Approval Date: May 20, 1998

See Numeric Index for expiration and any reaffirmation dates.

Case 2261
Alternative Rules for Design of Ellipsoidal and Torispherical Formed Heads Section VIII, Division 2

Inquiry: For Section VIII, Division 2 vessels, may torispherical and ellipsoidal formed heads subjected to internal pressure be designed to rules other than those given in AD-204.2, AD-204.3 AD-204.4, and AD-204.5?

Reply: It is the opinion of the Committee that Section VIII, Division 2 torispherical and ellipsoidal formed heads subjected to internal pressure may be designed using the following rules in lieu of those given in AD-204.2, AD-204.3, AD-204.4, and AD-204.5.

(a) Nomenclature

E_T= Modulus of elasticity at maximum design temperature, psi. The value of E_T for all materials shall be taken from Section II, Part D, Tables TM-1, 2, 3, 4, or 5. If the maximum design temperature is greater than that shown in the above Tables, then use the value of E_T corresponding to the maximum temperature given in the above Tables.

E_{RT}= Modulus of elasticity at 70°F, psi. The value of modulus of elasticity for all materials shall be taken from Section II, Part D, Tables TM-1, 2, 3, 4, or 5.

See AD-200.1 for other nomenclature.

(b) Torispherical Heads. The minimum required thickness of a torispherical head having $0.002 \le t/L \le 0.06$ shall be the larger of the thicknesses calculated by the following formulas (1) and (2).

$$t = \frac{0.5PLM}{S - 0.25P} \quad (1)$$

$$t = \frac{3\ PLKE_{RT}}{4\ S_a E_T} \quad (2)$$

The value of S_a shall be 115,000 psi for all ferrous and nonferrous materials except for aluminum, aluminum alloys, copper, copper alloys and titanium, for which the value of S_a shall be calculated by the following formula (3).

$$S_a = \frac{115{,}000 \times E_{RT}}{30 \times 10^6} \quad (3)$$

The value of M shall be obtained from Table 1. Interpolation may be used for r/D values which fall within the range of the tabulated values. No extrapolation of the values is permitted.

The value of K shall be obtained from Table 2. Interpolation may be used for r/D values which fall

TABLE 1

t/L	M for $r/D = 0.06$	M for $r/D = 0.07$	M for $r/D = 0.08$	M for $0.08 < r/D \le 0.2$
0.002	1.00	1.00	1.00	1.00
0.004	1.00	1.00	1.00	1.00
0.006	1.28	1.00	1.00	1.00
0.008	1.41	1.20	1.00	1.00
0.010	1.41	1.26	1.10	1.00
0.012	1.38	1.25	1.13	1.00
0.016	1.31	1.21	1.12	1.00
0.020	1.25	1.17	1.08	1.00
0.030	1.14	1.08	1.01	1.00
0.040	1.07	1.01	1.00	1.00
0.060	1.00	1.00	1.00	1.00

TABLE 2

t/L	K for $r/D =$ 0.06	K for $r/D =$ 0.08	K for $r/D =$ 0.10	K for $r/D =$ 0.14	K for $r/D =$ 0.17	K for $r/D =$ 0.20
0.002	7.87	6.29	5.24	3.95	3.31	2.81
0.004	6.77	5.60	4.69	3.49	2.93	2.50
0.006	6.04	5.14	4.38	3.27	2.73	2.33
0.008	5.51	4.78	4.14	3.13	2.60	2.21
0.010	5.11	4.49	3.93	3.02	2.51	2.13
0.012	4.79	4.25	3.76	2.93	2.44	2.06
0.016	4.31	3.87	3.47	2.77	2.33	1.97
0.020	3.96	3.58	3.24	2.63	2.24	1.91
0.030	3.48	3.10	2.84	2.37	2.07	1.79
0.040	3.32	2.97	2.69	2.23	1.95	1.72
0.060	3.12	2.80	2.56	2.17	1.92	1.71

within the range of the tabulated values. No extrapolation of the values is permitted.

For designs where $t/L > 0.06$, the thickness shall be set by the rules of AD-202. In AD-202 formulas, R shall be replaced by L.

(c) Ellipsoidal Heads. The minimum required thickness of an ellipsoidal head with $D/2h$ ratio less than or equal to 2.0 shall be established as an equivalent torispherical head using the rules given in (b) above. An acceptable approximation of a 2:1 ellipsoidal head is one with a knuckle radius of $0.17D$ and a spherical radius of $0.9D$.

(d) Crown and knuckle radii shall meet the rules given in AD-204.4.

(e) Integral head-skirt designs shall meet the rules of UG-32(1) of ASME Section VIII, Division 1. All transition joints shall be in accordance with AD-420 and Fig. AD-420.2.

(f) Size of the finished openings in the knuckle area shall not exceed the lesser of $2\frac{3}{8}$ in. or 0.5 r. For an ellipsoidal head, the knuckle area is the area located outside a circle whose center coincides with the center of the head and whose diameter is equal to 80% of the head inside diameter.

(g) All other applicable Code requirements shall be met.

(h) This Case number shall be shown on the Manufacturer's Data Report.