NC-3655 Consideration of Level D Service Limits

If the Design Specifications specify any Service Loading for which Level D Limits are designated [NCA-2142.2(b) (4)], the following requirements shall apply.

(a) For Service Loadings for which Level D Service Limits are designated, except as permitted by (b) below, the requirements of (1), (2), and (3) below shall apply.

(1) The permissible pressure shall not exceed 2.0 times the pressure $P_o$ calculated in accordance with eq. NC-3641.1(5). The calculation of $P_o$ shall be based on the maximum allowable stress for the material at the coincident temperature.

(2) The conditions of eq. NC-3653.1(a)(9a) shall be met using Service Level D coincident pressure $P$ and moment $(M_A + M_B)$, which result in the maximum calculated stress. The allowable stress to be used for this condition is $3.0S_h$, but not greater than $2.0S_p$. $S_h$ and $S_p$ are as defined in NC-3653.1.

(3) If the effects of anchor motion $M_{AM}$, from reversing dynamic loads are not considered in NC-3653, then the requirements of (b)(4) shall be satisfied.

(b) As an alternative to (a), for piping fabricated from material designated P-No. 1 through P-No. 9 in Section II, Part D, Subpart 1, Table 2A, and limited to $D_o/t_n \leq 40$, if Level D Service Limits are designated, which include reversing dynamic loads (NC-3622.4) that are not required to be combined with nonreversing dynamic loads (NC-3622.5), the requirements of (1) through (5) below shall apply.

(1) The pressure occurring coincident with the earthquake or other reversing type loading, $P_E$, shall not exceed the Design Pressure.

(2) The sustained stress due to weight loading shall not exceed the following:

$$B_2 \frac{D_o}{2l} M_W \leq 0.5S_h$$

where

$M_W$ = resultant moment due to weight effects, in.-lb (N-mm)

$S_h$ = as defined in NC-3653.1

(3) The stress due to weight and inertial loading due to reversing dynamic loads in combination with the Level D coincident pressure shall not exceed the following:

$$B_1 \frac{P_oD_o}{2E} + B_2' \frac{D_o}{2l} M_E \leq 3S_h$$

where

$B_2' = B_2$ from Table NC-3673.2(b)-1, except as follows:

$$B_2' = 0.87/h^{3/2}$$

for curved pipe or butt welding elbows [ $h$ as defined in Table NC-3673.2(b)-1] but not less than 1.0.
(3) If the effects of anchor motion, \( M_{AM} \), from reversing dynamic loads are not considered in ND-3653, then the requirements of (b)(4) shall be satisfied.

(b) As an alternative to (a), for piping fabricated from material designated P-No. 1 through P-No. 9 in Section II, Part D, Subpart 1, Table 2A and limited to \( D_o/t_n \leq 40 \), if Level D Service Limits are designated, which include reversing dynamic loads (ND-3622.4) that are not required to be combined with nonreversing dynamic loads (ND-3622.5), the requirements of (1) through (5) below shall apply.

(1) The pressure occurring coincident with the earthquake or other reversing type loading, \( P_E \), shall not exceed the Design Pressure.

(2) The sustained stress due to weight loading shall not exceed the following:

\[
\frac{B_2 D_o}{2l} M_W \leq 0.5 S_h
\]

where

\( M_W = \) resultant moment due to weight effects, in.-lb (N·mm)
\( S_h = \) as defined in ND-3653.1

(3) The stress due to weight and inertial loading due to reversing dynamic loads in combination with the Level D coincident pressure shall not exceed the following:

\[
\frac{B_1 P_E D_o}{2t} + \frac{B_2 D_o}{2l} M_E \leq 3 S_h
\]

where

\( B_2' = B_2 \) from Table ND-3673.2(b)-1, except as follows:

\( B_2' = 1.33 \) for girth butt welds between items that do not have nominally identical wall thicknesses

\( = 0.87/h^{2/3} \) for curved pipe or butt welding elbows [\( h \) as defined in Table ND-3673.2(b)-1], but not less than 1.0

\( B_{2b}' = 0.27 (R_m/T')^{2/3} \) and

\( B_{2r}' = 0.33 (R_m/T')^{2/3} \) for ASME B16.9 or MSS SP-87 butt welding tees [terms as defined in Table ND-3673.2(b)-1], but neither less than 1.0

\( M_E = \) the amplitude of the resultant moment due to weight and the inertial loading resulting from reversing dynamic loads, in.-lb (N·mm). In the combination of loads, all directional moment components in the same direction shall be combined before determining the resultant moment.

If the method of analysis is such that only magnitude without algebraic signs are obtained, the most conservative combination shall be assumed.

\( P_E = \) the pressure occurring coincident with the reversing dynamic load, psi (MPa)

**ND-3655 Consideration of Level D Service Limits**

If the Design Specifications specify any Service Loading for which Level D Limits are designated [NCA-2142.2(b)(4)], the following requirements shall apply:

(a) For Service Loadings for which Level D Service Limits are designated, except as permitted by (b) below, the requirements of (1), (2), and (3) below shall apply.

(1) The permissible pressure shall not exceed 2.0 times the pressure \( P_o \) calculated in accordance with eq. ND-3641.1(5). The calculation of \( P_o \) shall be based on the maximum allowable stress for the material at the coincident temperature.

(2) The conditions of eq. ND-3653.1(a)(9a) shall be met using Service Level D coincident pressure \( P \) and moment \( (M_A + M_I) \), which result in the maximum calculated stress. The allowable stress to be used for this condition is 3.0\( S_h \), but not greater than 2.0\( S_y \). \( S_h \) and \( S_y \) are defined in ND-3653.1.