IWA-3310 SURFACE PLANAR FLAWS

(a) A continuous indication shall be considered as a surface planar flaw if the detected area of the flaw is oriented primarily in any single plane, other than parallel to the surface of the component, and any portion of the flaw penetrates a surface of the component, as shown in Figure IWA-3310-1.

(b) A subsurface indication shall be considered a surface flaw if any portion of the flaw is less than 0.4d from the surface of the component nearest the flaw. If the nearest surface of the component is clad, S shall be measured to the clad-base metal interface. S is measured as shown in Figure IWA-3310-1. The thickness of the cladding used to establish the clad-base metal interface may be the nominal clad thickness specified on design drawings of the component.

IWA-3320 SUBSURFACE PLANAR FLAWS

(a) A continuous indication shall be considered a subsurface planar flaw if the detected area of the flaw is oriented primarily in any single plane other than parallel to the surface of the component, and if the distance S from the flaw to the nearest surface of the component is as shown in Figure IWA-3320-1. If the nearest surface of the component is clad, S shall be measured to the clad-base metal interface. The thickness of cladding used to establish the clad-base metal interface may be the nominal clad thickness specified on design drawings of the component.

(b) The modified surface proximity rule for discriminating surface from subsurface indications of Figure IWA-3320-2 may be used to eliminate the need for successive examinations of IWB-2420(b) and IWC-2420(c) for subsurface flaws in vessels.

IWA-3330 MULTIPLE PLANAR FLAWS

(a) Discontinuous indications shall be considered single planar flaws if the distance between adjacent flaws is equal to or less than the dimension S, where S is determined as shown in Figure IWA-3330-1.

(b) The rules of IWA-3310 and IWA-3320 shall be applied to characterize multiple planar flaws as surface or subsurface planar flaws, respectively.

(c) The dimensions a and θ of such multiple planar flaws shall be those of the square or rectangle that contains the detected area of all flaws within the proximity limits defined in (a).

(d) Combination of multiple planar flaws is not required for fatigue or stress corrosion cracking assessment.

IWA-3340 NONPLANAR FLAWS

(a) A continuous indication whose detected area is not oriented in a single plane (such as two or more intersecting inclined planes, curvilinear geometry, or combinations of nonplanar geometry) shall be resolved into two planar flaws by projection of the flaw area into planes normal to the maximum principal stresses, as shown in Figure IWA-3340-1.

(b) The rules of IWA-3310 and IWA-3320 shall be applied to characterize the projected areas of the flaws as surface or subsurface flaws, respectively.

(c) The dimensions a and θ of such flaws shall be those of a rectangle that contains the projected area of the flaw as shown in Figure IWA-3340-1.

IWA-3350 PARALLEL PLANAR FLAWS

(a) Discontinuous indications whose areas are oriented primarily in parallel planes, and other than parallel to the surface of the component, shall be considered single planar flaws if the adjacent planes are within a distance S, where S is determined as shown in Figure IWA-3350-1.

(b) The dimensions a and θ of such flaws shall be those of the square or rectangle that contains the detected area of all flaws within the flaw–plane adjacency limits of (a), as shown in Figure IWA-3350-1.

IWA-3360 LAMINAR FLAWS

(a) Planar indications oriented within 10 deg of a plane parallel to the surface of the component shall be considered laminar flaws, except where noted otherwise in referenced figures of IWB-3500.

(b) The area of a laminar flaw shall be 0.75 times the area of the square or rectangle that contains the detected area of those flaws that either overlap or are within a distance S of 1 in. (25 mm) of one another as shown in Figure IWA-3360-1.

IWA-3370 RADIOGRAPHIC EXAMINATION

(a) An indication detected by radiographic examination shall be considered to be a linear flaw unless the indication can be characterized as surface planar, subsurface planar, or laminar by supplemental examination.

(b) The supplemental examination of (a) may be by additional radiography, ultrasonic examination, or other methods provided they comply with the rules of IWA-2240.

IWA-3380 MULTIPLE NONALIGNED COPLANAR FLAWS

(a) Discontinuous indications that are coplanar and nonaligned in the through-wall direction of the section thickness t, and with at least one indication characterized as a surface flaw, shall be considered single planar surface flaws if the separation distances S1 and S2 between the individual flaws are equal to or less than the dimensions specified in Flaw #1 of Figure IWA-3380-1.

(b) The dimensions a and θ of the combined single flaw of (a) shall be defined by the size of the bounding square or rectangle that contains the individual nonaligned flaws as delineated in Figure IWA-3380-1.
remote examination system shall have the capability of distinguishing and differentiating between the colors applicable to the component examination being conducted.

IWA-2215 Replication

Surface replication methods may be used for VT-1 and VT-3 examinations when the surface resolution is at least equivalent to that of direct visual observation.

IWA-2220 SURFACE EXAMINATION

(a) A surface examination indicates the presence of surface discontinuities. It may be conducted using a magnetic particle, liquid penetrant, eddy current, or ultrasonic method.

(b) Any linear indication detected by magnetic particle, liquid penetrant, or eddy current examination that exceeds the allowable linear surface flaw standards shall be recorded.

(c) Any flaw recorded by ultrasonic examination shall be compared to the volumetric examination acceptance standards of Table IWB-3514-1 or Table IWB-3514-2 for surface planar flaw.

IWA-2221 Magnetic Particle Examination

(a) Magnetic particle examination shall be conducted in accordance with Section V, Article 7.

(b) Magnetic particle examination of coated materials shall be conducted in accordance with Section V, Article 7, Mandatory Appendix I.

(c) For nonfluorescent particles the visible light intensity required is 50 fc. Alternatively, light shall be sufficient if the examination can resolve standard test chart characters as described for VT-1 in IWA-2210.

IWA-2222 Liquid Penetrant Examination

(a) Liquid penetrant examination shall be conducted in accordance with Section V, Article 6.

(b) For visible dye penetrant, the visible light intensity required is 50 fc. Alternatively, lighting shall be sufficient if the examiner can resolve standard test chart characters as described for VT-1 in IWA-2210.

IWA-2223 Eddy Current Examination

Eddy current examination for detection of surface flaws shall be conducted in accordance with Mandatory Appendix IV.

IWA-2224 Ultrasonic Examination

An ultrasonic examination performed from the inside surface of piping may be used as a surface examination method for Categories B-I and B-F piping welds NPS 4 and larger. The ultrasonic examination technique shall be demonstrated capable of detecting an acceptable flaw having the greatest a/f ratio or a 0.5 aspect ratio at the surface being examined.

IWA-2230 VOLUMETRIC EXAMINATION

A volumetric examination indicates the presence of discontinuities throughout the volume of material and may be conducted from either the inside or outside surface of a component.

IWA-2231 Radiographic Examination

For radiographic examinations employing either X-ray equipment or radioactive isotopes, the procedure shall be as specified in Section V, Article 2.
IWA-2232  Ultrasonic Examination

Ultrasonic examination shall be conducted in accordance with Mandatory Appendix I.

IWA-2233  Eddy Current Examination

Eddy current examination shall be conducted in accordance with Section V, Article 8, Mandatory Appendix II.

IWA-2234  Acoustic Emission Examination

Acoustic emission may be used in lieu of the successive inspections of IWB-2420(b) or IWC-2420(b) to monitor growth of flaws detected by other NDE methods. The flaws shall be sized by ultrasonic examination in accordance with Mandatory Appendix I prior to initiating use of acoustic emission. Acoustic emission monitoring shall be initiated prior to resuming operation of the system. Acoustic emission shall be conducted in accordance with Section V, Article 13, with the following additional requirements.

(a) The following flaw growth calculation and acceptance criteria shall be used.

(1) Every two months during the current inspection period, calculate the flaw growth in accordance with Section V, Article 13, Mandatory Appendix I. Using this growth rate, predict the flaw size at the end of the current inspection period.

(2) If the calculated flaw size at the end of the current inspection period meets the acceptance criteria of IWB-3600 or IWC-3600, as applicable, continue the two-month monitoring process described in (1) above.

(3) If the calculated flaw size at the end of the current inspection period does not meet the acceptance criteria of IWB-3600 or IWC-3600, as applicable, the following actions shall be performed.

(a) Calculate the flaw size at the end of the next two-month time span. If this calculated flaw size meets the acceptance criteria of IWB-3600 or IWC-3600, as applicable, continue the two-month monitoring process described in (1).

(b) If the calculated flaw size at the end of the next two-month time span does not meet the acceptance criteria of IWB-3600 or IWC-3600, as applicable, the component shall be corrected by repair/replacement activity in accordance with IWB-3130 or IWC-3120, as applicable.

IWA-2240  ALTERNATIVE EXAMINATIONS

Alternative examination methods, a combination of methods, or newly developed techniques may be substituted for the methods specified in this Division, provided the inspector is satisfied that the results are demonstrated to be equivalent or superior to those of the specified method.

IWA-2300  QUALIFICATIONS OF NONDESTRUCTIVE EXAMINATION PERSONNEL

IWA-2310  GENERAL

(a) Personnel performing nondestructive examinations (NDE) shall be qualified and certified using a written practice prepared in accordance with ANSI/ASNT CP-189, Standard for Qualification and Certification of Nondestructive Testing Personnel, and ANSI/ASNT CP-105, Standard for Topical Outlines for Qualification of Nondestructive Testing Personnel, as amended by the requirements of this Division. Certifications based on earlier editions of ANSI/ASNT CP-189 are valid until recertification is required. Recertification shall be in accordance with the edition of ANSI/ASNT CP-189 referenced in IWA-1600 as amended by the requirements of this Division. Outside agencies, as defined in Mandatory Appendix VII, may be used to qualify NDE personnel; however, the Employer shall be solely responsible for the certification of Level EI, II, and III personnel. Nondestructive and visual examination personnel qualified and certified in accordance with the requirements of this Division are qualified and certified to perform examinations in accordance with the requirements of previous Editions and Addenda.

(b) As an alternative to a personnel qualification program based on CP-189, the ASNT Central Certification Program (ACCP) may be used. The supplemental requirements of this Division shall apply to qualification of personnel in accordance with the ACCP.

IWA-2311  Written Practice

(a) The Employer shall prepare a written practice in accordance with ANSI/ASNT CP-189.

(b) The written practice shall specify the duties and responsibilities of the Principal Level III.

IWA-2312  NDE Methods Listed in ANSI/ASNT CP-189

(a) Qualifications shall be based on the methods, techniques, procedures, and equipment used for the NDE required by this Division.

(b) Training, qualification, and certification of ultrasonic examination personnel shall also comply with the requirements of Mandatory Appendix VII.

(c) Training, qualification, and certification of visual examination personnel shall comply with the requirements of Mandatory Appendix VI.

(d) The visual examination training and experience hours specified in ANSI/ASNT CP-189 shall be applied to the combined certification of an individual for VT-1,
VT-2, and VT-3 visual examination. Certification in only one of the VT techniques is a limited certification, and the requirements of IWA-2350 apply.

(c) Personnel certified in an NDE method, and whose training and experience in that method met the requirements of an edition of ASNT SNT-TC-1A or ANSI/ASNT CP-189 referenced by a previous edition or addenda of this Division, do not require additional training or experience hours when being certified or recertified to the same level by an employer, except as specified in (b).

IWA-2313  NDE Methods Not Listed in ANSI/ASNT CP-189

Personnel using NDE methods not addressed in ANSI/ASNT CP-189 shall be qualified as defined in ANSI/ASNT CP-189 or the ACCP and the Employer’s written practice.

IWA-2314  Certification and Recertification

(a) Personnel shall be qualified by examination and shall be certified in accordance with ANSI/ASNT CP-189, except that the ASNT Level III certificate is not required. Levels I, II, and III personnel shall be recertified by qualification examinations every 5 yr.

(b) Personnel qualified in accordance with the ACCP shall be recertified by examination every 5 yr.

(c) An ACCP certificate with current endorsements obtained by examination satisfies the General and Practical Examination requirements for Levels I and II NDE personnel.

(d) Level I, II, and III NDE personnel may be certified or recertified without additional training or experience hours when

(1) certification or recertification is to the same level, and

(2) the candidate’s training and experience in the NDE method met the requirements of an edition of ASNT SNT-TC-1A or ANSI/ASNT CP-189 referenced by a previous edition or addenda of this Division.

IWA-2315  Personnel Requirements for Eddy Current Examination of Steam Generator Tubing

Personnel performing analysis or evaluation of data shall be qualified by examination to perform analysis of multifrequency data and to use multiparameter signal combination techniques. The qualification shall include a practical examination that includes techniques used and the types of flaws that may be found during examination of steam generator tubing.

IWA-2316  Alternative Qualifications of VT-2 Visual Examination Personnel

(a) For system leakage tests and hydrostatic tests performed in accordance with IWA-5211(a) and IWA-5211(b), in lieu of the requirements of IWA-2310 through IWA-2314, VT-2 visual examination personnel may be qualified by satisfying the following requirements:

(1) at least 40 hr plant walkdown experience, such that gained by licensed and nonlicensed operators, local leak rate personnel, system engineers, quality control personnel, and nondestructive examination personnel

(2) at least 4 hr of training in the Section XI requirements and plant-specific procedures for VT-2 visual examination

(3) the vision test requirements of IWA-2321

(b) Personnel qualified in accordance with these alternative requirements shall not perform VT-2 functions other than examinations [e.g., verifying adequacy of procedures, training VT-2 personnel].

(c) These alternative qualification requirements shall be described in the Employer’s written practice.

IWA-2317  Alternative Qualifications of VT-3 Visual Examination Personnel

(a) In lieu of the requirements of IWA-2310 through IWA-2314, VT-3 visual examination personnel may be qualified by satisfying the following requirements:

(1) at least 40 hr plant experience, such as that gained by plant personnel involved in installation, maintenance, or examination of pumps, valves, and supports, quality control personnel, and nondestructive examination personnel

(2) at least 8 hr of training in the Section XI requirements and plant-specific procedures for VT-3 visual examination

(3) the vision test requirements of IWA-2321

(4) for initial qualification, and at least every 3 yr thereafter, pass a written examination of at least 30 questions covering VT-3 examination attributes, VT-3 examination requirements, and plant-specific VT-3 procedures.

(b) The alternative qualification requirements shall be described in the Employer’s written practice.

IWA-2320  QUALIFICATION EXAMINATIONS

IWA-2321  Vision Tests

The following tests shall be administered annually to NDE personnel:

(a) Personnel shall demonstrate natural or corrected near-distance acuity of 20/25 or greater Snellen fraction, with at least one eye, by reading words or identifying characters on a near-distance test chart, such as a Jaeger chart, that meets the requirements of IWA-2322. Equivalent measures of near-distance acuity may be used. In addition, personnel performing VT-2 or VT-3 visual examinations shall demonstrate natural or corrected far-distance acuity of 20/30 or greater Snellen fraction or equivalent with at least one eye.
ARTICLE IWA-4000
REPAIR/REPLACEMENT ACTIVITIES

IWA-4100 GENERAL REQUIREMENTS

IWA-4110 SCOPE

(a) The requirements of this Article apply regardless of the reason for the repair/replacement activity\(^4\) or the method that detected the condition requiring the repair/replacement activity.

(b) This Article provides requirements for repair/replacement activities\(^5\) associated with pressure-retaining components and their supports, including appurtenances, subassemblies, parts of a component, core support structures, metal containments and their integral attachments, and metallic portions of Class CC containments and their integral attachments. Repair/replacement activities include welding, brazing, defect removal, metal removal by thermal means, rerating, and removing, adding, and modifying items or systems. These requirements are applicable to procurement, design, fabrication,\(^6\) installation, examination, and pressure testing of items within the scope of this Division.

(c) This Article provides requirements for repair/replacement activities performed on concrete containments and post-tensioning system items for concrete containments as specified in Article IWL-4000.

IWA-4120 APPLICABILITY

(a) The requirements of this Article apply to items classified by the Owner in accordance with IWA-1400(a) as Code Class 1, 2, 3, MC, or CC, and their associated supports. Class 1 heat exchanger tube plugs and Class 2 and 3 welded or brazed heat exchanger tube plugs shall be considered pressure-retaining material.

(b) The requirements of this Article do not apply to the following, except as provided in (c) through (e):\(^6\)

(1) valve operators, controllers, position indicators, pump impellers, pump drivers, or other accessories and devices unless they have been classified as Code Class 1, 2, or 3 pressure-retaining items in accordance with IWA-1320

(2) instruments or permanently-sealed, fluid-filled tubing systems furnished with instruments, but do apply to instrument, control, and sampling piping when classified as Code Class 1, 2, or 3 in accordance with IWA-1320

(3) rupture disk material (the requirements of this Article do apply to the portion of a rupture disk holder that forms the pressure boundary)

(4) orifice plates connecting piping of the same design pressure that are held in place mechanically

(5) other than component supports or core supports, material that is not associated with the pressure-retaining function of a component, such as shafts, stems, trim, spray nozzles, bearings, bushings, springs, wear plates, seals, packing, gaskets, valve seats, and ceramic insulating material and special alloys used as seal material in electrical penetration assemblies

(6) component support items such as gaskets, seals, bushing, springs, compression spring end plates, bearings, retaining rings, washers, wear shoes, shims, slide plates, and hydraulic fluids. Requirements, if any, for these items shall be stated in the Owner’s Requirements.

(7) Class 2 and 3 heat exchanger tube mechanical plugs

(c) If items identified in (b) require welding or brazing to the pressure-retaining portion of a component or to a component support such installation shall comply with the requirements of this Article.

(d) Applicable Construction Code requirements, such as design requirements for Class 1 valve stems, Owner responsibilities for assuring adequacy of intervening elements in the component support load path, and nondestructive examination of springs for Class 1 component supports, shall be met for items identified in (b).

(e) Nonmandatory Appendix J provides guidance in determining applicability of this Article.

IWA-4130 ALTERNATIVE REQUIREMENTS

IWA-4131 Small Items

IWA-4131.1 Applicability. Repair/replacement activities involving the following items need not meet any other requirement of Article IWA-4000, provided the alternative requirements of IWA-4131.2 are met.\(^6\)

(a) Class 1 piping, tubing (except heat exchanger tubing, and sleeves and plugs used for heat exchanger tubing), valves, fittings, and associated supports, no larger than the smaller of (1) or (2) below:

(1) NPS\(^7\) \(1\) (DN 25); or

(2) the size and design such that, in the event of postulated failure during normal plant operating conditions, the reactor can be shut down and cooled in an orderly manner, assuming makeup is provided by normal reactor coolant makeup systems operable from on-site emergency power.
IWA-4630  TEMPER BEAD WELDING OF DISSIMILAR MATERIALS

IWA-4631  General Requirements
(a) Repair/replacement activities on welds that join P-No. 8 or P-No. 43 material to P-No. 1, 3, 12A, 12B, and 12C material may be made without the specified postweld heat treatment, provided the requirements of (b) and IWA-4633 and IWA-4634 are met.
(b) Repair/replacement activities in accordance with this paragraph are limited to those along the fusion line of a nonferritic weld to ferritic base material where \( \frac{3}{16} \) in. (3.2 mm) or less of nonferritic weld deposit exists above the original fusion line after defect removal. If the defect penetrates into the ferritic base material, welding of the base material may be performed in accordance with IWA-4633 provided the depth of the weld in the base material does not exceed \( \frac{3}{16} \) in. (3.2 mm). The repair/replacement activity performed on a completed joint shall not exceed one-half the joint thickness. The surface of the completed weld in the ferritic material shall not exceed 500 in.\(^2\) (325,000 mm\(^2\)).

IWA-4633  Welding Procedure

IWA-4633.1  Shielded Metal-Arc Welding. The procedure shall include the requirements of (a) through (g):
(a) The weld metal shall be deposited using A-No. 8 weld metal (Section IX, Table QW-442) for P-No. 8 to P-No. 1 or P-No. 3 weld joints or P-No. 43 weld metal (Section IX, Table QW-432) for either P-No. 8 or P-No. 43 to P-No. 1 or P-No. 3 weld joints. The maximum bead width shall be four times the electrode core diameter.
(b) All covered electrodes used for qualification test and welding shall be from freshly opened, hermetically sealed packages or heated ovens maintained between 225°F (110°C) and 350°F (180°C). Electrodes withdrawn from hermetically sealed containers or ovens for longer than 8 hr shall be discarded or shall be baked once in accordance with the manufacturer’s recommendations and placed immediately back into the holding ovens. If withdrawn again for longer than 8 hr, they shall be discarded.
(c) The electrodes may be maintained in heated ovens in the work area. The oven temperature shall be maintained between 225°F (110°C) and 350°F (180°C). Electrodes exposed to the atmosphere for more than 8 hr shall be discarded or shall be baked once in accordance with the manufacturer’s recommendations and placed immediately back into the holding ovens. Electrodes exposed to the atmosphere for more than 8 hr after being baked once shall be discarded.
(d) The area to be welded plus a band around the area of at least 1.5 times the component thickness or 5 in. (125 mm), whichever is less, shall be preheated and maintained at a minimum temperature of 350°F (175°C). The maximum interpass temperature shall be 450°F (230°C).
(e) All areas of the ferritic base material, exposed or not, on which weld metal is to be deposited, shall be covered with a single layer of weld deposit using \( \frac{1}{32} \) in. (2.5 mm) diameter electrodes. The weld bead crown surface shall be removed by grinding or machining before depositing the second layer. The second layer shall be deposited with \( \frac{1}{16} \) in. (3 mm) diameter electrodes. Subsequent layers shall be deposited with welding electrodes no larger than \( \frac{1}{32} \) in. (4 mm) in diameter (see Figure IWA-4633.1-1).
(f) After at least \( \frac{3}{16} \) in. (5 mm) of weld metal has been deposited, the weld area shall receive a postweld hydrogen bakeout by maintaining it at 450°F to 550°F (230°C to 290°C) for 4 hr minimum.
(g) Subsequent to the above postweld hydrogen bakeout, the balance of the welding may be performed using ambient temperature preheat and a maximum interpass temperature of 350°F (180°C).

IWA-4633.2  Gas Tungsten-Arc Welding. The procedure shall include the requirements of (a) through (f):
(a) The weld shall be made using A-No. 8 weld metal (Section IX, Table QW-442) for P-No. 8 to P-No. 1 or P-No. 3 weld joints or P-No. 43 weld metal (Section IX, Table QW-432) for either P-No. 8 or P-No. 43 to P-No. 1 or P-No. 3 weld joints.
(b) The weld metal shall be deposited by the automatic or machine gas tungsten arc weld process using cold wire feed.
(c) The area to be welded plus a band around the area of at least 1.5 times the component thickness or 5 in. (125 mm), whichever is less, shall be preheated and maintained at a minimum temperature of 300°F (150°C). The maximum interpass temperature shall be 450°F (230°C).
(d) The cavity shall be buttered with the first three layers of weld metal as shown in Figure IWA-4633.2-1, Steps 1 through 3, with the weld heat input for each layer controlled to within ±10% of that used in the procedure qualification test. Subsequent layers shall be deposited with a heat input equal to or less than that used for layers beyond the third in the procedure qualification test (see Figure IWA-4643.2-1, Step 4). The completed weld shall have at least one layer of weld reinforcement deposited and then this reinforcement shall be removed by mechanical means, making the finished surface of the weld substantially flush with the surface surrounding the weld.
(e) After at least \( \frac{3}{16} \) in. (5 mm) of weld metal has been deposited, the weld area shall receive a postweld hydrogen bakeout by maintaining it at 450°F to 550°F (230°C to 290°C) for a minimum of 2 hr in P-No. 1 materials. For P-No. 3 materials, the minimum holding time shall be 4 hr.
(f) Subsequent to the above postweld hydrogen bakeout, the balance of the welding may be performed using ambient temperature preheat and a maximum interpass temperature of 350°F (180°C).
(3) Visual examination acceptance standards shall comply with the following:

- (a) Linear indications are indications in which the length is more than three times the width. Rounded indications are circular or elliptical with length not more than three times the width.

- (b) Only indications with major dimensions greater than \( \frac{1}{16} \) in. (1.5 mm) shall be considered relevant. The following relevant indications are unacceptable:

  - (1) any cracks or linear indications

  - (2) rounded indications with major dimensions greater than \( \frac{1}{8} \) in. (5 mm)

  - (3) four or more rounded indications in a line separated by \( \frac{1}{16} \) in. (1.5 mm) or less edge to edge

  - (4) ten or more rounded indications in any 6 in.\(^2\) (4 000 mm\(^2\)) of surface, with major dimension of this area not to exceed 6 in. (150 mm), with the area taken in the most unfavorable location relative to the indication being evaluated.

### IWA-4700 HEAT EXCHANGER TUBING

### IWA-4710 PLUGGING

### IWA-4711 Explosive Welding

If explosive welding is used to weld plugs to Class 1 heat exchanger tubes or heat exchanger tubesheet bore holes, the requirements of IWA-4711.4 shall be met. These requirements may be used for Class 2 and Class 3 heat exchangers.

#### IWA-4711.1 General Requirements.

(a) Material used in manufacturing plugs shall be produced in compliance with requirements of a SA or SB material specification or any other material specification that has been approved for Section III.

(b) Each plug shall be traceable to a Certified Material Test Report that indicates the mechanical properties and chemistry.

(c) Records shall be maintained by the Owner, and shall include the following:

1. Plugging procedure
2. Welding procedure qualifications
3. Welding operator performance qualifications
4. Material certifications
5. Location of all plugged tubes or holes
6. Results of heat exchanger examinations required by this Subparagraph
7. Specific tubes or holes plugged by each welding operator

(d) Records of the procedure and welder qualification shall include the results of all tests required by IWA-4711.2, and shall be certified by the Repair/Replacement Organization. The Procedure Qualification Records shall include a description of all essential and nonessential variables [IWA-4711.2.1(a) and IWA-4711.2.1(b)]. The operator performance qualification record shall also list the procedure number and revision that was used for testing; the record of operator experience shall be kept current.

#### IWA-4711.2 Welding Qualification.

##### IWA-4711.2.1 Procedure Qualifications.

The Welding Procedure Specification for plugging shall be qualified as a new procedure specification and shall be completely requalified if any of the essential variables listed below are changed. Nonessential variables may be changed without requalification, provided the Welding Procedure Specification is amended to show these changes.

(a) Essential Variables

1. A change in the P-Number classification (Section IX, Table QW/QB-422) of any of the materials being joined. This includes the tube, plug, tubesheet, or tubesheet cladding. If the plug is to be joined to any part of the tubesheet cladding, this cladding must be duplicated in the procedure qualification. Materials not listed under a P-Number require separate qualification.

2. A decrease in the nominal design wall thickness of 10% or more (if the plug is welded to the tube).

3. A change in the tubesheet hole pattern.

4. A decrease in the proximity of two simultaneously detonated parts.

5. An increase in the number of plugs to be simultaneously detonated.

6. A change in detail controlling explosive densities and charge-to-mass ratios.

7. A change in the type of explosive.

8. A change of 10% or more in the explosive charge mass.

9. A decrease of 15% or more in the tubesheet ligament.

10. The deletion of cleaning of the tube, plug, or hole contact surfaces, or a change in the cleanliness requirements (including surface oxide removal) for such surfaces prior to explosive welding.

11. A change of whether or not the tubes had been expanded into contact with the tubesheets in the areas where bonding occurs.

12. Any change in the nominal plug configuration.

13. A change of 10% or more in the clearance (stand-off) between the tube or hole and the plug in the bonding area.

(b) Nonessential Variables

1. A change in the P-Number of tubesheet material for tube plugging (when plug is not joined to tubesheet)

2. A change in the tubesheet cladding (when the plug is not joined to the cladding) when the explosive charge is installed within one tube diameter of the cladding metal.

3. For tube plugging, a change in the tube-to-tubesheet seal welding procedure when the explosive charge is installed within one tube diameter of the tube-to-tubesheet seal weld [see (c)(3)]
ARTICLE IWB-2000
EXAMINATION AND INSPECTION

IWB-2200  PRESERVICE EXAMINATION

(a) Examinations required by this Article (with the exception of Examination Category B-P, and the visual VT-3
type examination of the internal surfaces of Table IWB-2500-1 (B-L-2, B-M-2)) shall be completed prior to
initial plant startup. In addition, these preservice examinations shall be extended to include essentially 100% of
the pressure-retaining welds in all Class I components, except in those components exempted from examination
by IWB-1220(a), IWB-1220(b), or IWB-1220(c). However, in the case of Table IWB-2500-1 (B-O), the examination
shall be extended to include essentially 100% of the welds in the installed peripheral control rod drive housings
only.

(b) Shop and field examinations may serve in lieu of the
on-site preservice examinations provided:
(1) In the case of vessels only, the examination is
performed after the hydrostatic test required by Section III
has been completed;
(2) Such examinations are conducted under
conditions and with equipment and techniques equivalent to
those that are expected to be employed for subsequent in-
service examinations;
(3) The shop and field examination records are, or
can be, documented and identified in a form consistent
with those required in Article IWA-6000.
(4) Examinations deferred until disassembly of a
component for maintenance, repair/replacement activity,
or volumetric examination, as allowed by Examination
Categories B-G-1, B-G-2, B-L-2, and B-M-2
(5) Welded attachments examined as a result of com-
ponent support deformation under Examination Category
B-K

If there are less than three items or welds to be examined
in an Examination Category, the items or welds may be
examined in any two periods, or in any one period if
there is only one item or weld, in lieu of the percentage
requirements of Table IWB-2411-1.

(b) If items or welds are added to the Inspection Pro-
gram, during the service lifetime of a plant, examination
shall be scheduled as follows:
(1) When items or welds are added during the first
period of an interval, at least 25% of the examinations re-
quired by the applicable Examination Category and Item
Number for the added items or welds shall be performed
during each of the second and third periods of that inter-
val. Alternatively, if deferral of the examinations is per-
mitted for the Examination Category and Item Number,
the second period examinations may be deferred to the
third period and at least 50% of the examinations re-
quired by the applicable Examination Category and Item
Number for the added items or welds shall be performed
during the third period.

Table IWB-2411-1
Inspection Program

<table>
<thead>
<tr>
<th>Inspection Period, Calendar Years of Plant Service Within the Interval</th>
<th>Minimum Examinations Completed, %</th>
<th>Maximum Examinations Credited, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

Note:
(1) If the first period completion percentage for any examination category exceeds 34%, at least 16% of the required examinations shall be performed in the second period.
ARTICLE IWB-3000
ACCEPTANCE STANDARDS

IWB-3100 EVALUATION OF EXAMINATION
RESULTS

IWB-3110 PRESERVICE VOLUMETRIC AND
SURFACE EXAMINATIONS

IWB-3111 General

(a) The preservice volumetric and surface examinations required by IWB-2200 and performed in accordance with IWA-2200 shall be evaluated by comparing the examination results with the acceptance standards specified in IWB-3112.

(b) Acceptance of components for service shall be in accordance with IWB-3112, IWB-3113, and IWB-3114.

IWB-3112 Acceptance

(a) A component whose volumetric or surface examination in accordance with IWB-2200 meets (1), (2), or (3) below shall be acceptable for service, provided the verified flaws are recorded in accordance with the requirements of IWA-1400(i) and IWA-2220(h) in terms of location, size, shape, orientation, and distribution within the component.

(1) The volumetric or surface examination confirms the absence of flaws or identifies only flaws that have already been shown to meet the nondestructive examination standards of NB-2500 or NB-3500, as documented in Quality Assurance Records (NCA-4134.17).

(2) Volumetric examination detects flaws that are confirmed by surface or volumetric examination to be non-surface-connected and that do not exceed the standards of Table IWB-3410-1.

(3) Volumetric examination detects flaws that are confirmed by surface or volumetric examination to be non-surface-connected and that are accepted by analytical evaluation in accordance with the provisions of IWB-3132.3 to the end of the service lifetime of the component and reexamined in accordance with the requirements of IWB-2420(h) and IWB-2420(c).

(b) A component whose volumetric or surface examination detects flaws that do not meet the criteria established in (a) shall be unacceptable for service, unless the component is corrected by a repair/replacement activity in accordance with IWB-3113 to the extent necessary to meet the provisions of (a) prior to placement of the component in service.

(c) A component whose volumetric or surface examination (IWB-2200) detects flaws, other than the flaws of (b), that exceed the standards of Table IWB-3410-1 is unacceptable for service, unless the component is corrected by a repair/replacement activity to the extent necessary to meet the acceptance standards prior to placement of the component in service.

IWB-3113 Repair/Replacement Activity and
Reexamination

The repair/replacement activity and reexamination shall comply with the requirements of Article IWA-4000. Reexamination shall be conducted in accordance with the requirements of IWA-2200. The recorded results shall demonstrate that the area subjected to the repair/replacement activity meets the acceptance standards of Table IWB-3410-1.

IWB-3114 Review by Authorities

(a) The Repair/Replacement Program and the reexamination results shall be subject to review by the enforcement authorities having jurisdiction at the plant site.

(b) Evaluation of examination results may be subject to review by the regulatory authority having jurisdiction at the plant site.

IWB-3120 PRESERVICE VISUAL EXAMINATIONS

IWB-3121 General

(a) The preservice visual examinations required by IWB-2200 and performed in accordance with IWA-2200 shall be evaluated by comparing the examination results with the acceptance standards specified in Table IWB-3410-1.

(b) Acceptance of components for service shall be in accordance with IWB-3122, IWB-3123, and IWB-3124.

IWB-3122 Acceptance

IWB-3122.1 Acceptance by Visual Examination.

(a) A component whose visual examination confirms the absence of the relevant conditions described in the standards of Table IWB-3410-1 shall be acceptable for service.

(b) A component whose visual examination detects the relevant conditions described in the standards of Table IWB-3410-1 shall be unacceptable for service, unless such
IWB-3521 Standards for Examination Category B-Q, Steam Generator Tubes

IWB-3521.1 Allowable Flaws for U-Tube Steam Generators. For single or multiple flaws of cracks, voidage, or intergranular corrosion in tubing of SB-163 material meeting the requirements of NB-2550 and having an r/t ratio of less than 8.70, the depth of an allowable O.D. flaw shall not exceed 40% of the tube wall thickness.

IWB-3521.2 Allowable Flaws for Straight-Tube Steam Generators. In the course of preparation.

IWB-3522 Standards for Examination Category B-P, All Pressure-Retaining Components

IWB-3522.1 Visual Examination, VT-2. A component whose visual examination (IWA-5240) detects any of the following relevant conditions shall meet IWB-3142 and IWA-5250 prior to continued service:

(a) any through-wall or through-weld, pressure-retaining material leakage from insulated and uninsulated components;

(b) leakage in excess of limits established by the Owner from mechanical connections (such as pipe caps, bolted connections, or compression fittings) or from components provided with leakage limiting devices (such as valve packing glands or pump seals);

(c) areas of general corrosion of a component resulting from leakage;

(d) discoloration or accumulated residues on surfaces of components, insulation, or floors that may be evidence of borated water leakage; or

(e) leakages or flow test results from buried components in excess of limits established by the Owner.

IWB-3523 Standards for Examination Category B-O, Pressure-Retaining Welds in Control Rod Drive and Instrument Nozzle Housings

IWB-3523.1 Allowable Planar Flaws.

(a) The size of an allowable planar flaw within the boundary of the examination surfaces and volumes delineated in Figure IWB-2500-1B shall not exceed the limits specified in IWB-3523.2 and IWB-3523.3, as applicable.

(b) Where a flaw extends beyond the boundaries of the examination surfaces and volumes, or separate flaws are detected that lie both within and beyond the boundaries but are characterized as a single flaw by the rules of IWA-3300, the overall flaw size shall be compared with the standards of (a).

(c) Any two or more coplanar aligned flaws characterized as separate flaws by IWA-3300 are allowable, provided the requirements of IWA-3390 are met.

IWB-3523.2 Allowable Flaw Standards for Surface Examination.

(a) The size of allowable flaws shall not exceed 3/16 in. (5 mm) for the preservice examination and 1/8 in. (6 mm) for the inservice examination.

(b) Where a flaw on the outer surface of the housing exceeds the allowable standards, the housing may be examined using the volumetric method, and the acceptance standards of IWB-3523.3 shall apply.

IWB-3523.3 Allowable Flaw Standards for Volumetric Examination.

(a) The depth of an allowable preservice flaw shall not exceed 10% of weld thickness; the length shall not exceed 60% of weld thickness.

(b) The depth of an allowable inservice flaw shall not exceed 12.5% of weld thickness; the length shall not exceed 75% of weld thickness.

IWB-3600 ANALYTICAL EVALUATION OF PLANAR FLAWS

IWB-3610 ACCEPTANCE CRITERIA FOR FERRITIC STEEL COMPONENTS 4 in. (100 mm) AND GREATER IN THICKNESS

(a) A flaw that exceeds the size of allowable flaws defined in IWB-3500 may be analytically evaluated using procedures such as described in Nonmandatory Appendix A to calculate its growth until the next inspection or the end of service lifetime of the component.

(b) For purposes of analytical evaluation, the depth of flaws in clad components shall be defined in accordance with Figure IWB-3610-1 as follows:

(1) Category 1 — A flaw that lies entirely in the cladding need not be analytically evaluated.

(2) Category 2 — A surface flaw that penetrates the cladding and extends into the ferritic steel shall be analytically evaluated on the basis of the total flaw depth in both the ferritic steel and cladding.

(3) Category 3 — A subsurface flaw that lies in both the ferritic steel and the cladding shall be treated as either a surface or a subsurface flaw depending on the relationship between S and d as shown in Figure IWB-3610-1.

(4) Category 4 — A subsurface flaw that lies entirely in the ferritic steel and terminates at the weld metal interface shall be treated as either a surface or subsurface flaw depending on the relationship between S and d as shown in Figure IWB-3610-1.

(5) Category 5 — A subsurface flaw contained entirely in the ferritic steel shall be treated as either a surface or a subsurface flaw depending on the relationship between S and d as shown in Figure IWB-3610-1.

(c) When examination results do not permit accurate determination of the flaw category, the more conservative category shall be selected.
ARTICLE IWC-2000
EXAMINATION AND INSPECTION

IWC-2200  PRESERVICE EXAMINATION

(a) All examinations required by this Article (with the exception of Table IWC-2500-1 (C-H)) for those components initially selected for examination in accordance with the Inspection Program and not exempt from inservice examinations by IWC-1220 shall be completed prior to initial plant startup.

(b) Shop and field examinations may serve in lieu of the on-site preservice examinations, provided

(1) in the case of vessels only, the hydrostatic test required by Section III has been completed;

(2) such examinations are conducted under conditions and with equipment and techniques equivalent to those which are expected to be employed for subsequent inservice examinations;

(3) the shop and field examination records are, or can be, documented and identified in a form consistent with those required in Article IWA-6000.

IWC-2400  INSPECTION SCHEDULE

IWC-2410  INSPECTION PROGRAM

Inservce examinations and system pressure tests may be performed during either system operation or plant outages.

IWC-2411  Inspection Program

(a) The required examinations in each examination category shall be completed during each inspection interval in accordance with Table IWC-2411-1, with the exceptions of Category C-H and of welded attachments examined as a result of component support deformation under Examination Category C-C. If there are less than three items or welds to be examined in an Examination Category, the items or welds may be examined in any two periods, or in any one period if there is only one item or weld, in lieu of the percentage requirements of Table IWC-2411-1.

(b) If items or welds are added to the Inspection Program, during the service lifetime of a plant, examination shall be scheduled as follows:

(i) When items or welds are added during the first period of an interval, at least 25% of the examinations required by the applicable Examination Category and Item Number for the added items or welds shall be performed during each of the second and third periods of that interval.

(2) When items or welds are added during the second period of an interval, at least 25% of the examinations required by the applicable Examination Category and Item Number for the added items or welds shall be performed during the third period of that interval.

(3) When items or welds are added during the third period of an interval, examinations shall be scheduled in accordance with (a) for successive intervals.

IWC-2420  SUCCESSIVE INSPECTIONS

(a) The sequence of component examinations which was established during the first inspection interval shall be repeated during each successive inspection interval, to the extent practical. The sequence of component examinations may be modified in a manner that optimizes scaffolding, radiological, insulation removal, or other considerations, provided that the percentage requirements of Table IWC-2411-1 are maintained.

(b) If a component is accepted for continued service in accordance with IWC-3122.3 or IWC-3132.3(a), the areas containing flaws or relevant conditions shall be reexamined during the next inspection period listed in the schedule of the Inspection Program of IWC-2400. Alternatively, acoustic emission may be used to monitor growth of existing flaws in accordance with IWA-2234. For vessel welds, the successive inspection is not required if the following conditions are met:

(1) The flaw is characterized as subsurface in accordance with Figure IWA-3320-2.

<table>
<thead>
<tr>
<th>Table IWC-2411-1 Inspection Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection Period, Calendar Years of</td>
</tr>
<tr>
<td>Inspection Interval</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>All</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

NOTE: (1) If the first period completion percentage for any examination category exceeds 34%, at least 16% of the required examinations shall be performed in the second period.
ARTICLE IWC-3000
ACCEPTANCE STANDARDS

IWC-3110 EVALUATION OF EXAMINATION RESULTS

IWC-3111 General

(a) The preservice volumetric and surface examinations required by IWC-2200 and performed in accordance with IWA-2200 shall be evaluated by comparing the examination results with the acceptance standards specified in IWC-3112.

(b) Acceptance of components for service shall be in accordance with IWC-3112, IWC-3113, and IWC-3114.

IWC-3112 Acceptance

(a) A component whose volumetric or surface examination in accordance with IWC-2200 meets (1), (2), or (3) below shall be acceptable for service, provided the verified flaws are recorded in accordance with the requirements of IWA-1400(1) and IWA-2220(b) in terms of location, size, shape, orientation, and distribution within the component.

(1) Volumetric or surface examination confirms the absence of flaws or identifies only flaws that have already been shown to meet the nondestructive examination standards of NC-2500 or NC-5300, as documented in Quality Assurance Records (NCA-4134.17).

(2) Volumetric examination detects flaws that are confirmed by surface or volumetric examination to be nonsurface-connected and that do not exceed the standards of Table IWC-3410-1.

(3) Volumetric examination detects flaws that are confirmed by surface or volumetric examination to be nonsurface-connected that are accepted by analytical evaluation in accordance with the provisions of IWC-3132.3 to be acceptable to the end of the service lifetime of the component and reexamined in accordance with the requirements of IWB-2420(b) and IWB-2420(c), in lieu of IWC-2420(b) and IWC-2420(c).

(b) A component whose volumetric or surface examination detects flaws that do not meet the criteria established in (a) shall be unacceptable for service, unless the component is corrected by a repair/replacement activity in accordance with IWC-3113 to the extent necessary to meet the provisions of (a) prior to placement of the component in service.

(c) A component whose examination detects flaws other than the flaws of (b) that exceed the standards of Table IWC-3410-1 is unacceptable for service unless the component is corrected by a repair/replacement activity to the extent necessary to meet the acceptance standards prior to placement of the component in service.

IWC-3113 Repair/Replacement Activity and Reexamination

The repair/replacement activity and reexamination shall comply with the requirements of Article IWA-4000. Reexamination shall be conducted in accordance with the requirements of IWA-2200. The recorded results shall demonstrate that the area subjected to the repair/replacement activity meets the acceptance standards of Table IWC-3410-1.

IWC-3114 Review by Authorities

(a) The Repair/Replacement Program and the reexamination results shall be subject to review by the enforcement authorities having jurisdiction at the plant site.

(b) Evaluation of examination results may be subject to review by the regulatory authority having jurisdiction at the plant site.

IWC-3120 INSERVICE VOLUMETRIC AND SURFACE EXAMINATIONS

IWC-3121 General

(a) The examination results shall be compared with the recorded results of the preservice and prior inservice examinations. Acceptance of the components for continued service shall be in accordance with the acceptance alternatives of IWC-3122.

(b) Where a required inservice examination detects flaws that are acceptable under IWC-3112(a), the component shall remain acceptable for service provided the flaws satisfy the acceptance standards of NC-2500 and NC-5300 or the acceptance standards of Table IWC-3410-1.

IWC-3122 Acceptance

IWC-3122.1 Acceptance by Examination. A component whose examination reconfirms the absence of flaws, detects flaws that do not exceed the acceptance standards listed in Table IWC-3410-1, or detects flaws that are acceptable in accordance with IWC-3121(b) shall be acceptable for continued service. Confirmed changes in flaws
**ARTICLE IWD-2000**

**EXAMINATION AND INSPECTION**

**IWD-2200  PRESERVICE EXAMINATION**

All examinations required by this Article (with the exception of Table IWD-2500-1 (D-B)) shall be performed completely, once, as a preservice examination requirement prior to initial plant startup.

**IWD-2400  INSPECTION SCHEDULE**

**IWD-2410  INSPECTION PROGRAM**

Inservice examinations and system pressure tests may be performed during either system operation or plant outages.

**IWD-2411  Inspection Program**

(a) The required examinations in each examination category shall be completed during each inspection interval in accordance with Table IWD-2411-1, with the exceptions of Category D-B and of welded attachments examined as a result of component support deformation under Examination Category D-A. If there are less than three items to be examined in an Examination Category, the items may be examined in any two periods, or in any one period if there is only one item, in lieu of the percentage requirements of Table IWD-2411-1.

(b) If items are added to the Inspection Program, during the service lifetime of a plant, examination shall be scheduled as follows:

<table>
<thead>
<tr>
<th>Table IWD-2411-1 Inspection Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection Period, Calendar</td>
</tr>
<tr>
<td>Years of Plant Service Within the Interval</td>
</tr>
<tr>
<td>All 3</td>
</tr>
<tr>
<td>7 50 [Note (1)]</td>
</tr>
<tr>
<td>10 100</td>
</tr>
</tbody>
</table>

NOTE: (1) If the first period completion percentage for any examination category exceeds 34%, at least 16% of the required examinations shall be performed in the second period.

(1) When items are added during the first period of an interval, at least 25% of the examinations required by the applicable Examination Category and Item Number for the added items shall be performed during each of the second and third periods of that interval.

(2) When items are added during the second period of an interval, at least 25% of the examinations required by the applicable Examination Category and Item Number for the added items shall be performed during the third period of that interval.

(3) When items are added during the third period of an interval, examinations shall be scheduled in accordance with (a) for successive intervals.

**IWD-2420  SUCCESSIVE INSPECTIONS**

(a) The sequence of component examinations which was established during the first inspection interval shall be repeated during each successive inspection interval, to the extent practical. The sequence of component examinations may be modified in a manner that optimizes scaffolding, radiological, insulation removal, or other considerations, provided that the percentage requirements of Table IWD-2411-1 are maintained.

(b) If components are accepted for continued service by evaluation in accordance with IWD-3132.3(a), the areas containing flaws or relevant conditions shall be reexamined during the next inspection period listed in the schedule of the Inspection Program of IWD-2400.

(c) If the reexaminations required by (b) above reveal that the flaws or relevant conditions remain essentially unchanged, or that the flaw growth is within the growth predicted by the analytical evaluation, for the next inspection period, then the component examination schedule may revert to the original schedule of successive inspections or the inspection interval defined by the analytical evaluation, whichever is limiting.

(d) If the reexaminations required by (b) above reveal new flaws or relevant conditions that exceed the applicable acceptance standards of IWD-3400, or growth of existing flaws in excess of the growth predicted by the analytical evaluation, then

(1) the entire weld, area, or part \(^5\) shall be examined during the current outage

(2) additional examinations shall be performed in accordance with IWD-2430

(e) If welded attachments are examined as a result of identified component support deformation and the results of these examinations exceed the acceptance
SUBSECTION IWE
REQUIREMENTS FOR CLASS MC AND METALLIC LINERS OF CLASS CC COMPONENTS OF LIGHT-WATER-COOLED PLANTS

ARTICLE IWE-1000
SCOPE AND RESPONSIBILITY

IWE-1100 SCOPE

This Subsection provides requirements for in-service inspection of Class MC pressure-retaining components and their integral attachments, and of metallic shell and penetration liners of Class CC pressure-retaining components and their integral attachments in light-water-cooled plants.

IWE-1200 COMPONENTS SUBJECT TO EXAMINATION

IWE-1210 EXAMINATION REQUIREMENTS

The examination requirements of this Subsection shall apply to Class MC pressure-retaining components and their integral attachments and to metallic shell and penetration liners of Class CC pressure-retaining components and their integral attachments. These examinations shall apply to surface areas, including welds and base metal.

IWE-1220 COMPONENTS EXEMPTED FROM EXAMINATION

The following components (or parts of components) are exempted from the examination requirements of Article IWE-2000:

(a) vessels, parts, and appurtenances outside the boundaries of the containment system as defined in the Design Specifications;

(b) embedded or inaccessible portions of containment vessels, parts, and appurtenances that met the requirements of the original Construction Code;

(c) portions of containment vessels, parts, and appurtenances that become embedded or inaccessible as a result of vessel repair/replacement activities if the conditions of IWE-1232(a), and IWE-1232(b), and IWE-5220 are met;

(d) piping, pumps, and valves that are part of the containment system, or which penetrate or are attached to the containment vessel. These components shall be examined in accordance with the requirements of Subsection IWB or Subsection IWC, as appropriate to the classification defined by the Design Specifications.

IWE-1230 ACCESSIBILITY FOR EXAMINATION

IWE-1231 Accessible Surface Areas

(a) As a minimum, the following portions of Class MC containment vessels, parts and appurtenances, and Class CC metallic shell and penetration liners shall remain accessible for either direct or remote visual examination, from at least one side of the vessel, for the life of the plant:

(1) openings and penetrations;

(2) structural discontinuities;

(3) 80% of the pressure-retaining boundary (excluding attachments, structural reinforcement, and areas made inaccessible during construction); and

(4) surface areas identified in IWE-1240

(b) The requirements of IWE-1232 shall be met when accessibility for visual examination is only from the interior surface.

IWE-1232 Inaccessible Surface Areas

(a) Portions of Class MC containment vessels, parts, and appurtenances that are embedded in concrete or otherwise made inaccessible during construction of the vessel or as a result of vessel repair/replacement activities are exempted from examination, provided:

(1) no openings or penetrations are embedded in the concrete;

(2) no openings or penetrations are embedded in the concrete.

For ASME Committee use only.
IWE-3124  Repair/Replacement Activity and Reexamination

The repair/replacement activity and reexamination shall comply with the requirements of Article IWA-4000. Reexamination shall be conducted in accordance with the requirements of IWA-2200. The recorded results shall demonstrate that the area subject to the repair/replacement activity meets the acceptance standards of IWE-3500.

IWE-3130  INSERVICE VISUAL EXAMINATIONS

A component whose visual examination as specified in Tables IWE-2500-1 (E-A), IWE-2500-1 (E-C), and IWE-2500-1 (E-G) detects areas that are suspect, shall be unacceptable for continued service unless, following verification of the suspect areas by the supplemental examination as required by IWE-3200, the requirements of IWE-3120 are satisfied.

IWE-3200  SUPPLEMENTAL EXAMINATIONS

Examinations that detect flaws or evidence of degradation that require evaluation in accordance with the requirements of IWE-3100 may be supplemented by other examination methods and techniques (IWA-2240) to determine the character of the flaw (i.e., size, shape, and orientation) or degradation. Visual examinations that detect surface flaws or areas that are suspect shall be supplemented by either surface or volumetric examination, when specified as a result of the engineering evaluation performed in IWE-3122.3.

IWE-3400  STANDARDS

IWE-3410  ACCEPTANCE STANDARDS

The acceptance standards of IWE-3500 shall be applied to evaluate the acceptability of the component for service following the preservice examination and each inservice examination.

IWE-3430  ACCEPTABILITY

Flaws or areas of degradation that do not exceed the allowable acceptance standards of IWE-3500 for the respective examination category shall be acceptable.

IWE-3500  ACCEPTANCE STANDARDS

IWE-3510  STANDARDS FOR EXAMINATION CATEGORY E-A, CONTAINMENT SURFACES

IWE-3511  General Visual Examination of Coated and Noncoated Areas

The condition of the examined area is acceptable if the Responsible Individual determines that there is no evidence of damage or degradation requiring further evaluation or performance of a repair/replacement activity. Suspect conditions shall be evaluated to the extent necessary to determine that the component function is not impaired.

IWE-3512  General Visual Examination of Moisture Barriers

Moisture barriers with wear, damage, erosion, tear, surface cracks, or other defects that permit intrusion of moisture against inaccessible areas of the pressure-retaining surfaces of the metal containment shell or liner shall be corrected by corrective measures. Corrective measures may be deferred until the next regularly scheduled outage if an engineering evaluation (IWE-3122.3) demonstrates that degradation from any moisture intrusion would not reduce the thickness of the base metal in local areas by more than 10% of the nominal plate thickness, or the degradation-reduced thickness can be shown by analysis to satisfy the requirements of the Design Specifications.

IWE-3513  Visual Examination, VT-3

The following relevant conditions shall require correction or evaluation to meet the requirements of IWE-3122 prior to continued service:
(a) pressure-retaining component corrosion or erosion that exceeds 10% of the nominal wall thickness; (b) loose, missing, cracked, or fractured parts, bolting, or fasteners; or (c) structural distortion or displacement of parts to the extent that the component function is impaired.

IWE-3520  STANDARDS FOR EXAMINATION CATEGORY E-C, CONTAINMENT SURFACES REQUIRING AUGMENTED EXAMINATION

IWE-3521  Visual Examination, VT-1

The following relevant conditions shall require correction or evaluation to meet the requirements of IWE-3122 prior to continued service:
(a) pressure-retaining component corrosion or erosion that exceeds 10% of the nominal wall thickness; (b) loose, missing, cracked, or fractured parts; (c) bolting or fastener relevant conditions listed in IWB-3517.1; (d) structural distortion or displacement of parts to the extent that component function is impaired; (e) moisture barrier conditions that fail to meet the acceptance standards of IWE-3512.

IWE-3522  Ultrasonic Examination

Examinations of Class MC pressure-retaining components and of metallic shell and penetration liners of Class CC pressure-retaining components that detect material loss in a local area exceeding 10% of the nominal wall thickness, or material loss in a local area projected to...
ARTICLE VI-4000
QUALIFICATION REQUIREMENTS

VI-4100 EXPERIENCE

VI-4110 INITIAL CERTIFICATION FOR VISUAL EXAMINATION

(a) Experience in each discipline is required for unlimited certification. The term “experience” refers to visual examination defined in IWA-2211, IWA-2212, and IWA-2213, or related experience in the applicable method such as the following:

(1) for VT-1, experience as a weld examiner, AWS CWI or AWS CAWI;

(2) for VT-1, experience in performing surface examinations;

(3) for VT-2, experience in pressure tests;

(4) for VT-2, plant walkthrough experience, such as that gained by licensed and nonlicensed operators, local leak rate personnel, system engineers, quality control personnel, and nondestructive examination personnel;

(5) for VT-3, installation, maintenance, or examination of pumps, valves, or supports;

(6) for VT-1 and VT-3, experience in installation, maintenance, or examination of RPV internals, or other remote visual examination;

(7) for Level III, documented visual training or examination activities; administration or development of VT-1, VT-2, or VT-3 visual examination training or examination programs; or experience as defined in (1) through (6) above.

(b) Experience shall be documented by specific tasks and disciplines, e.g., 10 hr VT-3 visual examination of supports.

(c) No more than 50% of the required experience for VT-1 visual examination shall be in surface examination.

VI-4200 TRAINING

Visual examination personnel shall successfully complete the training program outlined in Supplement 1. Training received in other NDE disciplines or academic training courses covering the topics in Supplement 1 may be credited toward certification. The hours of training shall be in accordance with ANSI/ASNT CP-189.

VI-4300 EXAMINATIONS

To be considered for examination, the Level I, II, and III candidates shall successfully complete the training required by VI-4200. Level I and II qualification examinations shall be in accordance with ANSI/ASNT CP-189. Level III qualification examinations shall be in accordance with IWA-2300.
no more than one-third of the specimens or grading units in the set contain flaws required to be detected. The specimens or grading units shall be masked such that flawd and blank specimens or grading units cannot be identified and the flaw locations are not visible.

**VII-4320 LEVELS I AND II QUALIFICATION EXAMINATIONS**

**VII-4321 Levels I and II General Examinations**

The General Examination shall be a written, closed book examination containing a minimum of 40 questions. The examination shall cover the technical principles relative to the ultrasonic (UT) method.

**VII-4322 Levels I and II Specific Examinations**

(a) The Specific Examination shall be a written examination containing a minimum of 40 questions. Necessary data, such as graphs, tables, specifications, procedures, and Codes shall be furnished.

(b) Forty to 60% of the specific examination questions shall cover Section XI NDE requirements. The remaining questions shall cover procedures and specifications applicable to the UT method.

**VII-4323 Levels I and II Practical Examinations**

(a) Candidates shall demonstrate to the satisfaction of a Level III that they are familiar with and can perform the applicable UT examinations using suitable calibration blocks and written UT procedures prepared for examination of plant components.

(b) The Practical Examination shall include examination of a specimen set that complies with VII-4310(b). Alternatively, successful completion of a UT performance demonstration in accordance with Mandatory Appendix VIII may serve as this Practical Examination.

(c) An assessment report containing at least ten check points shall be used to evaluate the candidate’s performance using longitudinal and shear wave techniques. The following check points shall be included:

1. scanning technique;
2. equipment set-up and calibration;
3. selection of search unit;
4. data recording (Levels I and II);
5. NDE report (Level II); and
6. evaluation in terms of the recording criteria.

(d) A description of the specimens and the calibration blocks, the procedures used, the assessment report, and the examination report prepared by the candidate shall be retained as part of the certification records.

**VII-4330 LEVEL III QUALIFICATION EXAMINATIONS**

(a) Level III Examinations shall be in accordance with AWS-2300, except that the Demonstration Examination shall meet VII-4323 Level II Practical Examination rules. In addition, the Specific Examination shall be a written examination containing at least 30 questions. Forty to 60% of the questions shall cover Section XI UT examination, evaluation, and acceptance criteria. Necessary data such as graphs, tables, specifications, procedures, and Codes shall be furnished.

(b) Level III personnel shall be recertified using the written Method, Specific, and Practical Examinations and the Demonstration Examination. Alternatively, Level III personnel may be recertified using only the written Method and Specific Examinations provided the following conditions are met:

1. The Level III candidate was previously certified or recertified using all the written examinations and the Demonstration Examination.

2. The Level III candidate is not being recertified due to interrupted service as defined in the Employer’s written practice.

3. The Level III candidate is not being recertified by a new Employer.

**VII-4340 ADMINISTRATION OF EXAMINATIONS**

**VII-4341 Levels I and II General, Specific, and Practical Examinations**

The General, Specific, and Practical Examinations shall be approved, administered, and graded by a Level III. The candidate shall perform the Practical Examinations using procedures, techniques, and equipment complying with Section XI requirements on specimens not used for training.

**VII-4342 Level III Basic, Method, Specific, Practical, and Demonstration Examinations**

(a) Level III Basic and Method Examinations shall be administered and graded by an outside agency.

(b) The Specific, Practical, and Demonstration Examinations shall be approved, administered, and graded by a Level III employed by an outside agency or the Employer.

**VII-4343 Written Examination Administration**

The administration of multiple-choice written examinations may be delegated by the Level III, with valid Level III certifications in the applicable test methods, to a noncertified proctor, if so documented.

**VII-4350 GRADING OF EXAMINATIONS**

(a) A minimum score of 80% is required for the composite score on a certification examination and a minimum score of 70% for each of the applicable general, basic, specific, method, demonstration, and practical examinations. When the examinations are graded by an outside agency, a grade of 80% shall be assigned for those examinations the candidate passed unless actual numerical grades are provided, in which case the numerical grades shall be recorded.
(b) The Levels I and II Practical Examinations and the Level III Demonstration Examinations shall be graded such that failure to accurately detect, locate, interpret, evaluate, or record, as applicable for the examination, 80% of the known conditions in the test specimen set shall cause the candidate to fail the examination. In addition, a maximum false call rate of 10% shall be imposed (i.e., no more than 10% of the blank test specimens shall be reported as flawed).

VII-4360 REEXAMINATION

(a) Those individuals failing to pass a qualification examination must receive additional training as determined by a Level III. This determination shall be based on topics or subjects on which the individual failed to attain a passing grade.

(b) The reexamination questions shall be assembled by a random selection process or the examination shall contain at least 30% different or reworded questions. The Practical or Demonstration Examination test specimen set shall contain at least 50% different flaws from those used during the most recent Practical or Demonstration Examination that was not passed by the candidate.

(c) No individual shall be reexamined more than twice within any consecutive 12-month period.

VII-4400 INTERRUPTED SERVICE

Personnel who have not performed the duties associated with their certification level during any consecutive 12-month period shall be considered to have interrupted service and shall be required to successfully complete a Practical Examination (Levels I and II personnel), or a Specific Examination (Level III personnel), to assure continued proficiency prior to further assignment to perform NDE. The results of this examination shall be documented and maintained as part of the individual’s certification records.
MANDATORY APPENDIX I
AMBIENT-TEMPERATURE TEMPER BEAD WELDING

I-1 GENERAL REQUIREMENTS

(a) This Mandatory Appendix applies to dissimilar austenitic filler metal welds between P-Nos. 1, 3, 12A, 12B, and 12C materials and their associated welds and welds joining P-No. 8 or 43 materials to P-Nos. 1, 3, 12A, 12B, and 12C materials with the following limitation. This Mandatory Appendix shall not be used to repair SA-302 Grade B material unless the material has been modified to include from 0.4% to 1.0% nickel, quenching, tempering, and application of a fine grain practice.

(b) The maximum area of an individual weld overlay based on the finished surface over the ferritic base material shall be 1,000 in² (65 000 mm²).

(c) Repair/replacement activities on a dissimilar metal weld in accordance with this Mandatory Appendix are limited to those along the fusion line of a nonferritic weld to ferritic base material on which 1/6 in. (3 mm) or less of nonferritic weld deposit exists above the original fusion line.

(d) If a defect penetrates into the ferritic base material, repair of the base material, using a nonferritic weld filler material, may be performed in accordance with this Mandatory Appendix, provided the depth of repair in the base material does not exceed 3/4 in. (10 mm).

(e) Prior to welding, the area to be welded and a band around the area of at least 1/2 times the component thickness or 5 in. (130 mm), whichever is less, shall be at least 50°F (10°C).

(f) Welding materials shall meet the Owner's Requirement and the Construction Code and Cases specified in the Repair/Replacement Plan. Welding materials shall be controlled so that they are identified as acceptable until consumed.

(g) Peening may be used, except on the initial and final layers.

I-2 WELDING QUALIFICATIONS

The welding procedures and operators shall be qualified in accordance with Section IX and the requirements of I-2.1 and I-2.2.

I-2.1 Procedure Qualification.

(a) The base materials for the welding procedure qualification shall be of the same P-Number and Group Number as the materials to be welded. The materials shall be postweld heat treated to at least the time and temperature that was applied to the materials being welded.

(b) The maximum interpass temperature for the first three layers of the test assembly shall be 150°F (66°C).

(c) The weld overlay shall be qualified using groove weld coupon. The test assembly groove depth shall be at least 1 in. (25 mm). The test assembly groove depth shall be at least twice the test assembly groove depth. The test assembly shall be large enough to permit removal of the required test specimens. The test assembly dimensions on either side of the groove shall be at least 6 in. (150 mm). The qualification test plate shall be prepared in accordance with Figure I-1.

(d) Ferritic base material for the procedure qualification test shall meet the impact test requirements of the Construction Code and Owner's Requirements. If such requirements are not in the Construction Code and Owner's Requirements, the impact properties shall be determined by Charpy V-notch impact tests of the procedure qualification base material at or below the lowest service temperature of the item to be repaired. The location and orientation of the test specimens shall be similar to those required in (e), but shall be in the base metal.

(e) Charpy V-notch tests of the ferritic heat-affected zone (HAZ) shall be performed at the same temperature as the base metal test of (d). Number, location, and orientation of test specimens shall be as follows:

(1) The specimens shall be removed from a location as near as practical to a depth of one-half the thickness of the deposited weld metal. The coupons for HAZ impact specimens shall be taken transverse to the axis of the weld and etched to define the HAZ. The notch of the Charpy V-notch specimen shall be cut approximately normal to the material surface in such a manner as to include as much HAZ as possible in the resulting fracture.

(2) If the material thickness permits, the axis of a specimen shall be inclined to allow the root of the notch to be aligned parallel to the fusion line.

(3) If the test material is in the form of a plate or forging, the axis of the weld shall be parallel to the principal direction of rolling or forging.

(f) The Charpy V-notch test shall be performed in accordance with SA-370. Specimens shall be in accordance with SA-370, Fig. 11, Type A. The test shall consist of a set of three full-size 10 mm × 10 mm specimens. The lateral expansion, percent shear, absorbed energy, test temperature, orientation, and location of all test specimens shall be reported in the Procedure Qualification Record.

(g) The average lateral expansion value of the three HAZ Charpy V-notch specimens shall be equal to or greater than the average lateral expansion value of the three unaffected base metal specimens. However, if the average lateral expansion value of the HAZ Charpy V-notch specimen is less than the average value for the unaffected
MANDATORY APPENDIX I

AMBIENT-TEMPERATURE TEMPER BEAD WELDING

I-1 GENERAL REQUIREMENTS

(a) This Appendix applies to dissimilar austenitic filler metal welds between P-Nos. 1, 3, 12A, 12B, and 12C² materials and their associated welds and welds joining P-No. 8 or 43 materials to P-Nos. 1, 3, 12A, 12B, and 12C² materials with the following limitation. This Appendix shall not be used to repair SA-302 Grade B material unless the material has been modified to include from 0.4% to 1.0% nickel, quenching, tempering, and application of a fine grain practice.

(b) The maximum area of an individual weld overlay based on the finished surface over the ferritic base material shall be 1000 in² (650000 mm²).

(c) Repair/replacement activities on a dissimilar-metal weld in accordance with this Appendix are limited to those along the fusion line of a nonferritic weld to ferritic base material on which ⅛ in. (3 mm) or less of nonferritic weld deposit exists above the original fusion line.

(d) If a defect penetrates into the ferritic base material, repair of the base material, using a nonferritic weld filler material, may be performed in accordance with this Appendix, provided the depth of repair in the base material does not exceed ⅛ in. (10 mm).

(e) Prior to welding, the area to be welded and a band around the area of at least 1½ times the component thickness or 5 in. (120 mm), whichever is less, shall be at least 50°F (10°C).

(f) Welding materials shall meet the Owner’s Requirements and the Construction Code and Cases specified in the Repair/Replacement Plan. Welding materials shall be controlled so that they are identified as acceptable until consumed.

(g) Peening may be used, except on the initial and final layers.

I-2 WELDING QUALIFICATIONS

The welding procedures and operators shall be qualified in accordance with Section IX and the requirements of I-2.1 and I-2.2.

I-2.1 Procedure Qualification

(a) The base materials for the welding procedure qualification shall be of the same P-Number and Group Number as the materials to be welded. The materials shall be postweld heat treated to at least the time and temperature that was applied to the materials being welded.

(b) The maximum interpass temperature for the first three layers of the test assembly shall be 150°F (66°C).

(c) The weld overlay shall be qualified using groove weld coupon. The test assembly groove depth shall be at least 1 in. (25 mm). The test assembly thickness shall be at least twice the test assembly groove depth. The test assembly shall be large enough to permit removal of the required test specimens. The test assembly dimensions on either side of the groove shall be at least 6 in. (150 mm). The qualification test plate shall be prepared in accordance with Fig. 1-1.

(d) Ferritic base material for the procedure qualification test shall meet the impact test requirements of the Construction Code and Owner’s Requirements. If such requirements are not in the Construction Code and Owner’s Requirements, the impact properties shall be determined by Charpy V-notch impact tests of the procedure qualification base material at or below the lowest service temperature of the item to be repaired. The location and orientation of the test specimens shall be similar to those required in I-2.1(e), but shall be in the base metal.