Special Stress Limits of **NE-3227.** The provisions of **NE-3228** may provide relief from certain of these stress limits if plastic analysis techniques are applied. The stress intensity limits are summarized in **Table NE-3221-1** and Figures **NE-3221-1, NE-3221-2, NE-3221-3,** and **NE-3221-4.**

### (15) **NE-3221.1 General Primary Membrane Stress Intensity.** (Derived from \( P_m \) in Figures **NE-3221-1, NE-3221-2, NE-3221-3,** and **NE-3221-4.)** This stress intensity is derived from the average value across the thickness of a section of the general primary stresses (**NE-3213.8**), produced by pressure and other specified mechanical loads but excluding all secondary and peak stresses. Averaging is to be applied to the stress components prior to determination of the allowable Design Limit and the Service Limits is as given below:

(a) **Design Limit and Level A and B Service Limits.** \( P_m \) shall not exceed 1.0\( S_{mc} \).

(b) **Level C Service Limits**

(1) \( P_m \) shall not exceed the greater of 1.2\( S_{mc} \) or 1.0\( S_y \) for regions of the vessel which are integral and continuous.

(2) \( P_m \) shall not exceed 1.0\( S_{mc} \) for regions of the vessel that are not integral and continuous, such as bolted flanges and mechanical joints.

(c) **Level D Service Limits**

### Table NE-3221-1

**Summary of Stress Intensity Limits**

<table>
<thead>
<tr>
<th>Loading Condition</th>
<th>Level A Service Stress Intensity Limit</th>
<th><strong>Level B Service Stress Intensity Limit and Level C Service Stress Limit Where the Structure Is Not Integral and Continuous</strong></th>
<th><strong>Level C Service Stress Intensity Limit Where the Structure Is Integral and Continuous</strong></th>
<th><strong>Level D Service Stress Intensity Limit Where the Structure Is Not Integral and Continuous and at Partial Penetration Welds</strong></th>
<th><strong>Level D Service Stress Intensity Limit Where the Structure Is Integral and Continuous (Elastic Analysis)</strong></th>
<th><strong>Level D Service Stress Intensity Limit Where the Structure Is Integral and Continuous (Inelastic Analysis)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
<td><strong>Design Stress Intensity Limit</strong></td>
<td><strong>Level B Service Stress Intensity Limit Where the Structure Is Not Integral and Continuous</strong></td>
<td><strong>Level C Service Stress Limit Where the Structure Is Integral and Continuous</strong></td>
<td><strong>Level D Service Stress Intensity Limit Where the Structure Is Not Integral and Continuous and at Partial Penetration Welds</strong></td>
<td><strong>Level D Service Stress Intensity Limit Where the Structure Is Integral and Continuous (Elastic Analysis)</strong></td>
<td><strong>Level D Service Stress Intensity Limit Where the Structure Is Integral and Continuous (Inelastic Analysis)</strong></td>
</tr>
<tr>
<td>( P_m )</td>
<td>1.0( S_{mc} )</td>
<td>1.0( S_{mc} )</td>
<td>1.0( S_{mc} )</td>
<td>1.2( S_{mc} ) or 1.0( S_y )</td>
<td>( S_f )</td>
<td>( S_f )</td>
</tr>
<tr>
<td>( P_L )</td>
<td>1.5( S_{mc} )</td>
<td>1.5( S_{mc} )</td>
<td>1.5( S_{mc} )</td>
<td>1.8( S_{mc} ) or 1.5( S_y )</td>
<td>1.5( S_f )</td>
<td>1.5( S_f )</td>
</tr>
<tr>
<td>( P_L + P_h )</td>
<td>1.5( S_{mc} )</td>
<td>1.5( S_{mc} )</td>
<td>1.5( S_{mc} )</td>
<td>1.8( S_{mc} ) or 1.5( S_y )</td>
<td>1.5( S_f )</td>
<td>1.5( S_f )</td>
</tr>
<tr>
<td>[[Note (3)]]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( P_L + P_h + Q )</td>
<td>N/A [Note (4)]</td>
<td>3.0( S_m )</td>
<td>3.0( S_m ) [Note (5)]</td>
<td>N/A [Note (4)]</td>
<td>N/A [Note (4)]</td>
<td>N/A [Note (4)]</td>
</tr>
<tr>
<td>( P_L + P_h + Q + F )</td>
<td>N/A [Note (4)]</td>
<td>( S_a )</td>
<td>( S_a ) [Note (5)]</td>
<td>N/A [Note (4)]</td>
<td>N/A [Note (4)]</td>
<td>N/A [Note (4)]</td>
</tr>
</tbody>
</table>

**NOTES:**

(1) Limits identified by (*) indicate a choice of the larger of two limits.

(2) \( S_f \) is 85% of the general primary membrane allowable permitted in Section III Appendices, Nonmandatory Appendix F. In the application of the rules of Section III Appendices, Nonmandatory Appendix F, \( S_{mc} \) if applicable, shall be as specified in Section II, Part D, Subpart 1, Tables 2A and 2B.

(3) Values shown are for a solid rectangular section. See **NE-3221.3(d)** for other than a solid rectangular section.

(4) N/A — No evaluation required.

(5) Evaluation not required for Level C Service.
### Figure NE-3221-1
Stress Categories and Limits of Stress Intensity for Design Conditions

<table>
<thead>
<tr>
<th>Stress Category</th>
<th>General Membrane</th>
<th>Local Membrane</th>
<th>Bending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol [Note (1)]</td>
<td>$P_m$</td>
<td>$P_c$</td>
<td>$P_a$</td>
</tr>
</tbody>
</table>
| Combination Stress Components and Allowable Limits of Stress Intensities | ![Diagram](image)

**Legend**

- Allowable value
- Calculated value

**NOTES:**

1. The symbols $P_m$, $P_c$, and $P_a$ do not represent single quantities, but rather sets of six quantities representing the six stress components $\sigma_1$, $\sigma_2$, $\tau_{12}$, $\tau_{23}$, $\tau_{31}$, and $\tau_{13}$.
2. Value shown is for a solid rectangular section. See NE-3221.3(d) for other than a solid rectangular section.

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**NE-3221.3 Primary General or Local Membrane Plus Primary Bending Stress Intensity.** (Derived from $P_L + P_B$ in Figures NE-3221-1, NE-3221-2, NE-3221-3, and NE-3221-4.) This stress intensity is derived from the highest value, across the thickness of a section, of the general or local primary membrane stress plus primary bending stresses produced by pressure and other loads but excluding all secondary and peak stresses. The allowable Design Limit and the allowable Service Limits are as given in (a) through (d) below.

(a) **Design Limit and Level A and B Service Limits.** For solid rectangular sections, 1.5 times the value given in NE-3221.1.

(b) **Level C Service Limits**

1. For solid rectangular sections where the structure is integral and continuous, 1.5 times the value given in NE-3221.1.

2. For solid rectangular sections where the structure is not integral and continuous, 1.5 times the value given in NE-3221.1.

(c) **Level D Service Limits**

1. When elastic analysis is used for solid rectangular sections where the structure is integral and continuous, 1.5 times the value given in NE-3221.1.

2. When elastic analysis is used for solid rectangular sections where the structure is not integral and continuous, 1.5 times the value given in NE-3221.1.

3. When inelastic component analysis is used, this Service Limit shall be 85% of the value permitted in Section III Appendices, Nonmandatory Appendix F.

(d) For other than solid rectangular sections, a value of $\alpha$ times the limit established in NE-3221.1 may be used, where the factor $\alpha$ is defined as the ratio of the load set producing a fully plastic section divided by the load set producing initial yielding in the extreme fibers of the section. In the evaluation of the initial yield and fully plastic section capacities, the ratios of each individual load in the respective load set to each other load in that load set shall be the same as the respective ratios of the individual loads in the specified design load set. The value of $\alpha$ shall
**Figure NE-3221-3**

Stress Categories and Limits of Stress Intensity for Level C Service Limits Where the Structure Is Integral and Continuous; and for Level D Service Limits Where the Structure Is Not Integral and Continuous, and at Partial Penetration Welds

<table>
<thead>
<tr>
<th>Stress Category</th>
<th>General Membrane</th>
<th>Local Membrane</th>
<th>Bending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description (Table NE-3217-1)</td>
<td>Average primary stress across solid section. Excludes effects of discontinuities and concentrations.</td>
<td>Average stress across any solid section. Considers effects of discontinuities but not concentrations.</td>
<td>Component of primary stress proportional to distance from centroid of solid section. Excludes effects of discontinuities and concentrations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol (Note 1)</th>
<th>( P_m )</th>
<th>( P_L )</th>
<th>( P_b )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combination of stress components and allowable limits of stress intensities.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \sigma )</td>
<td>( 1.0\sigma )</td>
<td>( 1.2\sigma_{mc} )</td>
<td>( 1.5\sigma )</td>
</tr>
<tr>
<td>( \tau )</td>
<td>( 1.8\sigma_{mc} )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend**

- Allowable value
- Calculated value

**NOTES:**
1. The symbols \( P_m, P_L, \) and \( P_b \) do not represent single quantities, but sets of six representing the six stress components \( \sigma_x, \sigma_y, \sigma_z, \tau_{x,y}, \tau_{x,z}, \tau_{y,z} \).
2. Values shown are for a solid rectangular section. See NE-3221-3(d) for other than a solid rectangular section.
3. Use greater of values specified.