that differ in thickness by more than one-fourth the thickness of the thinner section or by more than 1/8 in. (3 mm), whichever is less. When a taper is required on any formed head thicker than the shell and intended for butt-welded attachment [see Figure PW-9.3.3, illustrations (c) and (d)], the length of the skirt as measured from the tangent line shall meet the requirements in Figure PW-9.3.3 and the taper shall be entirely within the skirt. When the transition is formed by removing material from the thicker section, the minimum thickness of that section, after the material is removed, shall not be less than that required by Part PG. The centerline misalignment between shell and head shall be no greater than one-half the difference between the actual shell and head thickness, as illustrated in Figure PW-9.3.3, illustrations (a) through (d).

PW-9.4 Prohibited Welded Joints. Corner joints as depicted in Figure PW-9.4 are prohibited.

PW-10 HEAT TREATMENT

Vessels and vessel parts shall be preheated and post-weld heat treated in accordance with the requirements in PW-38 and PW-39.

PW-11 VOLUMETRIC EXAMINATION OF WELDED BUTT JOINTS

PW-11.1 Welded butt joints requiring volumetric examination are specified in Table PW-11. Unless Table PW-11 restricts volumetric examination to one method, either the radiographic or the ultrasonic method may be used. Acceptance of the weld shall be determined by the method selected for the initial examination of the completed weld. If repairs are required, the repairs shall be examined using the same method by which the unacceptable imperfections were detected. Subsequent examination of the weld following acceptance is beyond the scope of this Section.

PW-11.2 Definitions. For use with Table PW-11 and elsewhere in this Section, the following definitions apply:

*butt joint*: a joint between two members aligned approximately in the same plane.

*circumferential butt weld*: includes circumferential welded butt joints in drums, headers, pipes, and tubes, and welded butt joints attaching formed heads to drums, shells, and headers.

*longitudinal butt weld*: includes longitudinal and spiral welded butt joints in drums, shells, headers, pipes, and tubes; any welded butt joint within a sphere or within a formed or flat head or tubesheet; and welded butt joints attaching insert nozzles of the type shown in Figure PW-16.1, illustrations (q-1) through (q-4).

*nondestructive examination (NDE)*: examination methods used to verify the integrity of materials and welds in a component without damaging its structure or altering its mechanical properties. NDE may involve surface, subsurface, and volumetric examination.

*NPS*: nominal pipe size.

*volumetric NDE*: a method capable of detecting imperfections that may be located anywhere within the examined volume. For Section I construction, volumetric NDE is limited to radiographic (RT) and ultrasonic (UT) examination methods.

PW-11.3 For use with Table PW-11, the size and thickness of welded butt joints is defined as the larger and thicker of the two abutting edges after edge preparation.

The geometric unsharpness $U_g$ is defined by the equation

$$U_g = \frac{Fd}{F}$$

where

$D$ = distance from source of radiation to the weld

$d$ = distance from the source side of the weld to the film

$F$ = source size; the maximum projected dimension of the radiating source (or effective focal spot) in the plane perpendicular to the distance $D$ from the weld

$U_g$ = geometric unsharpness

PW-13 HEAD-TO-FLANGE REQUIREMENTS

Dished heads, other than hemispherical, concave to pressure to be attached by butt welding, and flanged heads or flanged furnace connections to be fillet welded, shall have a length of flange not less than 1 in. (25 mm) for heads or furnace openings not over 24 in. (600 mm) in external diameter and not less than 1 1/2 in. (38 mm) for heads or furnace openings over 24 in. (600 mm) in diameter.