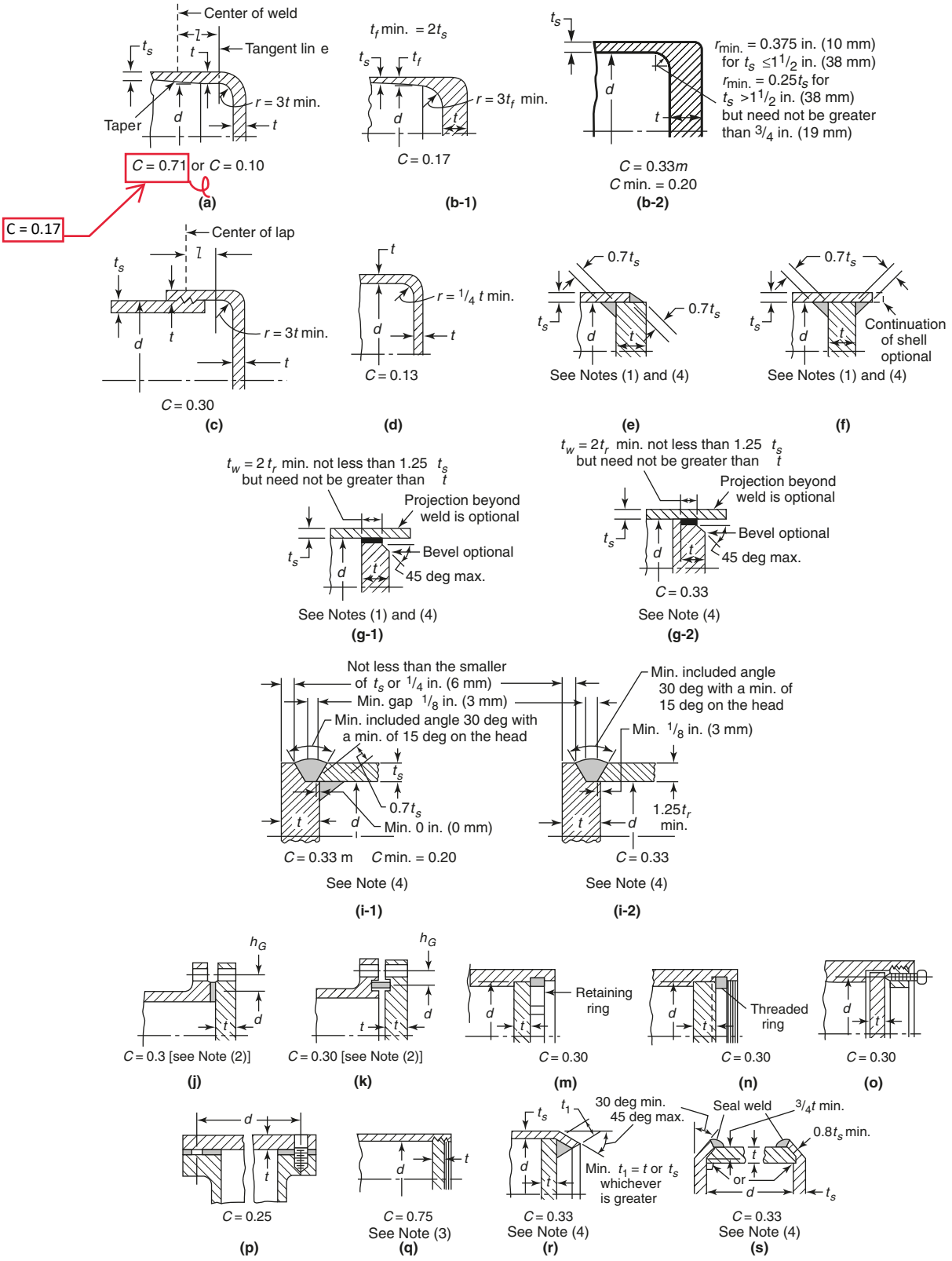
(23)

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.

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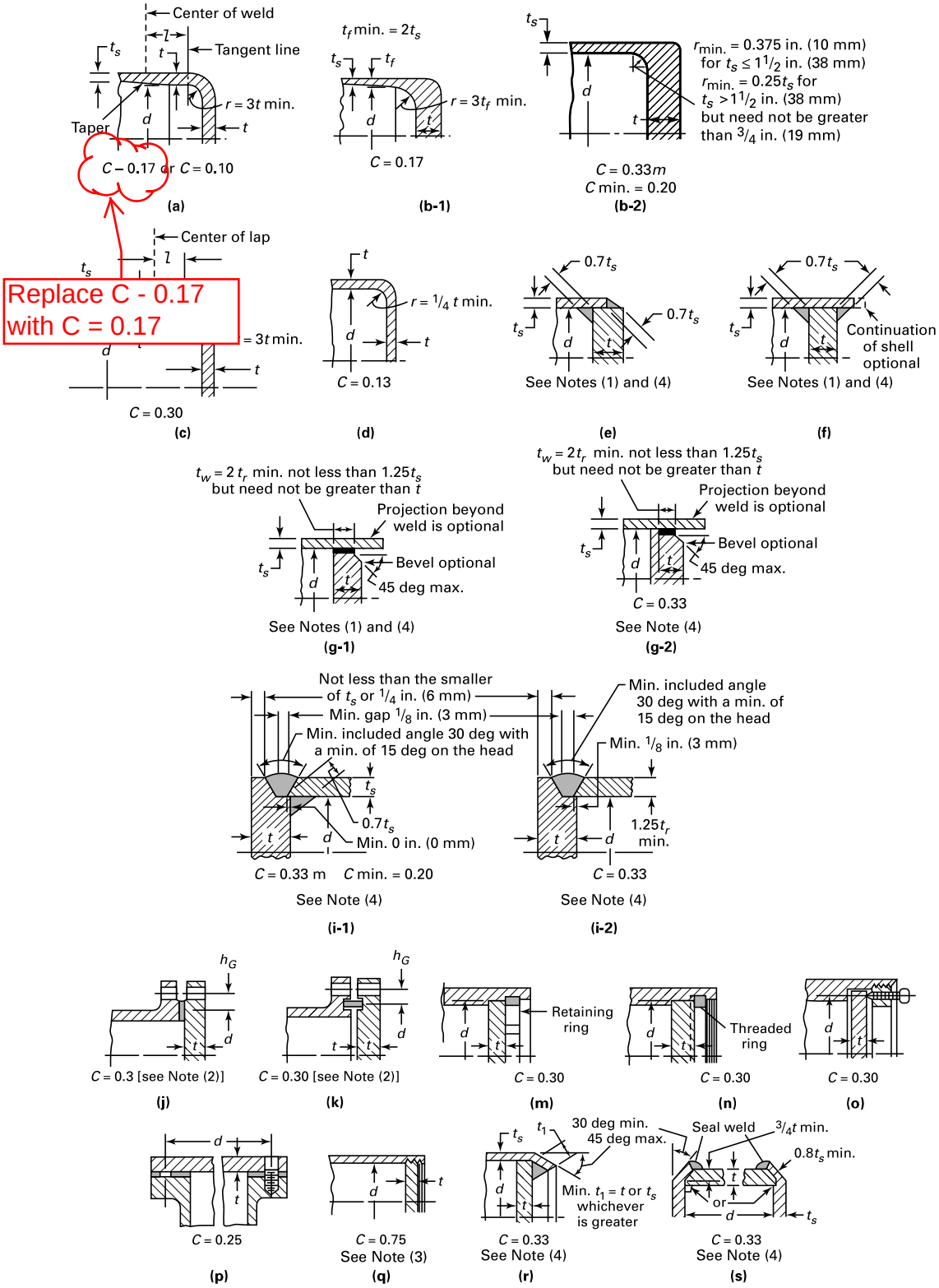
Figure PG-31
Some Acceptable Types of Unstayed Flat Heads and Covers



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

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Figure PG-31
Some Acceptable Types of Unstayed Flat Heads and Covers (Cont'd)

NOTES:
(1) For illustrations (e), (f), and (g-1) circular covers, $C = 0.33m$, C min. = 0.20; noncircular covers, $C = 0.33$.
(2) Use PG-31.3.2 eq. (2) or PG-31.3.3 eq. (5).
(3) When pipe threads are used, see Table PG-39.
(4) Volumetric examination is not required for any of the weld joints shown in illustrations (e), (f), (g-1), (g-2), (i-1), (i-2), (r), and (s).

value of P shall be the maximum allowable working pressure, the value of S at design temperature shall be used, and W shall be the sum of the bolt loads required to resist the end pressure load and to maintain tightness of the gasket.[8] For gasket seating, P equals zero, the value of S at atmospheric temperature shall be used, and W shall be the average of the required bolt load and the load available from the bolt area actually used.

PG-31.3.3 Flat unstayed heads, covers, or blind flanges may be square, rectangular, elliptical, obround, segmental, or otherwise noncircular. Their required thickness shall be calculated by the following equation:

$$t = d\sqrt{ZCP/S} \quad (3)$$

where

$$Z = 3.4 - \frac{2.4d}{D} \quad (4)$$

with the limitation that Z need not be greater than $2\frac{1}{2}$.

Equation (3) does not apply to noncircular heads, covers, or blind flanges attached by bolts causing a bolt edge moment [Figure PG-31, illustrations (j) and (k)]. For noncircular heads of this type, the required thickness shall be calculated by the following equation:

$$t = d\sqrt{(ZCP/S) + \left(6Wh_G/SLd^2\right)} \quad (5)$$

When using eq. (5), the thickness t shall be calculated in the same way as specified above for PG-31.3.2 eq. (2).

(21) **PG-31.4** For the types of construction shown in Figure PG-31, the minimum values of C to be used in PG-31.3.2 eq. (1), PG-31.3.2 eq. (2), PG-31.3.3 eq. (3), and PG-31.3.3 eq. (5) are:

Figure PG-31, illustration (a): $C = 0.17$ for flanged circular and noncircular heads forged integral with or buttwelded to the shell, pipe, or header, with an inside corner radius not less than three times the required head thickness, with no special requirement with regard to length of flange, and where the welding meets all the requirements for circumferential joints given in Part PW. The forged head shall meet the requirements of PW-17.

$C = 0.10$ for circular heads, where the flange length for heads of the above design is not less than

$$l = \left(1.1 - 0.8\frac{t_s^2}{t_h^2}\right)\sqrt{dt_h} \quad (6)$$

When $C = 0.10$ is used, the slope of the tapered sections shall be no greater than 1:3.

Figure PG-31, illustration (b-1): $C = 0.17$ for circular and noncircular heads forged integral with or buttwelded to the shell, pipe, or header, where the corner radius on the inside is not less than three times the thickness of the flange and where the welding meets all the requirements for circumferential joints given in Part PW. The forged head shall meet the requirements of PW-17.

Figure PG-31, illustration (b-2): $C = 0.33m$ but not less than 0.20 for forged circular and noncircular heads integral with or butt welded to the shell, pipe, or header, where the hubbed flange thickness is not less than the shell thickness, and the corner radius on the inside is not less than the following:

$r_{min} = 0.375$ in. (10 mm) for $t_s \le 1\frac{1}{2}$ in. (38 mm)

$r_{min} = 0.25t_s$ for $t_s > 1\frac{1}{2}$ in. (38 mm) but need not be greater than $\frac{3}{4}$ in. (19 mm)

The welding shall meet all requirements for circumferential joints in Part PW. The forged head shall meet the requirements of PW-17.

Figure PG-31, illustration (c): $C = 0.30$ for circular flanged plates screwed over the end of the shell, pipe, or header, with inside corner radius not less than $3t$, in which the design of the threaded joint against failure by shear, tension, or compression, resulting from the end force due to pressure, is based on a factor of safety of at least 4, and the threaded parts are at least as strong as the threads for standard piping of the same diameter. Seal welding may be used, if desired.

Figure PG-31, illustration (d): $C = 0.13$ for integral flat circular heads when the dimension d does not exceed 24 in. (600 mm); the ratio of thickness of the head to the dimension d is not less than 0.05 nor greater than 0.25; the head thickness t_h is not less than the shell thickness t_s, the inside corner radius is not less than $0.25t$; and the construction is obtained by special techniques of upsetting and spinning the end of the shell, pipe, or header, such as are employed in closing header ends.

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