\[ t = \text{nominal thickness of part penetrated, in. (mm)} \]
\[ t_{min} = \text{the smaller of } \frac{3}{4} \text{ in. (19 mm) or the thickness of the thinner of the parts joined} \]
\[ t_c = 0.7t_n \text{ or } \frac{3}{4} \text{ in. (6 mm), whichever is less} \]
\[ t_n = \text{nominal thickness of penetrating part, in. (mm)} \]
\[ t_w = 0.7t_n \]
\[ t_1 + t_2 = \frac{1}{2}t_{min} \]
\[ t_1 \text{ or } t_2 = \text{not less than the smaller of } \frac{3}{4} \text{ in. (6 mm) or } 0.7t_{min} \]

(2) **Welded From One Side**

(a) Partial penetration welds used to connect nozzles from one side are allowed only for attachments on which there are no piping reactions. They shall meet the fabrication requirements of NE-4244(d) and shall be capable of being examined in accordance with the requirements of NE-5242.

(b) The minimum dimensions of Figure NE-4244(d)-2 shall be met where:

\[ c = \text{diametral clearance between nozzle and vessel penetration, in. (mm)} \]
\[ = 0.010 \text{ in. (0.25 mm) for } d \leq 1 \text{ in. (25 mm)} \]
\[ = 0.020 \text{ in. (0.50 mm) for } 1 < d \leq 4 \text{ in. (100 mm)} \text{ and} \]
\[ = 0.030 \text{ in. (0.75 mm) for } d > 4 \text{ in. (100 mm)} \text{ max., except that the above limits on maximum clearance need not be met for the full length of the opening provided there is a region at the weld preparation and a region near the end of the opening opposite the weld which does meet the above limits on maximum clearance and the latter region is extensive enough (not necessarily continuous) to provide a positive stop for nozzle deflection.} \]
\[ d = \text{outside diameter of nozzle or the inner cylinder as shown in Figure NE-4244(d)-2, in. (mm)} \]
\[ r_1 = \frac{3}{4}t_n \text{ or } \frac{3}{4} \text{ in. (19 mm), whichever is less} \]
\[ r_2 = \frac{3}{16} \text{ in. (1.5 mm) min.} \]
\[ r_3 = r_2 \text{ or equivalent chamfer, min.} \]
\[ r_4 = \frac{3}{8}t_n \text{ or } \frac{3}{8} \text{ in. (19 mm), whichever is smaller} \]
\[ t = \text{nominal thickness of part penetrated, in. (mm)} \]
\[ t_c = 0.7t_n \text{ or } \frac{3}{4} \text{ in. (6 mm), whichever is less} \]
\[ t_n = \text{nominal thickness of penetrating part [or the lesser of } t_{n1} \text{ or } t_{n2} \text{ in Figure NE-4244(d)-2, in. (mm)} \]
\[ \lambda = \frac{3}{16} \text{ in. (1.5 mm) min.} \]
\[ \lambda = t_n \text{ max.} \]

(3) The corners to the end of each nozzle extending less than \( \sqrt{d_{t_0}} \) beyond the inner surface of the part penetrated shall be rounded to a radius of one-half of the thickness \( t_n \) of the penetrating part or \( \frac{3}{4} \text{ in. (19 mm), whichever is smaller}. \)

(4) Weld groove design for partial penetration joints attaching nozzles may require special consideration to achieve the 1.25\( t_n \) minimum depth of weld and adequate access for welding examination. The welds shown in the sketches of Figure NE-4244(d)-2 and Figure NE-4244(d)-3 may be on either the inside or the outside of the shell. Weld preparation may be J-groove as shown in the figures or straight bevel.

(e) **Attachment of Fittings with Internal Threads.** The attachment of internally threaded fittings shall meet the requirements of (1) through (3) below.

(1) Except as provided for in (2) and (3) below, the provisions of NE-4244(e) shall be met. The minimum weld dimensions shall be as shown in Figure NE-4244(e)-1 where:

\[ t_e = \frac{3}{8} \text{ in. (6 mm), min.} \]
\[ t_{min} = \text{lesser of } \frac{3}{8} \text{ in. (19 mm) or the thickness of the parts joined} \]
\[ t_w = \text{thickness of Sch. 160 pipe (ASME B36.10), in. (mm)} \]
\[ t_1 + t_2 = \frac{1}{4} t_{min} \]
\[ t_1 \text{ or } t_2 = \text{not less than smaller of } \frac{3}{4} \text{ in. (6 mm) or } 0.7t_{min} \]

(2) Fittings shown in Figure NE-4244(e)-1 sketches (a-2), (b-2), (c-2), and (d) not exceeding NPS 2 (DN 50) may be attached by welds that are exempt from size requirements other than those specified in NE-3359.

(3) **Openings**

(a) When internally threaded fittings and bolting pads not exceeding NPS 3 (DN 80) are attached to vessels having a wall thickness not greater than \( \frac{3}{8} \text{ in. (10 mm)} \) by a fillet weld deposited from the outside only, the welds shall comply with the dimensions shown in Figure NE-4244(e)-2. These openings do not require reinforcement other than that inherent in the construction as permitted in NE-3332.1.

(b) If the opening exceeds NPS 5 (DN 125), it shall be reinforced in accordance with NE-3332 with the nozzle or other connections attached, using a suitable detail in Figure NE-4244(e)-1.

(f) **Attachment of Tubed Connections.** Tubes recessed into thick walled vessels or headers, welded from only one side, shall have a welding groove in the vessel wall not deeper than \( t_n \) on the longitudinal axis of the opening. A recess \( \frac{1}{8} \text{ in. (1.5 mm)} \) deep shall be provided at the bottom of the groove in which to center the nozzle. The dimension \( t_w \) of the attachment weld shall not be less than \( t_n \) nor less than \( \frac{3}{4} \text{ in. (6 mm). The minimum dimension for } t_e \text{ shall be } \frac{3}{4} \text{ in. (6 mm) [Figure NE-4244(f)-1 sketches (a) and (b)].} \)

**NE-3355 Welding Grooves**

The dimensions and shape of the edges to be joined shall be such as to permit complete fusion and penetration, except as otherwise permitted in NE-3352.4.
Figure NE-4244(d)-3
Partial Penetration Weld Connections for Coaxial Cylinders

(a) 1.26 \( t_n \) min.
(b) 3/4 \( t_n \) min.
(c) 1.25 \( t_n \) min.

GENERAL NOTE: For definition of symbols, see NE-3352.4(d)

Figure NE-4244(e)-1
Acceptable Types of Fittings With Internal Threads

(a-1) (a-2)
(b-1) (b-2)
(c-1) (c-2)

(c-3)
(d)

3 in. NPS max.

GENERAL NOTE: For definition of symbols, see NE-3352.4(e)
Figure NE-4244(d)-1
Acceptable Types of Welded Nozzles Using Partial Penetration Welds

(a) $t_n$ $t_1$ $t_2$
(b) $t_n$ $t_1$ $t_2$
(c) $t_n$ $t_1$ $t_2$
(d) $t_n$ $t_1$ $t_c$
(e) $t_n$ $t_1$ $t_c$
(f) $t_n$ $t_1$ $t_2$

GENERAL NOTE: For definition of symbols, see NE-3352.4(d)