service by the methods of NE-3221.5(e) using the design fatigue curve of Fig. I-9.4, provided the requirements of (1), (2), and (3) below are met.

(1) The maximum value of the service stress (NE-3232.2) at the periphery of the bolt cross section (resulting from direct tension plus bending) and neglecting stress concentration shall not exceed 2.75S_m, if the higher of the two fatigue design curves given in Fig. I-9.4 is used. The 2.75S_m limit for direct tension is unchanged.

(2) Threads shall be of a V-type having a minimum thread root radius no smaller than 0.003 in. (0.08 mm).

(3) Fillet radii at the end of the shank shall be such that the ratio of fillet radius to shank diameter is not less than 0.060.

(c) Fatigue Strength Reduction Factor (NE-3213.17). Unless it can be shown by analysis or tests that a lower value is appropriate, the fatigue strength reduction factor used in the fatigue evaluation of threaded members shall not be less than 4.0. However, when applying the rules of NE-3232.3(b) for high-strength alloy steel bolts, the value used shall not be less than 4.

(d) Effect of Elastic Modulus. Multiply S_m (as determined in NE-3216.1 or NE-3216.2) by the ratio of the modulus of elasticity given on the design fatigue curve to the value of the modulus of elasticity used in the analysis. Enter the applicable design fatigue curve at this value on the ordinate axis and find the corresponding number of cycles on the abscissa. If the service cycle being considered is the only one which produces significant fluctuating stresses, this is the allowable number of cycles.

(e) Cumulative Damage. The bolts shall be acceptable for the specified cyclic application of loads and thermal stresses provided the cumulative usage factor U as determined in NE-3221(e)(5) does not exceed 1.0.

NE-3236 Design Stress Values

The design stress intensity values S_m and allowable stress values S are 1.1 times the values given in Section II, Part D, Subpart 1, Table 3 for bolting. Values for intermediate temperatures may be found by interpolation. The basis for establishing stress values is given in Appendix III.

NE-3300 DESIGN BY FORMULA

NE-3310 DESIGN CRITERIA

NE-3311 Requirements for Acceptability

Rules are provided in this Subarticle for Design Loadings and Levels A and B Service Loadings which do not include substantial\(^9\) mechanical or thermal loads other than pressure. The design shall be such that the rules of this Subarticle are satisfied for any configurations and loadings explicitly treated.

(a) The allowable stress value at temperature T is 1.1 times that tabulated in Section II, Part D, Subpart 1, Tables 1A and 1B and is to be used.

NE-3320 DESIGN CONSIDERATIONS

NE-3324 Vessels Under Internal Pressure

NE-3324.1 General Requirements. Equations are given in this paragraph for determining the minimum thicknesses under internal pressure loading in cylindrical and spherical shells and ellipsoidal, conical, and hemispherical heads.

NE-3324.2 Nomenclature. The symbols used in Fig. NE-3324.2-1 are defined as follows:

\[ D = \text{inside diameter of the head skirt; or inside length of the major axis of an ellipsoidal head; or inside diameter of a conical head at the point under consideration, measured perpendicular to the longitudinal axis} \]

\[ D_o = \text{outside diameter of the head skirt; or outside length of the major axis of an ellipsoidal head; or outside diameter of a conical head at the point under consideration, measured perpendicular to the longitudinal axis} \]

\[ D_1 = \text{inside diameter of the conical portion of a toriconical head at its point of tangency to the knuckle, measured perpendicular to the axis of the cone} \]

\[ D/2h = \text{ratio of the major to the minor axis of ellipsoidal heads, which equals the inside diameter of the skirt of the head divided by twice the inside height of the head and is used in Table NE-3324.2-1} \]

\[ h = \text{one-half of the length of the minor axis of the ellipsoidal head or the inside depth of the ellipsoidal head measured from the tangent line head bend line} \]

\[ K = \text{a factor in the equations for ellipsoidal heads depending on the head proportion } D/2h \text{ (Table NE-3324.2-1)} \]

\[ L = \text{inside spherical or crown radius for torispherical and hemispherical heads} \]

\[ L_o = \text{outside spherical or crown radius} \]

\[ P = \text{Design Pressure, psi (MPa)} \]

\[ R = \text{inside radius of the shell course under consideration before corrosion allowance is added} \]

\[ R_o = \text{outside radius of the shell course under consideration} \]