               |                |                   |                        |       |                |                |          |          |              |               |          |             | 2.6          |
| GS-2 6125-9859<br>8x72"    | 1-2  |                    |                       | ✓      |        |          |                 |                |                   |                        |       |                |                |          |          | ✓            |               |          |             | 2.5          |
| GS-2 13 6125-9859<br>8x72" | 1-2  |                    |                       | ✓      |        | ✓        |                 |                |                   |                        |       |                |                |          |          |              |               |          |             | 2.3          |
|                            | 2-3  |                    |                       | ✓      |        |          |                 |                |                   |                        |       |                |                |          |          |              |               |          |             | 2.3          |
| GS-3 7934-9859<br>8x72"    | 1-2  |                    |                       | ✓      |        | ✓        |                 |                |                   |                        |       |                |                |          |          |              |               |          |             | 2.6          |
|                            | 2-3  |                    |                       | ✓      |        |          |                 |                |                   |                        |       |                |                |          |          |              |               |          |             | 2.5          |
|                            |      |                    |                       |        |        |          |                 |                |                   |                        |       |                |                |          |          |              |               |          |             | 1            |

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Technician, Level & Date: D. S. Low 6300 LHA-II 11-14-16  
Reviewed By (if applicable):  
Customer's Signature (if applicable):



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Reviewed By (if applicable)

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Purchase Order: J2465

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Reviewed By (if applicable)

D. Sturgen LVL. II 12.2.16

100-RTFORM-001p2 | Rev 3





National Board Number: 401

Mfg. Representative: JRDate: 11/30/16Authorized Inspector: [Signature]Date: 11/30/16

# **FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS** (Alternate Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)

**As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1**

1. Manufactured and certified by DRAGON PRODUCTS LTD 205 FM 1909 LIBERTY, TX 77575

(Name and address of Manufacturer)

2. Manufactured for ENCANA - DENVER, CO

(Name and address of Purchaser)

3. Location of installation UNKNOWN

(Name and address)

4. Type Horizontal 129959 - 00002465 401 2016  
(Horizontal or vertical, tank) (Manufacturer's serial number) (CRN) (Drawing number) (National Board number) (Year built)5. ASME Code, Section VIII, Division 1 2015 EDITION

[Edition and Addenda, if applicable (date)]

(Code Case numbers)

[Special service per UG-120(d)]

6. Shell SA-516-70 0.625" 0.0625" 72" 180"  
(Material spec. number, grade) (Nominal thickness) (Corr. allow.) (Inner diameter) (Length (overall))

## **Body Flanges on Shells**

| No. | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Location | Bolting    |                  |                      |                 |
|-----|------|----|----|------------|-------------|----------|--------------|----------|------------|------------------|----------------------|-----------------|
|     |      |    |    |            |             |          |              |          | Num & Size | Bolting Material | Washer (OD, ID, thk) | Washer Material |
| -   | -    | -  | -  | -          | -           | -        | -            | -        | -          | -                | -                    | -               |
| -   | -    | -  | -  | -          | -           | -        | -            | -        | -          | -                | -                    | -               |
| -   | -    | -  | -  | -          | -           | -        | -            | -        | -          | -                | -                    | -               |
| -   | -    | -  | -  | -          | -           | -        | -            | -        | -          | -                | -                    | -               |

7. Seams TYPE 1 FULL 100% - TYPE 1 Spot 100% 2  
(Long, welded, dbl., singl., lap, butt) (R. T. (spot or full)) (Eff., %) (H. T. temp.) (Time, hr) (Girth (welded, dbl., singl., lap, butt)) (R. T. (spot or full)) (Eff., %) (No. of courses or full))8. Heads: (a) Material SA-516-70 (b) Material SA-516-70

(Spec. no., grade)

(Spec. no., grade)

|     | Location (Top, Bottom, Ends) | Minimum Thickness | Corrosion Allowance | Crown Radius | Knuckle Radius | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side To Pressure (Convex or Concave) |
|-----|------------------------------|-------------------|---------------------|--------------|----------------|------------------|--------------------|----------------------|---------------|--------------------------------------|
| (a) | LEFT                         | 0.513"            | 0.0625"             | -            | -              | 2:1              | -                  | -                    | -             | CONCAVE                              |
| (b) | RIGHT                        | 0.513"            | 0.0625"             | -            | -              | 2:1              | -                  | -                    | -             | CONCAVE                              |

## **Body Flanges on Heads**

|     | Location | Type | ID | OD | Flange Thk | Min Hub Thk | Material | How Attached | Bolting    |                  |                      |                 |
|-----|----------|------|----|----|------------|-------------|----------|--------------|------------|------------------|----------------------|-----------------|
|     |          |      |    |    |            |             |          |              | Num & Size | Bolting Material | Washer (OD, ID, thk) | Washer Material |
| (a) | -        | -    | -  | -  | -          | -           | -        | -            | -          | -                | -                    | -               |
| (b) | -        | -    | -  | -  | -          | -           | -        | -            | -          | -                | -                    | -               |

9. MAWP 250 PSI 0 PSI at max. temp. 200° F 200° F  
(Internal) (External) (Internal) (External)Min. design metal temp. -20° F at 250 PSI Hydro., pneu., or comb. test pressure 325 PSI

Proof test -

10. Nozzles, inspection, and safety valve openings:

| Purpose (Inlet, Outlet, Drain, etc.) | No. | Diameter or Size | Type | Material |        | Nozzle Thickness |         | Reinforcement Material | Attachment Details |        | Location (Insp. Open.) |
|--------------------------------------|-----|------------------|------|----------|--------|------------------|---------|------------------------|--------------------|--------|------------------------|
|                                      |     |                  |      | Nozzle   | Flange | Nom.             | Corr.   |                        | Nozzle             | Flange |                        |
| Manway/Cvr                           | 1   | 24"-150#         | RFSO | SA-106B  | SA-105 | 0.500"           | 0.0625" | SA-516-70              | TYPE 7             | TYPE 7 | SHELL                  |
| Inlet                                | 1   | 8"-150#          | LWN  | SA-105   | -      | 0.875"           | 0.0625" | -                      | TYPE 7             | -      | HEAD                   |
| Outlet                               | 3   | 3"-150#          | LWN  | SA-105   | -      | 0.625"           | 0.0625" | -                      | TYPE 7             | -      | SHELL                  |
| Water/Oil LLC                        | 2   | 4"-150#          | LWN  | SA-105   | -      | 0.750"           | 0.0625" | -                      | TYPE 7             | -      | SHELL                  |
| Drain                                | 2   | 3"-150#          | LWN  | SA-105   | -      | 0.625"           | 0.0625" | -                      | TYPE 7             | -      | SHELL                  |
| PI                                   | 1   | 1"               | CPLG | SA-105   | -      | 3000#            | 0.0625" | -                      | TYPE 7             | -      | SHELL                  |
| Water/Oil Lvl Gauge                  | 4   | 1"               | CPLG | SA-105   | -      | 3000#            | 0.0625" | -                      | TYPE 7             | -      | SHELL                  |

11. Supports: Skirt NO Lugs NA Legs NA Other SADDLES Attached SHELL/WELDED  
(Yes or no) (Number) (Number) (Describe) (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: -

(Name of part, item number, Manufacturer's name and identifying stamp)

IMPACT EXEMPT PER UG-20(f), SAFETY PER UG-125, SEE ATTACHED U-4

National Board Number: 401

Mfg. Representative: SR

Authorized Inspector: Jim Regis

Date: 11/30/16

Date: 12/15/16

FORM U-1A (Back)

CERTIFICATE OF SHOP / FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 47,938

expires 06/13/17

Date 11/30/16

Co. name DRAGON PRODUCTS LTD

(Manufacturer)

Signed

Jim Regis  
(Representative)

CERTIFICATE OF SHOP / FIELD INSPECTION

Vessel constructed by DRAGON PRODUCTS LTD at 205 FM 1909, LIBERTY, TX 77575

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by ONE CIS INSURANCE COMPANY - LYNN, MA

have inspected the component described in this Manufacturer's Data Report on 11/30/16, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 12/15/16

Signed

Kevin W. Murray  
(Authorized Inspector)

Commissions NB# 9932AN

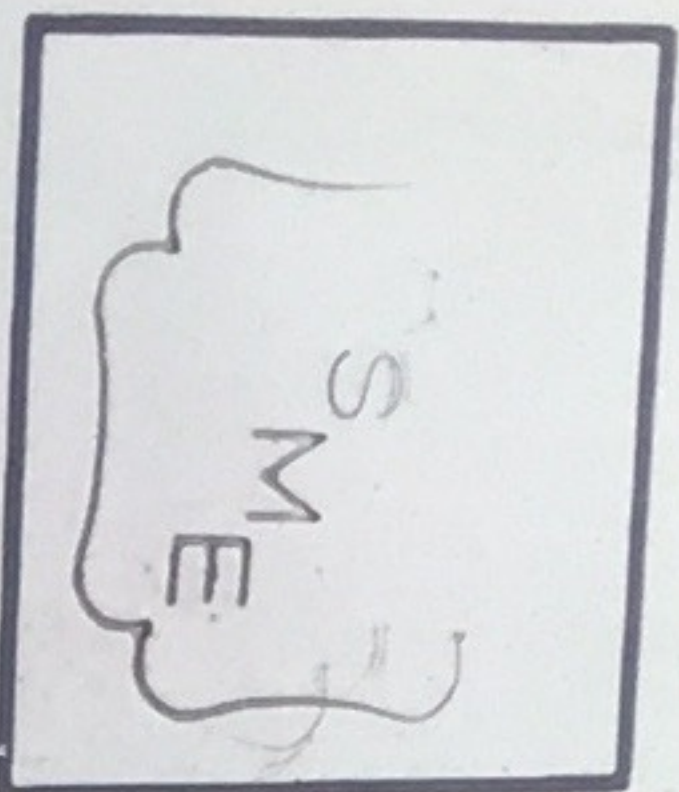
[National Board (incl. endorsements)]











U  
W

RT2

NB

401

CERTIFIED BY:

DRAGON PRODUCTS LTD

MAWP

250

PSI

AT

200

°F

MDMT

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°F AT

250

PSI



DRAGON

129959

SERIAL NO.

2016

YEAR BUILT

325 PSI

TEST PRESS.

11/2016

TEST DATE

72"ID X 180" 3-PHASE SEPARATOR

DRAGON PRODUCTS LTD, BEAUMONT, TEXAS