ND-3329.6 Dimensions of Staybolts.

(a) The required area of a staybolt at its minimum cross section and exclusive of any allowance for corrosion shall be obtained by dividing the load on the staybolt, computed in accordance with (b) below, and by increasing the allowable stress value by a factor of 1.10 for the material used (Section II, Part D, Subpart 1, Tables 1A and 1B).

NOTE: The minimum cross section is usually at the root of the thread.

(b) The area supported by a stay shall be computed on the basis of the full pitch dimensions, with a deduction for the area occupied by the stay. The load carried by a stay is the product of the area supported by the stay and the maximum allowable pressure.

(c) Stays made of parts joined by welding shall be designed using a joint efficiency of 0.60 for the weld.

ND-3330 OPENINGS AND REINFORCEMENT

ND-3331 General Requirements for Openings

(a) Openings in cylindrical or conical portions of vessels or in formed heads shall preferably be circular, elliptical, or obround. When the long dimension of an elliptical or obround opening exceeds twice the short dimensions, the reinforcement across the short dimensions shall be increased as necessary to provide against excessive distortion due to twisting moment.

(b) Openings may be of other shapes than those given in (a) above, and all corners shall be provided with a suitable radius. When the openings are of such proportions that their strength cannot be computed with assurance of accuracy or when doubt exists as to the safety of a vessel with such openings, the part of the vessel affected shall be subjected to a proof hydrostatic test as prescribed in ND-6900.

(c) See below.

(1) The rules for reinforcement of openings given in ND-3330 are intended to apply to openings not exceeding the following:

(-a) for vessels 60 in. (1 500 mm) diameter and less: one-half the vessel diameter but not to exceed 20 in. (500 mm);

(-b) for vessels over 60 in. (1 500 mm) diameter: one-third the vessel diameter but not to exceed 40 in. (1 000 mm).

(2) Larger openings shall be given special attention. Two-thirds of the required reinforcement shall be within 1/4 the thickness required by the allowable stress for the material used (Section II, Part D, Subpart 1, Tables 1A and 1B) and by multiplying the result by 1.10.

(d) All references to dimensions in ND-3330 apply to the finished dimensions, excluding material added as corrosion allowance.

(e) Any type of opening may be located in a welded joint.

ND-3332 Reinforcement Requirements for Openings in Shells and Formed Heads

ND-3332.1 Openings Not Requiring Reinforcement.

Reinforcement shall be provided in amount and distribution such that the requirements for area of reinforcement are satisfied for all planes through the center of the opening and normal to the surface of the vessel, except that single circular openings need not be provided with reinforcement if the openings have diameters equal to or less than NPS 2 (DN 50).

ND-3332.2 Required Area of Reinforcement. The total cross-sectional area of reinforcement \( A \) required in any given plane for a vessel under internal pressure shall not be less than

\[
A = \frac{dK}{F}
\]

where

\[
d = \text{finished diameter of a circular opening or finished dimension (chord length) of an opening on the plane being considered for elliptical and obround openings in corroded condition}
\]

\[
F = \text{a correction factor which compensates for the variation in pressure stresses on different planes with respect to the axis of a vessel. A value of 1.00 shall be used for all configurations except that Figure ND-3332.2-1 may be used for integrally reinforced openings in cylindrical shells and cones.}
\]

\[
t_r = \text{the required thickness of a shell or head computed in accordance with the rules of this Article for the Design Pressure, except that:}
\]

(a) when the opening and its reinforcement are entirely within the spherical portion of a torispherical head, \( t_r \) is the thickness required by ND-3324.8(b), using \( E = 1 \) and \( M = 1 \);

(b) when the opening is in a cone, \( t_r \) is the thickness required for a seamless cone of diameter \( D \) measured where the nozzle axis pierces the inside wall of the cone;

(c) when the opening and its reinforcement are in an ellipsoidal head and are located entirely within a circle the center of which coincides with the center of the head and the diameter of which is equal to 80% of the shell diameter, \( t_r \) is the thickness required for a seamless sphere of radius \( K_1D \), where \( D \) is the shell diameter and \( K_1 \) is given by Table ND-3332.2-1.