# ASME SEC. VIII DIV.1 STRENGTH CALCULATION

## CYLINDERICAL SHELL THICKNESS FOR INT/EXT & NOZZLE LOAD

***INPUT DATA*** 계산실행 ***1.0***

| | | | | | |
|---|---|---|---|---|---|
| * DESCRIPTION | PES21 | | * ITEM NO. | E-1004 | |
| | | | DESIGN DATA | | |
| * INTERNAL DESIGN PRESSURE | 4.5 | Kg/cm^2 | * EXTERNAL DESIGN PRESSURE | 1.05 | Kg/cm^2 |
| * INSIDE RADIUS (CORRODED) | 1524 | mm | * JOINT EFFICIENCY | 1.0 | |
| * CORROSION ALLOWANCE | 3 | mm | * DESIGN TEMPERATURE | 300 | ºF |
| * MATERIAL | A516-70 | | * DESIGN LENGTH FOR EXTERNAL PRESSURE CHECK | 2438 | mm |
| * SHELL USED THICKNESS | 13 | mm | * NOZZLE SIZE ATTACHING IN SHELL | 3"(DN75) | |
| * NOZZLE THICKNESS, tn | 13 | mm | * FLANGE RATING | 150# | |
| * REINFORCING PAD RADIUS, ro | 203.2 | mm | * REINFORCING PAD THICKNESS, tp | 13 | |

***RESULT OF CALCULATION***

RESULT OF THICKNESS CALCULATION

| | | | |
|---|---|---|---|
| * Used thickness check for internal pressure | O.K | * Used thickness check for external pressure | O.K |
| | | * Used thickness check for nozzle load & local stress | O.K |

1. THICKNESS FOR INTERNAL PRESSURE

[A] Per UG-27 (C)(1) CIRCUMFERENTIAL STRESS (LONG.SEAM)

| | | |
|---|---|---|
| * Allowable stress @ Design Temp. | 1,406.1 | Kg/cm^2 |

| | | | | | |
|---|---|---|---|---|---|
| * Allowable stress @ Room Temp | 1,406.1 | Kg/cm^2 | * Circumferential stress, P < 0.385 SE = | 541.4 | Kg/cm^2 |
| * Min. required thickness ; t1 = PR/(SE-0.6P) | 4.89 | mm | * Stress check | O.K | |

[B] Per UG-27 (C)(2) LONGITUDINAL STRESS (CIRCUM.SEAM)

| | | | | | |
|---|---|---|---|---|---|
| * Circumferential stress, P < 1.25 SE = | 1,757.7 | Kg/cm^2 | | | |
| * Min. required thickness ; t2 = PR/(2SE+0.4P) | 2.44 | mm | * Stress check | O.K | |

[C] MINIMUM DESIGN TH'K

| | | | | | |
|---|---|---|---|---|---|
| * Shell Min. required Thickness, t = The larger of t1 or t2 or t3 + C | 7.89 | mm | * Shell Mininum thickness as per UG-16(b), t3+C | 4.60 | mm |
| * MAWP(HOTD)=SEt-C/R+0.6t-C | 9.2 | Kg/cm^2 | ** MAWP(NEW&COLD)=SEt/R+0.6t | 12.0 | Kg/cm^2 |

2. THICKNESS FOR EXTERNAL PRESSURE

| | | | | | |
|---|---|---|---|---|---|
| * The ratio of outside dia./Shell thickness, Ratio1 | 306.8 | | * Modulus Elasticity | 2,038,903 | Kg/cm^2 |
| * The ratio of design length /outside dia., Ratio2 | 0.795 | | * Factor "A" | 0.0003125 | |
| * Max. allowable external pressure,(4*Factor "B")/(3*Ratio1) | 1.360 | Kg/cm^2 | * Factor "B" | 313 | |

3. NOZZLE NOAD CALCULATION

| | | | | | |
|---|---|---|---|---|---|
| * Radial Nozzle Force, P | 367.2 | Kg | * Circumferential Moment, MC | 55.1 | Kg-m |
| | | | * Longitudinal Moment, ML | 71.4 | Kg-m |
| * Gamma (λ) = Rm / T, (T=Ts-CA) | 66.26 | | * Beta(β) =0.875*ro / Rm = | 0.117 | |

2. RESULT OF X-STRESS CALCULATION, Kg/cm^2

| Applicable Formulars | FIG NO | Curve Value | Au | AL | Bu | BL | Cu | CL | Du | DL |
|---|---|---|---|---|---|---|---|---|---|---|
| Local | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Membrane(p) =Kn*{Nφ/(P/Rm)}*(P/Rm*T) | 3C | 6.8 | - | - | - | - | -7.1 | -7.1 | -7.1 | -7.1 |
| Local Membrane(P) =Kn*{Nφ/(P/Rm)}*(P/Rm*T) | 4C | 12.5 | -13.1 | -13.1 | -13.1 | -13.1 | - | - | - | - |
| Bending(P)=Kb*{Mφ/P}*(6*P/T^2) | 1C | 0 | - | - | - | - | 0.0 | 0.0 | 0.0 | 0.0 |
| Bending(P)=Kb*{Mφ/P}*(6*P/T^2) | 2C-1 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | - | - | - | - |
| Local Membrane(Mc) =Kn*{Mφ/(Mc/Rm^2β)}*(Mc/Rm^2βT) | 3A | 0 | - | - | - | - | 0.0 | 0.0 | 0.0 | 0.0 |
| Bending(Mc) =Kb*{Mφ/(Mc/Rmβ)}*(6*Mc/RmβT^2) | 1A | 0 | - | - | - | - | 0.0 | 0.0 | 0.0 | 0.0 |
| Local Membrane(ML) =Kn*{Mφ/(ML/Rm^2β)}*(ML/Rm^2βT) | 3B | 7.568 | -86.7 | -86.7 | 86.7 | 86.7 | - | - | - | - |
| Bending(ML) =Kb*{Mφ/(ML/Rmβ)}*(6*ML/RmβT^2) | 1B-1 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | - | - | - | - |
| Membrane(Pd) =Pd*Rm/T | | | 298.2 | 298.2 | 298.2 | 298.2 | 298.2 | 298.2 | 298.2 | 298.2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Add algebraically for summation of σφ (Circumferential) | | | 198.4 | 198.4 | 371.8 | 371.8 | 291.1 | 291.1 | 291.1 | 291.1 |
| Calculated Membrane Stress, mx | | | 198.4 | 371.8 | | | 291.1 | | 291.1 | |

3. RESULT OF Y-STRESS CALCULATION, Kg/cm^2

| Applicable Formulars | FIG NO | Curve Value | Au | AL | Bu | BL | Cu | CL | Du | DL |
|---|---|---|---|---|---|---|---|---|---|---|
| Local Membrane(P) =Kn*{NΨ/(P/Rm)}*(P/Rm*T) | 3C | 6.8 | -7.1 | -7.1 | -7.1 | -7.1 | - | - | - | - |
| Local Membrane(P) =Kn*{NΨ/(P/Rm)}*(P/Rm*T) | 4C | 12.5 | - | - | - | - | -13.1 | -13.1 | -13.1 | -13.1 |
| Bending(P)=Kb*{MΨ/P}*(6*P/T^2) | 1C-1 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | - | - | - | - |
| Bending(P)=Kb*{MΨ/P}*(6*P/T^2) | 2C | 0 | - | - | - | - | 0.0 | 0.0 | 0.0 | 0.0 |
| Local Membrane(Mc) =Kn*{MΨ/(Mc/Rm^2β)}*(Mc/Rm^2βT) | 4A | 4.392 | - | - | - | - | -38.8 | -38.8 | 38.8 | 38.8 |
| Bending(Mc) =Kb*{MΨ/(Mc/Rmβ)}*(6*Mc/RmβT^2) | 2A | 0.0436 | - | - | - | - | -153.2 | 153.2 | 153.2 | -153.2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Local Membrane(ML) =Kn*{MΨ/(ML/Rm^2β)}*(ML/Rm^2βT) | 4B | 2.617 | -30.0 | -30.0 | 30.0 | 30.0 | - | - | - | - |
| Bending(ML) =Kb*{MΨ/(ML/Rmβ)}*(6*ML/RmβT^2) | 2B-1 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | - | - | - | - |
| Membrane(Pd) =Pd*Rm/(2*T) | | | 149.1 | 149.1 | 149.1 | 149.1 | 149.1 | 149.1 | 149.1 | 149.1 |
| Add algebraically for summation of σΨ (Longitudinal) | | | 112.0 | 112.0 | 171.9 | 171.9 | -56.0 | 250.4 | 328.0 | 21.6 |
| Calculated Membrane Stress, my | | | 112.0 | | 171.9 | | 97.2 | | 174.8 | |
| Shear stress due to Torsion, Mt | Mt / (2 *π * ro ^ 2 * T) | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Shear stress due to Torsion, Vc | Vc / (2 *π * ro * T) | | 0.0 | 0.0 | 0.0 | 0.0 | - | - | - | - |
| Shear stress due to Torsion, VL | VL / (2 *π * ro * T) | | - | - | - | - | 0.0 | 0.0 | 0.0 | 0.0 |
| Add algebraically for summation of Shear Stress,τφΨ | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| MEMBRANE + BENDING STRESS INTENSITIES AT THE NOTED LOCATION, When τ ≠ 0, S= The largest absolute value of either, 0.5{(σΨ+σφ)± √(σΨ+σφ)^2+4τφΨ^2} or √(σΨ+σφ)^2+4τφΨ^2 | | | 198.4 | 198.4 | 371.8 | 371.8 | 291.1 | 291.1 | 328.0 | 291.1 |
| | | | 112.0 | 112.0 | 171.9 | 171.9 | 56.0 | 250.4 | 291.1 | 21.6 |
| | | | 86.4 | 86.4 | 199.8 | 199.8 | 347.1 | 40.7 | 37.0 | 269.4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| MAX. COMBINED STRESS INTENSITY, Primary(Pm+PL), Smax = | 198.4 | 198.4 | 371.8 | 371.8 | 347.1 | 291.1 | 328.0 | 291.1 |
| Allowable Stress, Smax = 3*Sm | 4,218.4 | 4,218.4 | 4,218.4 | 4,218.4 | 4,218.4 | 4,218.4 | 4,218.4 | 4,218.4 |
| Judgement | O.K | O.K | O.K | O.K | O.K | O.K | O.K | O.K |
| MEMBRANE INTENSITIES AT THE NOTED LOCATION, | 198.4 | 198.4 | 371.8 | 371.8 | 291.1 | 291.1 | 291.1 | 291.1 |
| When $\tau \neq 0$, S= The largest absolute value of either, 0.5 {( my+mx)±√( my+mx)^2+4τφΨ^2} | 112.0 | 112.0 | 171.9 | 171.9 | 20.6 | 173.8 | 251.4 | 98.2 |
| or √( my+mx)^2+4τφΨ^2 | 86.4 | 86.4 | 199.8 | 199.8 | 193.9 | 193.9 | 116.2 | 116.2 |
| MAX. MEMBRANE STRESS INTENSITY, Primary+Secondary), Smax = | 198.4 | 198.4 | 371.8 | 371.8 | 291.1 | 291.1 | 291.1 | 291.1 |
| Allowable Stress, Smax = 1.5*Sm | 2,109.2 | 2,109.2 | 2,109.2 | 2,109.2 | 2,109.2 | 2,109.2 | 2,109.2 | 2,109.2 |
| Judgement | O.K | O.K | O.K | O.K | O.K | O.K | O.K | O.K |

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