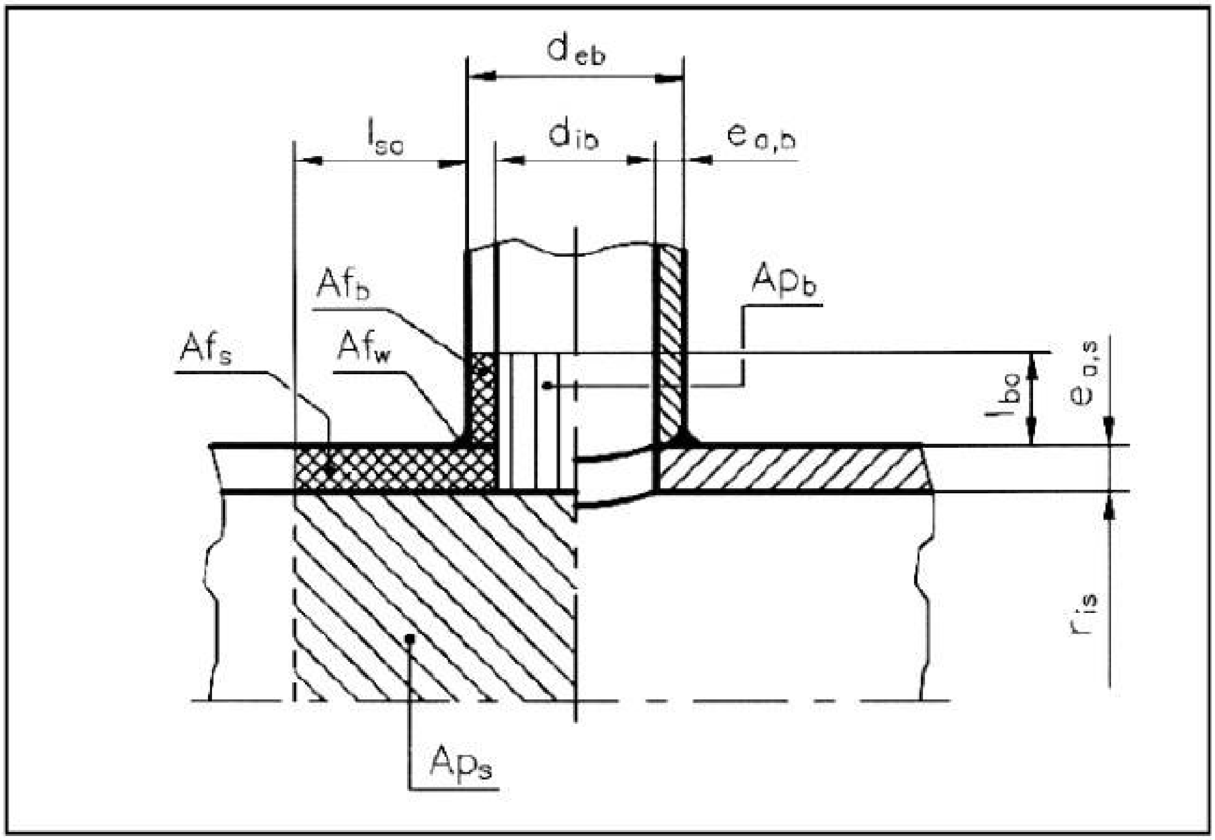

Figure 9.4-7 Cylindrical shell with isolated opening and set-on nozzle

EN13445-3 Section 9. Nozzles In Cylindrical Shells

$P := 0.5$ Design Pressure

$fs := 120$ Design Stress Shell

$fb := 90$ Design Stress Nozzle

$fp := 0$ Design Stress Of Pad

$e_{cs} := 10$ Assumed thickness of Shell wall, can be taken as ea $e_{as} := e_{cs}$

$e_{ab} := 8$ Nozzle Thickness

$di := 100$ Inside Diameter Of Branch

$Di := 1200$ Inside Diameter Of Shell (taken at centre of branch for a cone)

$\alpha := 0$ Half included cone angle (0 for a cylinder)

$Protrusion := 0$ Nozzle Protrusion Into Shell

$Seton := 1$ Branch Set-on if = 1, else 0

$Afp := 0$ Area Of Pad Within distance Iso (Pad thickness < ShellThickness)

$Afw := 5\cdot\frac{5}{2}$ All Fillet Weld Areas within reinforcement limit

==

$r_{is} := \frac{Di}{2} + e_{as}$ Shell Radius $r_{is} = 610$

ISo = Length of Reinforcement along Shell

$Iso := \sqrt{\left(2\cdot r_{is} + e_{cs}\right)\cdot e_{cs}}$ $Iso = 110.905$

IBo = Length of Reinforcement along Branch

$Ibo := \sqrt{\left[\left(di + 2\cdot e_{ab}\right) - e_{ab}\right]\cdot e_{ab}}$ $Ibo = 29.394$

$Ibi := 0.5\cdot Ibo$ Nozzle Protrusion

$Ibi := if(Ibi > Protrusion, Protrusion, Ibi)$ $Ibi = 0$

Apb & Aps For Set in and set on Nozzles In Cylinders or Cones

$Apb := 0.5 \cdot di \cdot (Ibo + e_{as})$ $\qquad$ $Apb = 1969.694$

$a := 0.5 \cdot (di + 2 \cdot e_{as})$ $\qquad$ $As_s := r_{is} \cdot (Iso + a)$ $\qquad$ Cylinders

$As_c := 0.5 \cdot (Iso + a) \cdot \left[r_{is} + \left[r_{is} + (Iso + a) \cdot \tan\left(\frac{\alpha \cdot \pi}{180}\right) \right] \right]$ $\qquad$ Cones

$Aps := if(\alpha = 0, As_s, As_c)$ $\qquad$ $Aps = 1.043 \cdot 10^5$

Set In Nozzle

$Afs_{in} := e_{cs} \cdot Iso$

$Afb_{in} := e_{ab} \cdot (Ibo + Ibi + e_{as})$

Set On Nozzle

$Afs_{on} := e_{cs} \cdot (Iso + e_{ab})$

$Afb_{on} := e_{ab} \cdot Ibo$

$Afs := if(Seton = 1, Afs_{on}, Afs_{in})$ $\qquad$ $Afs = 1.189 \cdot 10^3$

$Afb := if(Seton = 1, Afb_{on}, Afb_{in})$ $\qquad$ $Afb = 235.151$

$f_{ob} := if(fs < fb, fs, fb)$ $\qquad$ $f_{op} := if(fs < fp, fs, fp)$

$Ap\phi := 0$

Check Adequacy Of Branch Compensation

$RHS := (Afs + Afw) \cdot (fs - 0.5 \cdot P) + Afp \cdot (f_{op} - 0.5 \cdot P) + Afb \cdot (f_{ob} - 0.5 \cdot P)$

$LHS := P \cdot (Aps + Apb + 0.5 \cdot Ap\phi)$

$RHS = 164990.85$ $\qquad$ > = $\qquad$ $LHS = 53110.98$

Check Limits in Fig 9.4-14 and 9.4-15.
If it fails Fig 9.4-14, the branch thickness, for the purposes of calculations, can be reduced.

9.6 Multiple Openings

The Minimum Length of a Ligament Between two adjacent openings

$$Ligament := if\left[0.2\cdot\sqrt{(2\cdot r_{is} + e_{cs})} > 3\cdot e_{as}, 0.2\cdot\sqrt{(2\cdot r_{is} + e_{cs})}, 3\cdot e_{as}\right] \qquad Ligament = 30$$

If the Ligament is greater than this value, then the Distance Iso for each nozzle may have to be reduced to fit.

9.7 Openings Close to aShell Discontinuity, Cylinders

Wmin, is the minimum distance between the top of an opening in a cylindrical shell to a discontinuity. The discontinuity can be the end of the shell, junction of a cone or dished head.

$$W_{min} := if\left[0.2\cdot\sqrt{(2\cdot r_{is} + e_{cs})} > 3\cdot e_{as}, 0.2\cdot\sqrt{(2\cdot r_{is} + e_{cs})}, 3\cdot e_{as}\right] \qquad W_{min} = 30$$

Note If distance W is greater than Wmin but less than the calculated distance Iso, Iso must be reduced to the value of W for all the above calculations.

Wmin, If the opening is in cylindrical section of the small end of a cone or in a the side of a nozzle, then the distance between the top or bottom of the opeining to the outside diameter of a shell or discontinuity.

$$W_{min} := \sqrt{(Di - e_{as})\cdot e_{as}} \qquad W_{min} = 109.087$$

Wmin, If the shell is fitted with an expansion joint the distance between the top or bottom of the opeining and the end of the shell (Not the joint).

$$W_{min} := \frac{\sqrt{(Di - e_{as})\cdot e_{as}}}{2} \qquad W_{min} = 54.544$$

Note If distance W is greater than Wmin but less than the calculated distance Iso + Wmin, Iso must be reduced to the value of W-Wmin for all the above calculations.