



# Diversified Technology Services

2045 Preisker Ln. Suite-A - Santa Maria, CA 93454 - (805) 928-6392

Equipment ID Number: **FWKO-111**

Date: **25-Oct-03**

Client: **DTS Client**

Location: **Somewhere USA**

## Pressure Vessel Calculation U-1A Form Information

### MFG Info:

Manufactured By: **Vessel Builder USA**  
 Type: **Horiz** Ser.#: **Unkown** NB. #: **2114** Year Built: **1971**

### Operating Conditions:

MAWP: **60** psi at max temp. **650** °F

### Shell:

Matl.: **SA-516-70** Stress at Temp: **17500** Nom.: **0.375** C/A: **0.0625**  
 Diameter ID **143.25** Eff.(%): **1** Est. M/T: **0.0%**

### Heads:

(A) Matl: **SA-516-70** Stress at Temp: **17500** Eff.(%): **1** Est. M/T: **0.0%**  
 (B) Matl: **SA-516-70** Stress at Temp: **17500** Eff.(%): **1** Est. M/T: **0.0%**

ID	Nominal Thickness	Corrosion Allow	Crown Radius	Knuckle Radius	Elliptical Ratio	Connical Apex Angle	Hemi Radius	Flat Diam.
<b>A</b>	0.500	0.0625	122	10.5				
<b>B</b>	0.500	0.0625	122	10.5				

### Nozzles:

ID	Size	Nominal Thickness	Material	Matl Stress @ temp.	Eff (%)	Est. Mill Tolerance
<b>A</b>	2.0	0.154	A-53-B	18000	1.00	12.5%
<b>B</b>	16.0	0.375	A-53-B	18000	1.00	12.5%
<b>C</b>	24.0	0.375	A-53-B	18000	1.00	12.5%
<b>D</b>						
<b>E</b>						
<b>F</b>						
<b>G</b>						

The Values used in these calculations were defined by U-1A forms supplied by the Owner.  
  
 There was a U-1A form provided for this particular Vessel.

API-510 Inspector: **API Certified Inspector**

Certification Number: **16**



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## Pressure Vessel Calculation Form for Cylindrical Shells

<p><b>Formula:</b></p> $t = \frac{Pr}{SE-0.6P}$	<p style="text-align: right;">Nominal Thickness of Material (Nom) : <u>0.375</u></p> <p>Pressure (MAWP) : <u>60</u> Material Allowable Stress (S): <u>17500</u></p> <p>Joint Efficiency (E): <u>1</u> Vessel ID in inches (D) : <u>143.25</u></p>
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**Variables:**

Fluid Level in feet (FL): <u>4.00</u>	Vessel total height in feet (VH): <u>8.00</u>	Corrosion Allow. (CA): <u>0.0625</u>
Specific Gravity (SG): <u>0.885</u>	Distance from top of Vessel to bottom of Shell Course (DFT): <u>8.00</u>	Mill Tolerance Percentage (MT): <u>0.0%</u>

**Calculations for Variables:**

Static Head:

$$SH = FL - (VH - DFT) \times SG$$

$$SH = 4.00 - (8.00 - 8.00) \times 0.89$$

$$SH = 4.00 - 0.00 \times 0.89$$

$$SH = 4.00 \times 0.885$$

$$SH = 3.540$$

Static Head Compensation for "P"

$$P = MAWP + SH$$

$$P = 60.0 + 3.540$$

$$P = 63.540$$

**Calculation for Pressure t-min.**

$$t = \frac{Pr}{SE-0.6P}$$

$$t = \frac{63.5 \times 71.625}{17500.000 \times 1.000 - 0.600 \times 63.5}$$

$$t = \frac{4551.053}{17500.000 - 38.124}$$

$$t = \frac{4551.053}{17461.876}$$

$$t = 0.261$$

**Calculation for Structural t-min.**

$$t_s = Nom - MT - CA$$

$$t_s = (0.375 - 0.0\%) - 0.063$$

$$t_s = 0.375 - 0.063$$

$$t_s = 0.313$$

Structural t-min based on M/T and C/A only.

$$t_s = 0.313 \text{ Inches}$$

**Pressure t-min Requirements:**

$$t = 0.261 \text{ Inches}$$

Actual Nominal Min Required with C/A

$$t_n = 0.323 \text{ Inches}$$

API-510 Inspector: API Certified Inspector Certification Number: 16



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Equipment ID Number: FWKO-111 Date: 25-Oct-03

Client: DTS Client Location: Somewhere USA

## Pressure Vessel Calculation Form for Torispherical Head (A)

<b>Formula:</b> ASME Sect. VIII Div-1 (1-4(d))  $t = \frac{PLM}{2SE-0.2P}$	<b>Statistics:</b> Nominal Thickness of Material (Nom) : <u>0.500</u> Material Allowable Stress (S) : <u>17500</u> Inside Crown Radius (L) : <u>122</u> Pressure (MAWP) : <u>60</u> Joint Efficiency (E) : <u>1</u>
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<b>Variables:</b> Fluid Level in feet (FL): <u>4.00</u> Specific Gravity (SG): <u>0.885</u>	Vessel total height in feet (VH): <u>8.00</u> Distance from top of Vessel to bottom of Shell Course (DFT): <u>8.00</u>	Torispherical Head Proportion Factor (M): <u>1.6</u> Corrosion Allow. (CA): <u>0.0625</u> Mill Tolerance Percentage (MT): <u>0.0%</u>
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**Calculations for Variables:**

Static Head:

$$SH = FL - (VH - DFT) \times SG$$

$$SH = 4.00 - (8.00 - 8.00) \times 0.89$$

$$SH = 4.00 - 0.00 \times 0.89$$

$$SH = 4.00 \times 0.89$$

$$SH = 3.54$$

Static Head Compensation for "P"

$$P = MAWP + SH$$

$$P = 60.0 + 3.54$$

$$P = 63.5$$

Calculation for L/r to provide factor "M"

$$122 / 10.5 = 11.62$$

**Calculation for Pressure t-min.**

$$t = \frac{PLM}{2SE-0.2P}$$

$$t = \frac{63.5 \times 122 \times 1.60}{35000.000 \times 1.000 - 0.200 \times 63.5}$$

$$t = \frac{12403.008}{35000.000 - 12.708}$$

$$t = \frac{12403.008}{34987.292}$$

$$t = 0.355$$

**Calculation for Structural t-min.**

$$t_s = Nom - MT - CA$$

$$t_s = (0.500 - 0.0\%) - 0.063$$

$$t_s = 0.5 - 0.063$$

$$t_s = 0.438$$

**Structural t-min based on M/T and C/A only.**

$$t_s = 0.438 \text{ Inches}$$

**Pressure t-min Requirements:**

$$t = 0.355 \text{ Inches}$$

**Actual Nominal Min Required with C/A**

$$t_n = 0.417 \text{ Inches}$$

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# Diversified Technology Services

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Equipment ID Number: FWKO-111      Date: 25-Oct-03  
 Client: DTS Client      Location: Somewhere USA

## Pressure Vessel Calculation Form for Cylindrical Nozzles (A)

<b>Formula:</b>  $t = \frac{Pr}{SE-0.6P}$	<b>Statistics:</b> Nominal Thickness of Material (Nom) : <u>0.154</u> Pressure (MAWP) : <u>60</u> Material Allowable Stress (S) : <u>18000</u> Joint Efficiency (E) : <u>1.00</u> Nozzle ID in inches (D) : <u>2</u>
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<b>Variables:</b> Fluid Level in feet (FL): <u>0.00</u> Specific Gravity (SG): <u>0.000</u>	Vessel total height in feet (VH): <u>0.00</u> Distance from top of Vessel to bottom of Shell Course (DFT): <u>0</u>	Corrosion Allow. (CA): <u>0.0625</u> Mill Tolerance Percentage (MT): <u>12.5%</u>
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**Calculations for Variables:**

<u>Static Head:</u> $SH = FL - (VH - DFT) \times SG$ $SH = 0.00 - (0.00 - 0.00) \times 0.00$ $SH = 0.00 - 0.00 \times 0.00$ $SH = 0.00 \times 0.000$ $SH = 0.000$	<u>Static Head Compensation for "P"</u> $P = MAWP + SH$ $P = 60.0 + 0.000$ $P = 60.000$
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**Calculation for Pressure t-min.**

$$t = \frac{Pr}{SE-0.6P}$$

$$t = \frac{60.0 \times 1.000}{18000 \times 1.000 - 0.600 \times 60.0}$$

$$t = \frac{60.000}{18000.000 - 36.000}$$

$$t = \frac{60.000}{17964.000}$$

$$t = 0.003$$

**Calculation for Structural t-min.**

$$t_s = Nom - MT - CA$$

$$t_s = (0.154 - 12.5\%) - 0.063$$

$$t_s = 0.135 - 0.063$$

$$t_s = 0.072$$

Structural t-min based on MT and C/A only.

**$t_s = 0.072$  Inches**

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Pressure t-min Requirements:

**$t = 0.003$  Inches**

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Actual Nominal Min Required with C/A

**$t_n = 0.066$  Inches**

API-510 Inspector:      API Certified Inspector      Certification Number:      16



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Equipment ID Number: FWKO-111 Date: 25-Oct-03

Client: DTS Client Location: Somewhere USA

## Pressure Vessel Calculation Form for Cylindrical Nozzles (B)

<b>Formula:</b>	$t = \frac{Pr}{SE-0.6P}$	<b>Statistics:</b>	Nominal Thickness of Material (Nom) : <u>0.375</u>
			Pressure (MAWP) : <u>60</u> Material Allowable Stress (S) : <u>18000</u> Joint Efficiency (E) : <u>1.00</u> Nozzle ID in inches (D) : <u>16</u>

<b>Variables:</b>	Fluid Level in feet (FL) : <u>0.00</u>	Vessel total height in feet (VH) : <u>0.00</u>	Corrosion Allow. (CA) : <u>0.0625</u>
Specific Gravity (SG) : <u>0.000</u>	Distance from top of Vessel to bottom of Shell Course (DFT) : <u>0</u>	Mill Tolerance Percentage (MT) : <u>12.5%</u>	

### Calculations for Variables:

#### Static Head:

$$SH = FL - (VH - DFT) \times SG$$

$$SH = 0.00 - (0.00 - 0.00) \times 0.00$$

$$SH = 0.00 - 0.00 \times 0.00$$

$$SH = 0.00 \times 0.000$$

$$SH = 0.000$$

#### Static Head Compensation for "P"

$$P = MAWP + SH$$

$$P = 60.0 + 0.000$$

$$P = 60.000$$

#### Calculation for Pressure t-min.

$$t = \frac{Pr}{SE-0.6P}$$

$$t = \frac{60.0 \times 8.000}{18000 \times 1.000 - 0.600 \times 60.0}$$

$$t = \frac{480.000}{18000.000 - 36.000}$$

$$t = \frac{480.000}{17964.000}$$

$$t = 0.027$$

#### Calculation for Structural t-min.

$$t_s = Nom - MT - CA$$

$$t_s = (0.375 - 12.5\%) - 0.063$$

$$t_s = 0.328 - 0.063$$

$$t_s = 0.266$$

#### Structural t-min based on M/T and C/A only.

$$t_s = 0.266 \text{ Inches}$$

#### Pressure t-min Requirements:

$$t = 0.027 \text{ Inches}$$

#### Actual Nominal Min Required with C/A

$$t_n = 0.089 \text{ Inches}$$

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## Pressure Vessel Calculation Form for Cylindrical Nozzles (C)

<b>Formula:</b>  $t = \frac{Pr}{SE-0.6P}$	<b>Statistics:</b> Nominal Thickness of Material (Nom) : <u>0.375</u> Pressure (MAWP) : <u>60</u> Material Allowable Stress (S) : <u>18000</u> Joint Efficiency (E) : <u>1.00</u> Nozzle ID in inches (D) : <u>24</u>
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<b>Variables:</b> Fluid Level in feet (FL): <u>0.00</u> Specific Gravity (SG): <u>0.000</u>	Vessel total height in feet (VH): <u>0.00</u> Distance from top of Vessel to bottom of Shell Course (DFT): <u>0</u>	Corrosion Allow. (CA): <u>0.0625</u> Mill Tolerance Percentage (MT): <u>12.5%</u>
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**Calculations for Variables:**

<u>Static Head:</u> $SH = FL - (VH - DFT) \times SG$ $SH = 0.00 - (0.00 - 0.00) \times 0.00$ $SH = 0.00 - 0.00 \times 0.00$ $SH = 0.00 \times 0.000$ $SH = 0.000$	<u>Static Head Compensation for "P"</u> $P = MAWP + SH$ $P = 60.0 + 0.000$ $P = 60.000$
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**Calculation for Pressure t-min.**

$$t = \frac{Pr}{SE-0.6P}$$

$$t = \frac{60.0 \times 12.000}{18000 \times 1.000 - 0.600 \times 60.0}$$

$$t = \frac{720.000}{18000.000 - 36.000}$$

$$t = \frac{720.000}{17964.000}$$

$$t = 0.040$$

**Calculation for Structural t-min.**

$$t_s = Nom - MT - CA$$

$$t_s = (0.375 - 12.5\%) - 0.063$$

$$t_s = 0.328 - 0.063$$

$$t_s = 0.266$$

Structural t-min based on MT and C/A only.

**$t_s = 0.266$  Inches**

**Pressure t-min Requirements:**

**$t = 0.040$  Inches**

**Actual Nominal Min Required with C/A**

**$t_n = 0.103$  Inches**

API-510 Inspector:      API Certified Inspector      Certification Number:      16