WB-4433 Structural Attachments

Structural attachments shall conform reasonably to the curvature of the surface to which they are to be attached and shall be attached by full penetration, fillet, or partial penetration continuous welds. When fillet and partial penetration welds are used on containments, the requirements of WB-3123.2 shall be met. Attachments to the internal surfaces of containments shall be made only with full penetration welds. Figure WB-4433-1 illustrates some of the typical details for attaching structural attachments to a containment using full penetration welds.

WB-4434 Welding of Internal Structural Supports to Clad Containments

Internal structural supports on clad containments shall be welded to the base metal and not to the cladding, except for weld overlay cladding.

WB-4435 Welding of Nonstructural and Temporary Attachments and Their Removal

(a) Nonstructural attachments welded to the containment need not comply with WB-2000 and may be welded with continuous fillet or partial penetration welds, provided the requirements of (1) through (4) below are met.

(1) The welding procedure and the welders have been qualified in accordance with WB-4321.

(2) The material is identified and is compatible with the material to which it is attached.

(3) The welding material is identified and compatible with the materials joined.

(4) The welds are postweld heat treated when required by WB-4620.

(b) Removal of nonstructural attachments, when temporary, shall be accomplished as follows.

(1) The immediate area around the temporary attachment is marked in a suitable manner so that after removal the area can be identified until after it has been examined in accordance with (3) below.

(2) The temporary attachment is completely removed in accordance with the procedures of WB-4211.

(3) After the temporary attachment has been removed, the marked area is examined by the liquid penetrant or magnetic particle method in accordance with the requirements of WB-5110, and meets the acceptance standards of WB-5340 or WB-5350, whichever is applicable.

(4) As an alternative to (a)(4) above, postweld heat treatment may be deferred until after removal of the attachment.

WB-4450 REPAIR OF WELD METAL DEFECTS

Defects in weld metal detected by the examinations required by WB-5000, or by the tests of WB-6000, shall be eliminated and repaired when necessary.

WB-4452 Elimination of Surface Defects

Weld metal surface defects may be removed by grinding or machining, and need not be repaired by welding, provided that the requirements of (a) through (c) below are met.

(a) The remaining thickness of the section is not reduced below that required by WB-3000.

(b) The depression, after defect elimination, is blended uniformly into the surrounding surface.

(c) The area is examined by a magnetic particle or liquid penetrant method in accordance with WB-5110 after blending and meets the acceptance standards of WB-5300 to ensure that the defect has been removed or reduced to an imperfection of acceptable limit. Defects detected by visual or volumetric method and located on an interior surface need only be reexamined by the method which initially detected the defect when the interior surface is inaccessible for surface examination.

WB-4453 Requirements for Making Repairs of Welds

Excavations in weld metal, when repaired by welding, shall meet the following requirements.

WB-4453.1 Defect Removal. Defects may be removed by mechanical means or by thermal gouging processes. The area prepared for repair shall be examined by a liquid penetrant or magnetic particle method in accordance with WB-5110, and meet the acceptance standards of WB-5340 or WB-5350. This examination is not required where defect elimination removes the full thickness of the weld and where the backside of the weld joint is not accessible for removal of examination materials.

WB-4453.2 Requirements for Welding Material, Procedures, and Welders. The weld repair shall be made using welding material, welders, and welding procedures qualified in accordance with WB-4125 and WB-4300.

WB-4453.3 Blending of Repaired Areas. After repair, the surface shall be blended uniformly into the surrounding surface.

WB-4453.4 Examination of Repair Welds.

(a) The examination of a weld repair shall be repeated as required for the original weld, except that when the defect was originally detected by the liquid penetrant or magnetic particle method, and when the repair cavity does not exceed the lesser of \\frac{3}{16} in (10 mm) or 10% of the thickness, it need only be reexamined by the liquid penetrant or magnetic particle method.

(b) When repairs to welds joining P-No. 1 and P-No. 3 materials require examination by radiography as required in (a) above, but construction assembly prevents meaningful radiographic examination, ultrasonic examination may be substituted provided:

(1) the weld had been previously radiographed and met the applicable acceptance standards;
(2) the ultrasonic examination is performed using a procedure in accordance with Section V, Article 5, to the acceptance standards of WB-5330;

(3) the substitution is limited to Category A and B welds in containments, and similar type welds in other items.

The absence of suitable radiographic equipment is not justification for the substitution.

**WB-4453.5 Heat Treatment of Repaired Areas.** The area shall be heat treated in accordance with WB-4620.

**WB-4600 HEAT TREATMENT**

**WB-4610 WELDING PREHEAT REQUIREMENTS**

**WB-4611 When Preheat Is Necessary**

The need for and temperature of preheat are dependent on a number of factors, such as the chemical analysis, degree of restraint of the parts being joined, elevated temperature, physical properties, and material thicknesses. Some practices used for preheating are given in Section III Appendices, Nonmandatory Appendix D as a general guide for the materials listed by P-Numbers of Section IX. It is cautioned that the preheating suggested in Section III Appendices, Nonmandatory Appendix D does not necessarily ensure satisfactory completion of the welded joint and that the preheating requirements for individual materials within the P-Number may be more or less restrictive. The Welding Procedure Specification for the material being welded shall specify the minimum preheating requirements under the welding procedure qualification requirements of Section IX.

**WB-4612 Preheating Methods**

Preheat for welding or thermal cutting, when employed, may be applied by any method which does not harm the base material or any weld metal already applied, or which does not introduce deleterious material into the welding area which is harmful to the weld.

**WB-4613 Interpass Temperature**

Consideration shall be given to the limitations of interpass temperatures for quenched and tempered material to avoid detrimental effects on the mechanical properties.

**WB-4620 POSTWELD HEAT TREATMENT**

**WB-4621 Heating and Cooling Methods**

Postweld heat treatment (PWHT) may be accomplished by any suitable methods of heating and cooling, provided the required heating and cooling rates, metal temperature, metal temperature uniformity, and temperature control are maintained.
the requirements of WC-5120 and meets the acceptance standards of WC-5340 or WC-5350, whichever is applicable.

(4) As an alternative to (a)(4) above, postweld heat treatment may be deferred until after removal of the attachment.

**WC-4450 REPAIR OF WELD METAL DEFECTS**

**WC-4451 General Requirements**

Defects in weld metal detected by the examinations required by WC-5000 or by the tests of WC-6000 shall be eliminated and repaired when necessary or the indication reduced to an acceptable limit.

**WC-4452 Elimination of Surface Defects**

Weld metal surface defects may be removed by grinding or machining and need not be repaired by welding, provided the requirements of (a), (b), and (c) below are met.

(a) The remaining thickness of the section is not reduced below that required by WC-3000.

(b) The depression, after defect elimination, is blended uniformly into the surrounding surface.

(c) The area is examined by a magnetic particle or liquid penetrant method in accordance with WC-5100 after blending and meets the acceptance standards of WC-5300 to ensure that the defect has been removed or the indication reduced to an acceptable limit. Defects detected by visual or volumetric method and located on an interior surface need only be reexamined by the method which initially detected the defect when the interior surface is inaccessible for surface examination.

**WC-4453 Requirements for Making Repairs of Welds**

Excavations in weld metal, when repaired by welding, shall meet the requirements of the following subparagraphs.

**WC-4453.1 Defect Removal.** Defects may be removed by mechanical means or by thermal gouging processes. The area prepared for repair shall be examined by a liquid penetrant or magnetic particle method in accordance with WC-5100 and meet the acceptance standards of WC-5340 or WC-5350. This examination is not required where defect elimination removes the full thickness of the weld and where the backside of the weld joint is not accessible for removal of examination materials.

**WC-4453.2 Requirements for Welding Materials, Procedures, and Welders.** The weld repair shall be made using welding materials, welders, and welding procedures qualified in accordance with WC-4125 and WC-4300.

**WC-4453.3 Blending of Repaired Areas.** After repair the surface shall be blended uniformly into the surrounding surface.
WC-4453.4 Examination of Repair Welds.

(a) The examination of a weld repair shall be repeated as required for the original weld, except that it need only be reexamined by the liquid penetrant or magnetic particle method when the unacceptable indication was originally detected by the liquid penetrant or magnetic particle method and when the repair cavity does not exceed the following:

(1) $\frac{1}{4} t$ for $t \leq \frac{3}{4}$ in. (19 mm)
(2) $\frac{1}{4}$ in. (6 mm) for $\frac{3}{4}$ in. (19 mm) $< t \leq 2\frac{1}{2}$ in. (64 mm)
(3) the lesser of $\frac{3}{8}$ in. (10 mm) or $10\% t$ for $t > 2\frac{1}{2}$ in. (64 mm) where $t$ equals the thickness of the weld.

(b) When repairs to welds joining P-No. 1 and P-No. 3 materials require examination by radiography as required in (a) above, but construction assembly prevents meaningful radiographic examination, ultrasonic examination may be substituted, provided that:

(1) the weld has been previously radiographed and met the applicable acceptance standards;
(2) the ultrasonic examination is performed using a procedure in accordance with Section V, Article V to the acceptance standards of WC-5330;
(3) the substitution is limited to Category A and B welds in containments and similar type welds in other items.

The absence of suitable radiographic equipment is not justification for the substitution.

WC-4453.5 Heat Treatment of Repaired Areas. The area shall be heat treated in accordance with WC-4620.

WC-4500 Brazing

WC-4510 Rules for Brazing

WC-4511 Where Brazing May Be Used

Brazing is permitted for nonstructural attachments only.

WC-4512 Brazing Material

Where brazing is permitted, the brazing filler material and fluxes shall conform to the rules covering identification in WC-2150 and to the requirements of (a), (b), and (c) below.

(a) The filler material used in brazing shall be a nonferrous metal or alloy with a solidus temperature above 800°F (425°C) and at least 500°F (280°C) above the highest temperature of the joint in service.

(b) The filler material shall melt and flow freely by capillary action within the desired temperature range, and in conjunction with a suitable flux or controlled atmosphere the filler material shall wet and adhere to the surfaces to be joined.