PG-31 UNSTAYED FLAT HEADS AND COVERS

PG-31.1 The minimum thickness of unstayed flat heads, cover plates, and blind flanges shall conform to the requirements given in this paragraph. These requirements apply to both circular and noncircular heads and covers. Some acceptable types of flat heads and covers are shown in Figure PG-31. In this figure, the dimensions of the welds do not include any allowances for corrosion and/or erosion; additional weld metal should be provided where these allowances are applicable.

PG-31.2 The notations used in this paragraph and in Figure PG-31 are defined as follows:

- \( C \) = a factor depending on the method of attachment of head and on the shell, pipe, or header dimensions, and other items as listed in PG-31.4 below, dimensionless. The factors for welded covers also include a factor of 0.667 that effectively increases the allowable stress for such constructions to 1.55.
- \( D \) = long span of noncircular heads or covers measured perpendicular to short span
- \( d \) = diameter, or short span, measured as indicated in Figure PG-31
- \( h_c \) = gasket moment arm, equal to the radial distance from the center line of the bolts to the line of the gasket reaction, as shown in Figure PG-31, illustrations (j) and (k)
- \( L \) = perimeter of noncircular bolted head measured along the centers of the bolt holes
- \( l \) = length of flange of flanged heads, measured from the tangent line of knuckle, as indicated in Figure PG-31, illustrations (a) and (c)
- \( m \) = the ratio \( t_r/t_s \), dimensionless
- \( P \) = maximum allowable working pressure
- \( r \) = inside corner radius on a head formed by flanging or forging
- \( S \) = maximum allowable stress value, using values given in Section II, Part D, Subpart 1, Table 1A
- \( t \) = minimum required thickness of flat head or cover
- \( t_{1r} \) = throat dimension of the closure weld, as indicated in Figure PG-31, illustration (r)
- \( t_r \) = nominal thickness of the flange on a forged head, at the large end, as indicated in Figure PG-31, illustration (b-1)
- \( t_n \) = nominal thickness of flat head or cover
- \( t_r \) = thickness required for pressure of seamless shell, pipe, or header
- \( t_s \) = minimum specified thickness of shell, pipe, or header
- \( t_w \) = thickness through the weld joining the edge of a head to the inside of a drum, pipe, or header, as indicated in Figure PG-31, illustrations (g-1) and (g-2)
- \( W \) = total bolt load, as further defined in PG-31.3.2
- \( Z \) = a factor for noncircular heads and covers that depends on the ratio of short span to long span, as given in PG-31.3, dimensionless

\( K = 0.2 \text{ in. (5 mm)} = \text{Influence Coefficient for Figure PG-31, illustration (s)} \)
Figure PG-31
Some Acceptable Types of Unstayed Flat Heads and Covers

GENERAL NOTE: The above illustrations are diagrammatic only. Other designs that meet the requirements of PG-31 will be acceptable.

NOTES:
(1) For illustrations (e), (f), and (g-1) circular covers, \( C = 0.33 \); noncircular covers, \( C = 0.33 \).
(2) Use PG-31.3.3 eq (2) or PG-31.3.3 eq (5).
(3) When pipe threads are used, see Table PG-39.
Figure PG-31, illustration (r): $C = 0.33$ for circular plates having a dimension $d$ not exceeding 18 in. (450 mm) inserted into the shell, pipe, or header and welded as shown, and otherwise meeting the requirements for welded boiler drums including postweld heat treatment but omitting volumetric examination. The end of the shell, pipe, or header shall be crimped over at least 30 deg, but not more than 45 deg. The crimping may be done cold only when this operation will not injure the metal. The throat of the weld shall be not less than the thickness of the flat head or the shell, pipe, or header, whichever is greater.

Figure PG-31, illustration (s): $C = 0.33$ for circular beveled plates having a diameter, $d$, not exceeding 18 in. (450 mm) inserted into a shell, pipe, or header, the end of which is crimped over at least 30 deg, but not more than 45 deg, and when the undercutting for seating leaves at least 80% of the shell thickness. The beveling shall be not less than 75% of the head thickness. The crimping shall be done when the entire circumference of the cylinder is uniformly heated to the proper forging temperature for the material used. For this construction, the ratio $t_s/d$ shall be not less than the ratio $P/S$ nor less than 0.05. The maximum allowable working pressure for this construction shall not exceed $P = S K / d$.