(c) Pneumatically Tested Containments. The limits given in (b) above shall apply to pneumatically tested containments, except that the calculated membrane stress intensity shall be limited to 80% of the yield strength at the test temperature. For other than rectangular sections, \( P_{m} + P_{b} \) shall not exceed a value of \( \alpha \) times 0.8\( S_y \), where the factor \( \alpha \) is defined in (b)(2) above.

(d) Multichamber Containments. In case of multichamber containments, pressure may be applied simultaneously to the appropriate adjacent chamber to maintain the stress intensity limits given in (b) and (c) above (WC-6600).

**WC-3219 Fatigue Evaluation**

If cyclic loadings are identified in the Design Specifications, the need for a fatigue analysis shall be determined in accordance with WC-3219.1.

**WC-3219.1 Rules to Determine Need for Fatigue Analysis of Integral Parts of Containments.** A fatigue analysis need not be made, provided all of Condition A (WC-3219.1.1) or all of Condition B (WC-3219.1.2) is met. If neither Condition A nor Condition B is met, a detailed fatigue analysis shall be made in accordance with the rules of Section III Appendices, Mandatory Appendix XIII for those parts which do not satisfy the conditions. The rules of Condition A or Condition B are applicable to all integral parts of the containment, including integrally reinforced type nozzles.

**WC-3219.1.1 Condition A.** Fatigue analysis is not mandatory for materials having a specified minimum tensile strength not exceeding 80.0 ksi (550 MPa) when the total of the expected number of cycles of types (a) plus (b) plus (c) plus (d), defined below, does not exceed 1,000 cycles:

(a) is the expected design number of full range pressure cycles;

(b) is the expected number of operating pressure cycles in which the range of pressure variation exceeds 20% of the Design Pressure. Cycles in which the pressure variation does not exceed 20% of the Design Pressure are not limited in number. Pressure cycles caused by fluctuations in atmospheric conditions need not be considered;

(c) is the effective number of changes in metal temperature between any two adjacent points in the containment, including nozzles. The effective number of such changes is determined by multiplying the number of changes in metal temperature of a certain magnitude by the factor given in the following table, and by adding the resulting numbers. The factors are as follows:

<table>
<thead>
<tr>
<th>Metal Temperature Differential, °F (°C)</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 (28) or less</td>
<td>0</td>
</tr>
<tr>
<td>51 to 100 (29 to 56)</td>
<td>1</td>
</tr>
<tr>
<td>101 to 150 (57 to 83)</td>
<td>2</td>
</tr>
<tr>
<td>151 to 250 (84 to 139)</td>
<td>4</td>
</tr>
<tr>
<td>251 to 350 (140 to 194)</td>
<td>8</td>
</tr>
<tr>
<td>351 to 450 (195 to 250)</td>
<td>12</td>
</tr>
<tr>
<td>Excess of 450 (250)</td>
<td>20</td>
</tr>
</tbody>
</table>

(For example: Consider a design subjected to metal temperature differentials for the following number of times:

\[
\Delta T, \degree F (\degree C) \quad \text{Cycles}
\]

\[
40 (22) \quad 1,000
\]

\[
90 (50) \quad 250
\]

\[
400 (220) \quad 5
\]

the effective number of changes in metal temperature is

\[
1,000[0] + 250[1] + 5[12] = 310
\]

The number used as type (c) in performing the comparison with 1,000 is then 130. Temperature cycles caused by fluctuations in atmospheric conditions need not be considered.

(d) for containments with welds between materials having different coefficients of expansion, is the number of temperature cycles, which causes the value of \( (\alpha_1 - \alpha_2) \Delta T \) to exceed 0.00034, where \( \alpha_1 \) and \( \alpha_2 \) are the mean coefficients of thermal expansion, 1/°F (1/°C) (Section II, Part D, Subpart 2, Tables TE), and \( \Delta T \) is the operating temperature range, °F (°C). This does not apply to cladding.

**WC-3219.1.2 Condition B.** Fatigue analysis is not mandatory when all of the conditions of Section III Appendices, Mandatory Appendix XIII, XIII-3510 are met.

**WC-3220 DESIGN CONSIDERATION**

**WC-3224 Containments Under Internal Pressure**

**WC-3224.1 General Requirements.** For calculating the required area of reinforcement of openings, the minimum thickness of the containment vessel and parts shall be determined using the Design Pressure and the equations in the following paragraphs. In addition, the other Design Loadings shall be considered in establishing the value of \( F \) as defined below.
The design shall provide a Design Report conforming to the requirements of NC-3211.1(e).

<table>
<thead>
<tr>
<th>ΔT, °F (°C)</th>
<th>Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 (28)</td>
<td>1,000</td>
</tr>
<tr>
<td>90 (50)</td>
<td>250</td>
</tr>
<tr>
<td>400 (220)</td>
<td>5</td>
</tr>
</tbody>
</table>

The number used as type (c) in performing the comparison with 1,000 is then 310. Temperature cycles caused by fluctuations in atmospheric conditions need not be considered.

Adjacent points are defined as points that are spaced less than the distance \(2 \sqrt{Rt} \) from each other, where \(R\) and \(t\) are the mean radius and thickness, respectively, of the vessel, nozzle, flange, or other part in which the points are located.

(d) for vessels with welds between materials having different coefficients of expansion, is the number of temperature cycles which causes the value of \((\alpha_1 - \alpha_2) \Delta T\) to exceed 0.00034, where \(\alpha_1\) and \(\alpha_2\) are the mean coefficients of thermal expansion, \(1/°F (1/°C)\) (Section II, Part D, Subpart 2, Tables TE), and \(\Delta T\) is the service temperature range, °F (°C). This does not apply to cladding.

NC-3219.3.2 Condition BP. All of the requirements of NC-3219.2.2, Condition B, are met using the adjusted values in (a) through (c) below.

(a) Use a value of 4 instead of 3 in Section III Appendices, Mandatory Appendix XIII, XIII-3510(a).

(b) Use a value of one-quarter instead of one-third in Section III Appendices, Mandatory Appendix XIII, XIII-3510(b).

(c) Use a value of 2.7 instead of 2 in the denominator of Section III Appendices, Mandatory Appendix XIII, XIII-3510(c), XIII-3510(d), and XIII-3510(e).

NC-3220 DESIGN CONSIDERATIONS

NC-3221 Design Loadings

The provisions of NC-3210 apply.

NC-3222 Special Considerations

The provisions of NC-3121 and NC-3214 apply.

NC-3223 General Design Rules

NC-3223.1 General Requirements. The design shall be such that the design rules of NC-3200 are satisfied for all configurations and loadings, using the design stress intensity values \(S_m\) of Section II, Part D, Subpart 1, Tables 2A, 2B, and 4 multiplied by the stress intensity factor in Table NC-3217-1

\[
R_L = \text{radius of a cylinder at the large end of a cone to cylinder junction}
\]

\[
R_s = \text{radius of a cylinder at the small end of a cone to cylinder junction}
\]

\[
r = \text{inside knuckle radius of torispherical and toriconical heads}
\]

\[
S = \text{membrane stress intensity limit from Section II, Part D, Subpart 1, Tables 2A, 2B, and 4}
\]

\[
t = \text{minimum required thickness of shell}
\]

\[
t_r = Q \times t
\]

\[
\alpha = \text{one-half of the apex angle of a cone to cylinder junction}
\]