Fig. I-3.1 Pressurized Hot Tap Tee Reinforcing Sleeve End Fillet Weld Design

End face = 1.4 times calculated hoop thickness of sleeve (max.), if required

Chamfer/taper = 45 deg min. (approx.)

Effective weld throat = 0.7t to 1.0t

Fillet weld leg = 1.0t + gap to 1.4t = gap

Gap

Pipe wall thickness = t

Pressurized hot tapping tee reinforcing sleeve

The "=" sign should be replaced with a "+", as per para. 831.42 (j) (2).
Table 831.42 Reinforcement of Welded Branch Connections, Special Requirements

<table>
<thead>
<tr>
<th>Ratio of Nominal Branch Diameter to Nominal Header Diameter</th>
<th>More Than</th>
<th>More Than</th>
</tr>
</thead>
<tbody>
<tr>
<td>25% or Less</td>
<td>25%</td>
<td>50%</td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yield Strength in the Header</th>
<th>More Than 20%</th>
<th>More Than through 50%</th>
<th>More Than 50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% or less</td>
<td>(d) (j)</td>
<td>(g) (j)</td>
<td>(h) (i)</td>
</tr>
<tr>
<td>More than 20%</td>
<td>(d) (j)</td>
<td>(g) (j)</td>
<td>(h) (i)</td>
</tr>
<tr>
<td>through 50%</td>
<td>(d) (j)</td>
<td>(g) (j)</td>
<td>(h) (i)</td>
</tr>
<tr>
<td>More than 50%</td>
<td>(c) (d) (e)</td>
<td>(b) (e) (j)</td>
<td>(a) (e) (f)</td>
</tr>
</tbody>
</table>

**GENERAL NOTE:** The letters in the table correspond to the subparagraphs of para. 831.42.

### 831.42 Special Requirements

In addition to the requirements of para. 831.41, branch connections must meet the special requirements of the following paragraphs as given in Table 831.42.

- **(a)** Smoothly contoured wrought steel tees of proven design are preferred. When tees cannot be used, the reinforcing member shall extend around the circumference of the header. Flanges, saddle saddles, or other types of localized reinforcement are prohibited.

- **(b)** Smoothly contoured tees of proven design are preferred. When tees are not used, the reinforcing member should be of the complete encirclement type, but may be of the pad type, saddle type, or a welding outlet fitting type.

- **(c)** The reinforcement member may be of the complete encirclement type, pad type, saddle type, or welding outlet fitting type. The edges of reinforcement members should be tapered to the header thickness. It is recommended that legs of fillet welds joining the reinforcing member and header do not exceed the thickness of the header.

- **(d)** Reinforcement calculations are not required for openings 2 in. and smaller in diameter; however, care should be taken to provide suitable protection against vibrations and other external forces to which these small openings are frequently subjected.

- **(e)** All welds joining the header, branch, and reinforcing member shall be equivalent to those shown in Appendix I, Figs. I-1, I-2, and I-3.

- **(f)** The inside edges of the finished opening shall, whenever possible, be rounded to a 3/8 in. radius. If the encircling member is thicker than the header and is welded to the header, the ends shall be tapered down to the header thickness, and continuous fillet welds shall be made. In the case of hot tap or plugging fittings, use special requirement (j).

- **(g)** Reinforcement of openings is not mandatory; however, reinforcement may be required for special cases involving pressures over 100 psi, thin wall pipe, or severe external loads.

- **(h)** If a reinforcement member is required, and the branch diameter is such that a localized type of reinforcement member would extend more than half the circumference of the header, then a complete encirclement type of reinforcement member shall be used, regardless of the design hoop stress, or a smoothly contoured wrought steel tee of proven design may be used.

- **(i)** The reinforcement may be of any type meeting the requirements of para. 831.41.

- **(j)** For hot tap or plugging fittings of tee type configurations (see Fig. I-3A), where the reinforcing sleeve is pressurized and thicker than the header, and the application results in additional loading such as that from hot tapping and plugging equipment, the following requirements apply:

1. The minimum leg dimension of the fillet weld at the ends of the sleeve shall be 1.0t plus the gap observed or measured between the inside of the fitting and the outside of the pipe on installation, where t is the actual wall thickness of the pipe. This will result in a minimum effective weld throat of 0.7t.

2. The maximum leg dimension of the end fillet welds shall be 1.4t plus the gap observed or measured between the inside of the fitting and the outside of the pipe on installation, resulting in an effective weld throat not to exceed 1.0t.

3. If necessary, the fittings shall be tapered, beveled, or chamfered at their ends to a minimum approximate angle of 45 deg (with respect to the end face). Tapering, beveling, or chamfering should provide at least a nominal face to accommodate the fillet weld, but the face dimension should not exceed 1.4 times the calculated thickness required to meet the maximum hoop stress of the pressurized sleeve. The leg of the fillet deposited on the end face need not be carried out fully to the shoulder of the face if doing so would result in an oversized fillet weld.

4. Because each installation may be unique, the taper or chamfer shall be the responsibility of the user or otherwise by agreement between user and manufacturer.

### 831.5 Reinforcement of Multiple Openings

**831.51** When two or more adjacent branches are spaced at less than two times their average diameter (so that their effective areas of reinforcement overlap), the group of openings shall be reinforced in accordance with para. 831.4. The reinforcing metal shall be added as a combined reinforcement, the strength of which shall equal the combined strengths of the reinforcements that would be required for the separate openings. In no case shall any portion of a cross section be considered to apply to more than one opening or be evaluated more than once in a combined area.

**831.52** When more than two adjacent openings are to be provided with a combined reinforcement, the