ASME BPVC. XI-20XX
(Proposed revision of ASME BPVC. XI-2019)

ASME Boiler and Pressure Vessel Code- Section XI

Rules for Inservice Inspection of Nuclear Power Plant Components

March 2020 Draft Revisions

Tentative
Subject to Revision or Withdrawal
Specific permission required for Reproduction or Quotation
ASME Codes and Standards
IWA-4143  Stamping

(a) Application of the ASME NPT symbol is neither required nor prohibited for the fabrication of parts, appurtenances, piping subassemblies, and supports to be used by the Owner when performed by the Owner or Owner’s contracted at the Owner’s facilities by a Repair/Replacement Organization with a quality assurance program that complies with IWA-4142. This fabrication is subject to the inspection requirements of IWA-4170. These provisions may not be used to manufacture complete pumps, valves, vessels, or tanks.
Revise definition of ‘appurtenance’ and add new definitions for ‘part’ and ‘piping subassembly’ to IWA-9000

appurtenance: an item materials that are joined by welding or brazing intended to be attached, or that is attached, to a stamped completed component, that has work performed on it requiring verification by an Inspector.

appurtenance: an item to be attached to a stamped component that has work performed on it requiring verification by an Inspector (for components fabricated to Section III).

part: (for components fabricated to Section III) an item that is attached to or became a portion of a component or support before completion and stamping of the component or support. A replacement part for use in a repair/replacement activity is an item that will become a portion of a component or support after completion and stamping of the component or support. Parts have work performed on them requiring verification by an Inspector.

part: (for components fabricated to Construction Codes other than Section III) an item intended to be installed, or that is installed, in a component, meeting one of the following:
(a) materials joined by welding with filler metal or brazing,
(b) materials having hard-facing or corrosion-resistant weld metal overlay applied,
(c) materials joined by any means, when the Construction Code requires that fabrication to be verified by an Inspector.

piping subassembly: a section of piping system consisting of fittings, pipes, or tubes that is fabricated in a shop or in the field before being installed.

piping subassembly: a section of piping system consisting of fittings and pipes or tubes that are fabricated as subassemblies in a shop or in the field before being installed in a nuclear power system.

FOR INFORMATION ONLY

IWA-4225 Reconciliation of Parts, Appurtenances, and Piping Subassemblies
(a) Parts, appurtenances, and piping subassemblies may be fabricated to later Editions and Addenda of the Construction Code and later different Construction Codes, as permitted by IWA-4221(c), provided materials are reconciled in accordance with IWA-4224. The Owner shall evaluate any changes in weight, configuration, or pressure–temperature rating in accordance with IWA-4311.
(b) An earlier Edition and Addenda of the same Construction Code may be used, provided all technical requirements of the earlier Construction Code are reconciled to the Construction Code requirements of the component or appurtenance into which the replacement item is installed, provided materials are reconciled in accordance
Address LB negatives and SC XI Comments with IWA-4224.
1. Subject

BPV XI Revision to IWA-2212, VT-2 Examination and IWA-5241, Visual Examination, Insulated and Noninsulated Components

2. Proposal

Revise IWA-2212(c) and IWA-5241(c)

3. Explanation

A posting to the Inservice Inspection Program Owners Group (ISIPOG) website forum raised questions regarding ASME requirements related to performance of remote VT-2 examinations in areas other where access cannot be obtained. A question was raised regarding whether or not ASME rules should be modified to provide additional clarification regarding the use of remote VT-2 examinations in areas other than inaccessible (such as areas that may be accessible but harmful to the examiner). This item centers around the requirements of subparagraph IWA-5241(c) for utilizing leakage detection systems when performing VT-2 examinations in inaccessible areas and the requirements of IWA-2212 to clarify that examinations can be performed remotely where access is restricted or where there may be conditions that could cause bodily harm to the examiner.

Record 18-1626 was combined with this action for clarity.

4. Summary of Changes

Revise IWA-2212(c) and IWA-5241(c) to allow VT-2 examinations to be performed remotely when there is adequate lighting. This will clarify that VT-2 examinations can be performed remotely in areas where access is restricted.

5. Proposed Action

IWA-2212 VT-2 Examination

(a) VT-2 examination is conducted to detect evidence of leakage from pressure-retaining components, as required during the conduct of system pressure test.

(b) VT-2 examination shall be conducted in accordance with Article IWA-5000.

(c) As indicated in Table IWA-2211-1, there are no illumination, distance, and resolution demonstration requirements for VT-2.

Insert the following proposed (c): VT-2 examination shall be performed, either directly or remotely, with adequate illumination and resolution to detect evidence of leakage. As indicated in Table IWA-2211-1, there are no specific illumination, distance, and resolution demonstration requirements for VT-2.
IWA-5241 Insulated and Noninsulated Components

(a) The VT - 2 visual examination shall be conducted by examining the accessible external exposed surfaces of pressure-retaining components for evidence of leakage. 
(b) For components whose external surfaces are inaccessible for direct VT - 2 visual examination, only the examination of the surrounding area (including floor areas or equipment surfaces located underneath the components) for evidence of leakage shall be required.
(c) Components within rooms, vaults, etc., where access cannot be obtained, may be examined using remote visual equipment or installed leakage detection systems.
(d) Essentially vertical surfaces need only be examined at the lowest elevation where leakage may be detected.
(e) Discoloration or residue on surfaces shall be examined for evidence of boric acid accumulations from borated reactor coolant leakage.
(f) For insulated components in a borated portion of a system that is borated for the purpose of controlling reactivity, insulation shall be removed from pressure retaining bolted connections for VT - 2 visual examination. Insulation removal and VT - 2 visual examination of insulated bolted connections may be deferred until the system is depressurized. When corrosion-resistant bolting material with a chromium content of at least 10%, such as SA-564 Grade 630 H1100, SA-453 Grade 660, SB-637 Type 718, or SB-637 Type 750, is used, it is permissible to perform the VT - 2 visual examination without insulation removal.
(g) Essentially horizontal surfaces of insulation shall be examined at each insulation joint if accessible for direct VT - 2 examination.
(h) When examining insulated components, the examination of the surrounding area (including floor areas or equipment surfaces located underneath the components) for evidence of leakage, or other areas to which such leakage may be channeled, shall be required.
IWA-2120  Qualification of Authorized Inspection Agencies, Inspectors, and Supervisors

(a) The inspection required by this Division shall be performed by an Inspector employed by an ASME-accredited Authorized Inspection Agency or by an Inspector employed or appointed by enforcement authorities in the country or region having jurisdiction over the designated plant.

   (1) where the plant is in the United States, by an Inspector employed by a State or Municipality of the United States or an Inspector regularly employed by an insurance company authorized to write boiler and pressure vessel insurance in the United States

   (2) where the plant is in Canada, by an Inspector employed by a Canadian Province or, if authorized by the Province in which the plant is located, by an Inspector regularly employed by an insurance company licensed to write boiler and pressure vessel insurance in that Province

   (3) by an Inspector employed by other enforcement authorities in the United States or Canada having jurisdiction over the designated plant

(b) The ASME-accredited Authorized Inspection Agency, including its staff of Authorized Nuclear Inservice Inspector Supervisors and the Inspectors, shall meet the requirements of ASME QAI-1.

   (c) The Authorized Inspection Agency shall be accredited by ASME in accordance with the provisions set forth in ASME QAI-1.

ARTICLE IWA-9000

GLOSSARY

enforcement authority: a national, regional or local governing body, such as a Country, State or Municipality of the United States or a Province of Canada, empowered to enact and enforce Boiler and Pressure Vessel Code legislation.
<table>
<thead>
<tr>
<th>Standard, Method, or Specification</th>
<th>Revision Date or Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI 201.1R</td>
<td>2008</td>
</tr>
<tr>
<td>ACI 349.3R</td>
<td>2002 (Reapproved 2010)</td>
</tr>
<tr>
<td>ANSI/ASNT CP-105</td>
<td>2006</td>
</tr>
<tr>
<td>ANSI/ASNT CP-189</td>
<td>2006</td>
</tr>
<tr>
<td>ANSI/AWS D3.6M</td>
<td>Current Edition</td>
</tr>
<tr>
<td>APHA 427</td>
<td>1981</td>
</tr>
<tr>
<td>APHA 4500-S2-</td>
<td>1989</td>
</tr>
<tr>
<td>4110 [Note (1)]</td>
<td>2000</td>
</tr>
<tr>
<td>4500-NO3- [Note (1)]</td>
<td>2000</td>
</tr>
<tr>
<td>4500-S2- [Note (1)]</td>
<td>2000</td>
</tr>
<tr>
<td>ASME NQA-1</td>
<td>1994 or 2008 Edition with the 2009 Addenda</td>
</tr>
<tr>
<td>ASME QAI-1</td>
<td>Current Edition and Addenda</td>
</tr>
<tr>
<td>ASME/ANS RA-S</td>
<td>2008 with RA-Sa–2009 Addenda and RA-Sb–013 Addenda</td>
</tr>
<tr>
<td>ASTM D95</td>
<td>1970 through 2013</td>
</tr>
<tr>
<td>ASTM D512</td>
<td>1981 through 2012</td>
</tr>
<tr>
<td>ASTM D974</td>
<td>1987 through 2014</td>
</tr>
<tr>
<td>ASTM D992</td>
<td>1971 (Reapproved 1978)</td>
</tr>
<tr>
<td>ASTM D3867</td>
<td>1979 through 2009</td>
</tr>
<tr>
<td>ASTM D4327</td>
<td>1988 through 2011</td>
</tr>
<tr>
<td>ASTM E29</td>
<td>2013</td>
</tr>
<tr>
<td>ASTM E185</td>
<td>2015</td>
</tr>
<tr>
<td>ASTM E1065</td>
<td>2003</td>
</tr>
<tr>
<td>ASTM E1324</td>
<td>2005</td>
</tr>
<tr>
<td>ASTM E1921</td>
<td>2015</td>
</tr>
<tr>
<td>ASTM E2215</td>
<td>2015</td>
</tr>
</tbody>
</table>

Note:
(1) This method is published in "Standard Methods for the Examination of Water and Wastewater," published jointly by the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF).
IWB-3131 General

(a) The volumetric and surface examinations required by IWB-2500 and performed in accordance with IWA-2200 shall receive an NDE evaluation by comparing the examination results with the acceptance standards specified in Table IWB-3410-1, except where (b) is applicable.

(b) When flaws are detected by a required volumetric or surface examination, the component is acceptable for continued service provided the requirements of IWB-3112(a) or the acceptance standards of Table IWB-3410-1 are met.

(c) Volumetric and surface examination results shall be compared with recorded results of the preservice examination and prior inservice examinations. Confirmed changes in flaws from prior examinations shall be recorded in accordance with IWA-1400(i) and IWA-2220(b). Acceptance of the components for continued service shall be in accordance with IWB-3132 and IWB-3133.

IWB-3134 Review by Authorities

Analytical evaluation of examination results as required by IWB-3132.3 shall be submitted to the regulatory authority having jurisdiction at the plant site.

DELETED

IWC-3125 Review by Authorities

Evaluation analyses of examination results as required by IWC-3122.3 shall be submitted to the regulatory authority having jurisdiction at the plant site.

DELETED
Question 1: Is it the intent of IWE-3122 that supplemental examinations performed in accordance with IWE-3200 may be used to determine whether the acceptance standards of IWE-3500 have been met and the component is acceptable for continued service in accordance with IWE-3122.1?

Proposed Reply 1: Yes.


IN 18-2441/BC 19-427

Proposed Revision based on Ballot Comments, Mr. Palm’s Rewording and Withdrawal of Mr. Parks Disapproval. Changes from SC XI approved.

BC 19-427 for Recirculation Ballot

IWE-3200 Supplemental Examinations

Examinations that detect flaws or evidence of degradation may be supplemented by other examination methods and techniques (IWA-2220, IWA-2230, or IWA-2240) to determine the character of the flaw (i.e., size, shape, and orientation) or degradation, and may be used to accept the flaws or degradation in accordance with IWE-3122.1, IWE-3122.2, or IWE-3122.3 to: (1) accept by examination; (2) determine the need for corrective measures or repair/replacement activities; or (3) accept by engineering evaluation. to: (1) accept by examination; (2) determine the need for corrective measures or repair/replacement activities; or (3) accept by engineering evaluation.

Proposed Revision – Clean Version

IWE-3200 Supplemental Examinations

Examinations that detect flaws or evidence of degradation may be supplemented by other examination methods and techniques (IWA-2220, IWA-2230, or IWA-2240) to determine the character of the flaw (i.e., size,
shape, and orientation) or degradation, and may be used to accept the flaws or degradation in accordance with IWE-3122.1, IWE-3122.2, or IWE-3122.3.
2017 Section XI

IWA-6230  Owner’s Activity Report

(a) Form OAR-1 for the preservice examinations shall be completed prior to the date of placement of the unit into commercial service.

(b) For preservice and inservice examinations performed following placement of the unit into commercial service, Form OAR-1, as shown in Mandatory Appendix II, shall be processed as specified below within 90 calendar days of the completion of each refueling outage.

   (1) A listing of the items with flaws or relevant conditions that exceeded the acceptance criteria of Division 1 and that required evaluation for continued service in accordance with IWB-3132.3, IWC-3122.3, IWE-3122.3, IWL-3112, IWL-3212, and IWL-3222, shall be documented on Form OAR-1, Table 1. This information is required whether or not the flaw or relevant condition was discovered during a scheduled examination or test.

   (2) An abstract for the repair/replacement activities that were required due to an item containing a flaw or relevant condition that exceeded Section XI acceptance criteria shall be provided with the information and format of Form OAR-1, Table 2. This information is required even if the discovery of the flaw or relevant condition that necessitated the repair/replacement activity did not result from an examination or test required by Section XI. If the acceptance criteria for a particular item is not specified in Section XI, the provisions of IWA-3100(b) shall be used to determine which repair/replacement activities are required to be included in the abstract.

   (3) For Class MC and CCIWE-2000 and IWL-2000 examinations, the following information concerning the acceptability of inaccessible areas, when if unacceptable conditions were are found to exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas, shall be included:

   (3a) a description of the type and estimated extent of the degradation and the conditions that led to the degradation

   (3b) the results of engineering evaluations for each affected area and the results of each engineering evaluation

   (3c) a description of each corrective action
If there are multiple inspection plans with different intervals, periods, or Section XI Editions or Addenda, the different inspection intervals, periods, Editions, or Addenda shall be identified on Form OAR-1.

Form OAR-1 shall be certified by the Owner and presented to the Inspector for the required signature.

The completed Form OAR-1 shall be submitted to the regulatory and enforcement authorities having jurisdiction at the plant site, if required by these authorities.

**IWL-2512 Inaccessible Areas**

*(b)* Concrete surfaces exposed to foundation soil, backfill, or ground water shall be evaluated to determine susceptibility of the concrete to deterioration and the ability to perform the intended design function under conditions anticipated until the structure no longer is required to fulfill its intended design function. During the first 40 years of operation, the technical evaluation shall be performed and documented by or under the direction of the Responsible Engineer, at periodic intervals not to exceed 10 yr. Beyond 40 years of operation, this evaluation shall be performed and documented at intervals not to exceed 5 years. The evaluation shall include the following:

1. **existing** subgrade conditions, including ground water presence, chemistry, and dynamics; aggressive below-grade environment, or other plant-specific conditions that could cause accelerated aging and degradation

2. **existing** or potential concrete degradation mechanisms, including, but not limited to, aggressive chemical attack, erosion and cavitation, corrosion of embedded steel, freeze-thaw, settlement, leaching of calcium hydroxide, reaction with aggregates, increase in permeability or porosity, and combined effects

3. design and construction criteria associated with the inaccessible concrete, including structural design, detail and reinforcement, design recommendations implemented with regard to environmental exposure conditions, materials used, mixture proportioning, concrete production and placement, design and construction codes used, conformance of the structure to original design, and performance of any reanalysis

4. condition of installed protective barrier systems, such as membranes, coatings, grout curtains, special drainage systems, and dewatering systems

5. any condition-monitoring programs being implemented, such as settlement monitoring, ground water monitoring, condition surveys, and nondestructive examinations
(6) requirement for the visual examination of representative samples of below-grade concrete, if excavated for any reason, when an aggressive below-grade environment is present.

2017 Section XI - Clean Copy incorporating Changes

IWA-6230 Owner’s Activity Report

(a) Form OAR-1 for the preservice examinations shall be completed prior to the date of placement of the unit into commercial service.

(b) For preservice and inservice examinations performed following placement of the unit into commercial service, Form OAR-1, as shown in Mandatory Appendix II, shall be processed as specified below within 90 calendar days of the completion of each refueling outage.

(1) A listing of the items with flaws or relevant conditions that exceeded the acceptance criteria of Division 1 and that required evaluation for continued service in accordance with IWB-3132.3, IWC-3122.3, IWE-3122.3, IWL-3112, IWL-3212, and IWL-3222, shall be documented on Form OAR-1, Table 1. This information is required whether or not the flaw or relevant condition was discovered during a scheduled examination or test.

(2) An abstract for the repair/replacement activities that were required due to an item containing a flaw or relevant condition that exceeded Section XI acceptance criteria shall be provided with the information and format of Form OAR-1, Table 2. This information is required even if the discovery of the flaw or relevant condition that necessitated the repair/replacement activity did not result from an examination or test required by Section XI. If the acceptance criteria for a particular item is not specified in Section XI, the provisions of IWA-3100(b) shall be used to determine which repair/replacement activities are required to be included in the abstract.

(3)”For IWE-2000 and IWL-2000 examinations, the below information concerning the acceptability of inaccessible areas, if unacceptable conditions are found to exist that could indicate the presence of, or result in, degradation, shall be included with Form OAR-1:

(-a) a description of the type and estimated extent of the degradation and the conditions that led to the degradation

(-b) the results of engineering evaluations for each affected

(-c) a description of each corrective action
(4) If there are multiple inspection plans with different intervals, periods, or Section XI Editions or Addenda, the different inspection intervals, periods, Editions, or Addenda shall be identified on Form OAR-1.

(5) Form OAR-1 shall be certified by the Owner and presented to the Inspector for the required signature.

(6) The completed Form OAR-1 shall be submitted to the regulatory and enforcement authorities having jurisdiction at the plant site, if required by these authorities.

**IWL-2512 Inaccessible Areas**

(b) Concrete surfaces exposed to foundation soil, backfill, or ground water shall be evaluated to determine susceptibility of the concrete to deterioration and the ability to perform the intended design function under conditions anticipated until the structure no longer is required to fulfill its intended design function. During the first 40 yr of operation, the technical evaluation shall be performed and documented by or under the direction of the Responsible Engineer, at periodic intervals not to exceed 10 yr. Beyond 40 yr of operation; this evaluation shall be performed and documented at intervals not to exceed 5 yr. The evaluation shall include the following:

1. existing subgrade conditions, including ground water presence, chemistry, and dynamics; aggressive below-grade environment, or other plant-specific conditions that could cause accelerated aging and degradation

2. existing or potential concrete degradation mechanisms, including, but not limited to, aggressive chemical attack, erosion and cavitation, corrosion of embedded steel, freeze-thaw, settlement, leaching of calcium hydroxide, reaction with aggregates, increase in permeability or porosity, and combined effects

3. design and construction criteria associated with the inaccessible concrete, including structural design, detail and reinforcement, design recommendations implemented with regard to environmental exposure conditions, materials used, mixture proportioning, concrete production and placement, design and construction codes used, conformance of the structure to original design, and performance of any reanalysis

4. condition of installed protective barrier systems, such as membranes, coatings, grout curtains, special drainage systems, and dewatering systems

5. any condition-monitoring programs being implemented, such as settlement monitoring, ground water monitoring, condition surveys, and nondestructive examinations
(6) requirement for the visual examination of representative samples of below-grade concrete, if excavated for any reason
ARTICLE C-2000
ANALYTICAL EVALUATION PARAMETERS

C-2100 SCOPE

This Article provides procedures for defining the flaw geometry (shape, proximity, orientation, and location), applied stress, and acceptance criteria.

C-2200 FLAW SHAPE

The flaw should be completely bounded by a rectangular or circumferential planar area in accordance with the methods of IWA-3300. Figures C-2200-1 and C-2200-2 illustrate flaw characterization for circumferential and axial pipe flaws respectively.

Surface or subsurface flaw characterization shall be used depending on the type of flaw. For analyses other than subcritical flaw growth, if the flaw is subsurface, but within the proximity limits of IWA-3340-IWA-3310(b) and IWA-3320(a) from the surface of the component, the flaw shall be considered a surface flaw and shall be bounded by a rectangular or circumferential planar area with the base (major length) aligned along the surface.

For subcritical flaw growth analyses, a subsurface flaw shall be characterized as a surface flaw if

(a) its aspect ratio $a/l$ is less than or equal to 0.3 and any portion of the flaw is less than $0.8a$ from the surface of the component nearest the flaw, or

(b) its aspect ratio $a/l$ is greater than 0.3 and any portion of the flaw is less than $0.4a$ from the surface of the component nearest the flaw.
Table L-3210-1

Ferritic Piping Postulated Equivalent Single Crack Aspect Ratios (a/l)

<table>
<thead>
<tr>
<th>δσm / δσg</th>
<th>0.0218 (5.5)</th>
<th>0.344 (8.7)</th>
<th>0.719 (18.3)</th>
<th>1.125 (28.6)</th>
<th>≥2.125 (54)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0178</td>
<td>0.0149</td>
<td>0.0078</td>
<td>0.0071</td>
<td>0.0065</td>
</tr>
<tr>
<td>0.1</td>
<td>0.0371</td>
<td>0.0307</td>
<td>0.0240</td>
<td>0.0176</td>
<td>0.0146</td>
</tr>
<tr>
<td>0.25</td>
<td>0.0578</td>
<td>0.0592</td>
<td>0.0397</td>
<td>0.0280</td>
<td>0.0294</td>
</tr>
<tr>
<td>1</td>
<td>0.0606</td>
<td>0.0741</td>
<td>0.0735</td>
<td>0.0629</td>
<td>0.0714</td>
</tr>
<tr>
<td>3</td>
<td>0.0637</td>
<td>0.0974</td>
<td>0.0935</td>
<td>0.0917</td>
<td>0.1087</td>
</tr>
<tr>
<td>∞</td>
<td>0.1667</td>
<td>0.1667</td>
<td>0.1667</td>
<td>0.1667</td>
<td>0.1667</td>
</tr>
</tbody>
</table>

**GENERAL NOTE:** Linear interpolation is permissible.

**NOTE:**
1. The membrane-to-gradient cyclic stress ratio is stated as follows:

\[
\frac{\Delta \sigma_m}{\Delta \sigma_g} = \sum \frac{\Omega_i}{\Omega_{\text{total}}} \times \left( \frac{\Delta \sigma_m}{\Delta \sigma_g} \right)_i
\]

\[
\Omega_i = \left( \frac{\Delta \sigma_m + \Delta \sigma_g}{\Delta \sigma_m + \Delta \sigma_g} \right)^n \times N_i
\]

\[
\Omega_{\text{total}} = \sum \Omega_i
\]

Summation is over all types of transient loading conditions.

**(Note 3)**

---

Table L-3210-2

Austenitic Piping Postulated Equivalent Single Crack Aspect Ratios (a/l)

<table>
<thead>
<tr>
<th>δσm / δσg</th>
<th>0.0218 (5.5)</th>
<th>0.344 (8.7)</th>
<th>0.719 (18.3)</th>
<th>1.125 (28.6)</th>
<th>≥2.125 (54)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0105</td>
<td>0.0107</td>
<td>0.0081</td>
<td>0.0082</td>
<td>0.0088</td>
</tr>
<tr>
<td>0.1</td>
<td>0.0200</td>
<td>0.0253</td>
<td>0.0265</td>
<td>0.0289</td>
<td>0.0362</td>
</tr>
<tr>
<td>0.25</td>
<td>0.0410</td>
<td>0.0446</td>
<td>0.0654</td>
<td>0.0807</td>
<td>0.1667</td>
</tr>
<tr>
<td>1</td>
<td>0.0556</td>
<td>0.0833</td>
<td>0.1351</td>
<td>0.1639</td>
<td>0.4667</td>
</tr>
<tr>
<td>3</td>
<td>0.0588</td>
<td>0.1031</td>
<td>0.1530</td>
<td>0.1667</td>
<td>0.1667</td>
</tr>
<tr>
<td>∞</td>
<td>0.1667</td>
<td>0.1667</td>
<td>0.1667</td>
<td>0.1667</td>
<td>0.1667</td>
</tr>
</tbody>
</table>

**GENERAL NOTE:** Linear interpolation is permissible.

**NOTE:**
1. The membrane-to-gradient cyclic stress ratio is stated as follows:

\[
\frac{\Delta \sigma_m}{\Delta \sigma_g} = \sum \frac{\Omega_i}{\Omega_{\text{total}}} \times \left( \frac{\Delta \sigma_m}{\Delta \sigma_g} \right)_i
\]

\[
\Omega_i = \left( \frac{\Delta \sigma_m + \Delta \sigma_g}{\Delta \sigma_m + \Delta \sigma_g} \right)^n \times N_i
\]

\[
\Omega_{\text{total}} = \sum \Omega_i
\]

Summation is over all types of transient loading conditions.

**Note to Editor:** Add this column as a new Column 2 to both tables.

**Note to Editor:** Add the "[Note 3]" identified for both tables adjacent to (right of) the infinity sign.

**(3) For interpolation purposes, a value of 100 shall be used.**
<table>
<thead>
<tr>
<th>Standard, Method or Specification</th>
<th>Revision Date or Indicator</th>
<th>Standard, Method or Specification</th>
<th>Revision Date or Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI 201.1R</td>
<td>2008</td>
<td>ACI 201.1R</td>
<td>2008</td>
</tr>
<tr>
<td>ACI 349.3R</td>
<td>2002 (Reapproved 2010)</td>
<td>ACI 349.3R</td>
<td>2018</td>
</tr>
<tr>
<td>APHA 427</td>
<td>1981</td>
<td>APHA 427</td>
<td>1981</td>
</tr>
<tr>
<td>APHA 4500-S2</td>
<td>1989</td>
<td>APHA 4500-S2</td>
<td>1989</td>
</tr>
<tr>
<td>4110 [Note (1)]</td>
<td>2000</td>
<td>4110 [Note (1)]</td>
<td>2000</td>
</tr>
<tr>
<td>4500-NO3 [Note (1)]</td>
<td>2000</td>
<td>4500-NO3 [Note (1)]</td>
<td>2000</td>
</tr>
<tr>
<td>4500-S2 [Note (1)]</td>
<td>2000</td>
<td>4500-S2 [Note (1)]</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>the 2009 Addenda</td>
<td></td>
<td>2015[RK2]</td>
</tr>
<tr>
<td>ASTM D3867</td>
<td>1979 through 2009</td>
<td>ASTM D3867</td>
<td>1979 through 2016[RK3]</td>
</tr>
<tr>
<td>ASTM E29</td>
<td>2013</td>
<td>ASTM E29</td>
<td>2013</td>
</tr>
<tr>
<td>ASTM E185</td>
<td>2015</td>
<td>ASTM E185</td>
<td>2016</td>
</tr>
<tr>
<td>ASTM E1065</td>
<td>2003</td>
<td>ASTM E1065</td>
<td>2014</td>
</tr>
<tr>
<td>ASTM E1324</td>
<td>2005</td>
<td>ASTM E1324</td>
<td>2016</td>
</tr>
<tr>
<td>ASTM E1921</td>
<td>2015</td>
<td>ASTM E1921</td>
<td>2017</td>
</tr>
<tr>
<td>ASTM E2215</td>
<td>2015</td>
<td>ASTM E2215</td>
<td>2016</td>
</tr>
</tbody>
</table>
IWF-1230 SUPPORTS EXEMPT FROM EXAMINATION

Supports exempt from the examination requirements of Article IWF-2000 are those connected to piping and other items exempted from volumetric, surface, or VT-1 or VT-3 or general visual examination by IWB-1220(a) through IWB-1220(c); IWC-1221, IWC-1222; IWD-1220(a) through IWD-1220(d); and IWE-1220(a), IWE-1220(c), and IWE-1220(d). In addition, portions of supports that are inaccessible by being encased in concrete, buried underground, or encapsulated by guard pipe are also exempt from the examination requirements of Article IWF-2000.

GENERAL NOTE: Figures IWF-1300.1(d) and (e) also apply where a gap exists between the nonintegral support and the pressure-retaining component.
ARTICLE VIII-3000
QUALIFICATION REQUIREMENTS

VIII-3100 QUALIFICATION TEST REQUIREMENTS

VIII-3110 DETECTION

(a) Qualification test specimens shall meet the requirements of the appropriate Supplement listed in Table VIII-3110-1.

(b) Qualification test specimens may be segments of full-scale mock-ups or separate specimens cut from full-scale segments. Additional specimens can be generated by altering the flow direction or by changing reference points. Divulgence of full-scale mock-up identification to the candidate is acceptable, provided the flaw locations and specimen identifications are not provided.

(c) The examination procedure, equipment, and personnel are qualified for detecting flaws upon successful completion of the performance demonstration specified in the appropriate Supplement listed in Table VIII-3110-1.

(d) For piping welds whose requirements are in course of preparation, the requirements of Mandatory Appendix III, as supplemented by Table I-2000-1, shall be met.

VIII-3120 SIZING

(a) Qualification test specimens shall meet the requirements of the appropriate Supplement listed in Table VIII-3110-1.

(b) Qualification test specimen may be segments of full-scale mock-ups or separate specimens cut from full-scale segments. Additional specimens can be generated by altering the flow direction or by changing reference points. Divulgence of full-scale mock-up identification to the candidate is acceptable, provided the flaw locations (unless allowed by the specific supplement) and specimen identifications are not provided.

(c) The examination procedure, equipment, and personnel are qualified for sizing flaws upon successful completion of the performance demonstration specified in the appropriate Supplement listed in Table VIII-3110-1. When the applicable piping supplement contains no provisions for a performance demonstration using axially oriented flaws, examination personnel, equipment, procedures, and the associated techniques qualified for

### Table VIII-3110-1

<table>
<thead>
<tr>
<th>Component Qualification Supplements</th>
<th>Applicable Supplement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Piping Welds</strong></td>
<td></td>
</tr>
<tr>
<td>Wrought austenitic</td>
<td>2</td>
</tr>
<tr>
<td>Ferritic</td>
<td>3</td>
</tr>
<tr>
<td>Cast austenitic</td>
<td>[Note (1)]</td>
</tr>
<tr>
<td>Structural weld inlay (corrosion-resistant clad) austenitic</td>
<td>[Note (1)]</td>
</tr>
<tr>
<td>Dissimilar metal</td>
<td>10</td>
</tr>
<tr>
<td>Overlay</td>
<td>11</td>
</tr>
<tr>
<td>Coordinated implementation of Supplements 2 and 3</td>
<td>12</td>
</tr>
<tr>
<td>Coordinated implementation of Supplements 10, 2, and 3 from the inside surface</td>
<td>14</td>
</tr>
<tr>
<td><strong>Vessels</strong></td>
<td></td>
</tr>
<tr>
<td>Clad/base metal interface region</td>
<td>4</td>
</tr>
<tr>
<td>Nozzle examinations from the outside surface</td>
<td>5</td>
</tr>
<tr>
<td>Reactor vessel welds other than clad/base metal interface</td>
<td>6</td>
</tr>
<tr>
<td>Nozzle examinations from the inside surface</td>
<td>7</td>
</tr>
<tr>
<td><strong>Bolts and Studs</strong></td>
<td>8</td>
</tr>
</tbody>
</table>

**NOTE:**

(1) In the course of preparation.

Add text (RED) in Table 3110-1 to include Supplement 14 and clarify Supplement 12.
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 in-service 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

(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.

6. When examination results do not permit accurate determination of the flaw category, the more conservative category shall be selected.

7. The component containing the flaw is acceptable for continued service during the evaluated time period if the following are satisfied:

1. the criteria of IWB-3611 or IWB-3612;

2. the primary stress limits of Article NB-3000, assuming a local area reduction of the pressure-retaining membrane that is equal to the area of the detected flaw(s) as determined by the flaw characterization rules of Article IWA-3000.
For purposes of analytical evaluation, the depth of flaws in clad piping items shall be defined in accordance with Figure IWB-3600-1. The flaw characterization rules of IWA-3300 shall be used for the transformation of a subsurface flaw to a surface flaw using dimensions $S$ and $d$. For Category 1, the flaw need not be analytically evaluated.
The analytical evaluation of flaws is addressed by the procedures in this subsection.

(a) A flaw that exceeds the size of allowable flaws defined in IWB-3500 may be analytically evaluated using procedures described in this section-subarticle to calculate flaw growth until the next inspection or the end of the service lifetime of the component or piping item.

(b) For purposes of analytical evaluation, the depth of flaws in clad components and piping items shall be defined in accordance with Figure IWB-3600-1 as follows:

1. Category 1 — A flaw that lies entirely in the cladding, as shown in Figure IWB-3600-1, 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 as shown in Figure IWB-3600-1.
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-3600-1.
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-3600-1.
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-3600-1.

(c) The flaw characterization rules of IWA-3300 shall be used for the transformation of a subsurface flaw to a surface flaw using dimensions S and d illustrated in Figure IWB-3600-1.

(d) When examination results do not permit accurate determination of the flaw category, the more conservative category shall be selected.
INSERT B

(a) A flaw that exceeds the size of allowable flaws defined in IWB-3510 and IWB-3512 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-3600-1. For Category 1, the flaw need not be analytically evaluated.
(1) The flaw characterization rules of IWA-3300 shall be used for the transformation of a subsurface flaw to a surface flaw using dimensions $S$, $a$, and $d$ as defined in this figure.
(2) The size of allowable surface flaws that penetrate through the cladding into base metal shall not exceed the standards of (a) above, except that the depth $a$ of the flaw shall be the total depth minus the nominal clad thickness.

**IWC-3514.2 Allowable Flaw Standards for Ferritic Piping.** The standards are in the course of preparation. The standards of IWB-3514 may be applied.

**IWC-3514.3 Allowable Flaw Standards for Austenitic or High Alloy Piping.**

(a) The size of allowable flaws shall not exceed the limits specified in Table IWC-3514-1.

(b) Where flaws on the outer surface of piping as detected by the surface examination method during an in-service examination exceed the allowable standards of IWC-3514.5, the flaws may be examined by the volumetric method. The acceptance of these flaws shall be governed by the allowable flaw standards for the volumetric examination method in Table IWC-3514-1.

**IWC-3514.4 Allowable Laminar Flaws for Austenitic Piping.** The area of allowable laminar flaws, as defined by IWA-3360, within the boundary of the examination zones shown in Figures IWC-2500-7 and IWC-2500-9 through IWC-2500-13 shall not exceed the limits specified in Table IWB-3514-3.

**IWC-3514.5 Allowable Linear Flaw Standards for Austenitic or High Alloy Piping.**

(a) The size of an allowable linear flaw within the boundaries of the examination surfaces in Figures IWC-2500-7 and IWC-2500-9 through IWC-2500-13 shall not exceed the limits specified in Table IWB-3514-2.

(b) Where a flaw extends beyond the boundaries of the examination surfaces in Figures IWC-2500-7 and IWC-2500-9 through IWC-2500-13, or where discontinuous linear flaws lie both within and beyond the boundaries and are characterized as a single flaw by the rules of IWA-3400, the size of allowable overall linear flaws shall not exceed the limits specified in Table IWB-3514-2.

**IWC-3514.6 Surface-Connected Flaws in Contact With the Reactor Coolant Environment That Are Detected by Preservice Examination in Materials Susceptible to Stress Corrosion Cracking.** When a surface-connected flaw that will be in contact with the reactor coolant environment during normal operation is detected using volumetric examination, the weld shall be reexamined twice subsequent to the preservice examination. The first reexamination shall be performed after a time interval that is greater than 2 yr, and fewer than 6 yr, subsequent to plant start-up following the preservice examination. The time interval for the second reexamination shall be determined using the rules of IWC-3640 for analytical evaluation of flaws and shall not exceed 10 yr subsequent to plant start-up following the preservice examination. The time interval between the two reexaminations shall be at least 2 yr, except that it shall not extend the second reexamination beyond the end of the evaluation period.

**IWC-3516 Standards for Examination Category C-H, All Pressure-Retaining Components**

**IWC-3516.1 Visual Examination, VT-2.** A component whose visual examination (IWA-5240) detects any of the following relevant conditions shall meet IWC-3132 and IWA-5250 prior to continued service:

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

(b) nonborated water leakage in excess of limits established by the Owner from mechanical connections (such as pipe caps, bolted connections, or compression fittings)

(c) areas of general corrosion of a component resulting in leakage

(d) leakage in excess of limits established by the Owner from components provided with leakage limiting devices (such as valve packing glands or pump seals)

(e) borated water leakage or evidence of borated water leakage (discoloration or accumulated residues on surfaces of components, insulation, or floor areas) not addressed in (a) or (d)

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

**IWC-3600 ANALYTICAL EVALUATION OF PLANAR FLAWS**

**IWC-3610 ACCEPTANCE CRITERIA FOR FERRITIC COMPONENTS**

These criteria are in the course of preparation. In the interim, the criteria of IWB-3610 may be applied.

**IWC-3640 ANALYTICAL EVALUATION PROCEDURES AND ACCEPTANCE CRITERIA FOR FLAWS IN AUSTENITIC AND FERRITIC PIPING**

Piping containing flaws exceeding the acceptance standards of IWC-3514 may be analytically evaluated to determine acceptability for continued service to the next inspection or to the end of the evaluation period. A pipe containing flaws is acceptable for continued service for a specified evaluation time period if the criteria of IWC-3642, IWC-3643, or IWC-3644 are satisfied.

**IWC-3641 Analytical Evaluation Procedures**

Analytical evaluation procedures based on flaw size or applied stress, such as those described in Nonmandatory Appendix C or H, may be used, subject to the following:

(a) The analytical evaluation procedures and acceptance criteria in Nonmandatory Appendix C are applicable to piping NPS 1 (DN 25) and greater. The procedures and
### Table IWD-3410-1 Acceptance Standards

<table>
<thead>
<tr>
<th>Examination Category</th>
<th>Component and Part Examined</th>
<th>Acceptance Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-A</td>
<td>Welded attachments for vessels, piping, pumps, and valves</td>
<td>IWD-3510</td>
</tr>
<tr>
<td>D-B</td>
<td>Pressure-retaining components</td>
<td>IWD-3511</td>
</tr>
</tbody>
</table>

### IWD-3500 ACCEPTANCE STANDARDS

**IWD-3510 STANDARDS FOR EXAMINATION CATEGORY D-A, WELDED ATTACHMENTS FOR VESSELS, PIPING, PUMPS, AND VALVES**

In the course of preparation. The requirements of IWC-3500 may be used.

**IWD-3511 Standards for Examination Category D-B, All Pressure-Retaining Components**

IWD-3511.1 Visual Examination, VT-2. A component whose visual examination (IWA-5240) detects any of the following relevant conditions shall meet IWD-3132 and IWA-5250 prior to continued service:

(a) any through-wall or through-weld, pressure-retaining material leakage from insulated and noninsulated components
(b) nonborated water leakage in excess of limits established by the Owner from mechanical connections (such as pipe caps, bolted connections, or compression fittings)
(c) areas of general corrosion of a component resulting in leakage
(d) leakage in excess of limits established by the Owner from components provided with leakage limiting devices (such as valve packing glands or pump seals)
(e) borated water leakage or evidence of borated water leakage (discoloration or accumulated residues on surfaces of components, insulation, or floor areas) not addressed in (a) or (d)
(f) leakages or flow test results from buried components in excess of limits established by the Owner

### IWD-3600 ANALYTICAL EVALUATION OF PLANAR FLAWS

**IWD-3610 ACCEPTANCE CRITERIA FOR FERRITIC COMPONENTS**

In the course of preparation. The requirements of IWC-3610 may be used.

### IWD-3640 ANALYTICAL EVALUATION PROCEDURES AND ACCEPTANCE CRITERIA FOR FLAWS IN AUSTENITIC AND FERRITIC PIPING

Piping containing flaws exceeding the acceptance standards of IWD-3500 may be analytically evaluated to determine acceptability for continued service to the next inspection or to the end of the evaluation period. A pipe containing flaws is acceptable for continued service for a specified evaluation time period if the criteria of IWD-3642, IWD-3643, or IWD-3644 are satisfied.

**IWD-3641 Analytical Evaluation Procedures**

Analytical evaluation procedures based on flaw size or applied stress, such as those described in Nonmandatory Appendix C or Nonmandatory Appendix H may be used subject to the following:

(a) The analytical evaluation procedures and acceptance criteria in Nonmandatory Appendix C are applicable to piping NPS 1 (DN 25) and greater. The procedures and criteria in Nonmandatory Appendix H are applicable to piping NPS 4 (DN 100) and greater. Nonmandatory Appendices C and H are applicable to portions of adjoining pipe fittings within a distance of \((R_z t)^{1/2}\) from the weld centerline, where \(R_z\) is the outside radius and \(t\) is the thickness of the pipe. The weld geometry and weld-base metal interface are defined in Nonmandatory Appendix C.

(b) The analytical evaluation procedures and acceptance criteria are applicable to seamless or welded wrought carbon steel piping and pipe fittings, and associated weld materials, that have a specified minimum yield strength not greater than 40 ksi (280 MPa).

(c) The analytical evaluation procedures and acceptance criteria are applicable to seamless or welded, wrought or cast, austenitic pipe and pipe fittings and associated weld materials that are made of wrought stainless steel, Ni-Cr-Fe alloy, or cast stainless steel, and have a specified minimum yield strength not greater than 45 ksi (310 MPa).

(d) A flaw growth analysis shall be performed on the detected flaw to predict its growth due to fatigue or stress corrosion cracking mechanisms, or both, when applicable, during a specified evaluation time period. The time...
ARTICLE C-2000
ANALYTICAL EVALUATION PARAMETERS

C-2100 SCOPE

This Article provides procedures for defining the flaw geometry (shape, proximity, orientation, and location), applied stress, and acceptance criteria.

C-2200 FLAW SHAPE

The flaw should be completely bounded by a rectangular or circumferential planar area in accordance with the methods of IWA-3300. Figures C-2200-1 and C-2200-2 illustrate flaw characterization for circumferential and axial pipe flaws respectively.

Surface or subsurface flaw characterization shall be used depending on the type of flaw. When the flaw is subsurface, but within the proximity limit of IWA-3340 from the surface of the component, the flaw shall be considered a surface flaw and shall be bounded by a rectangular or circumferential planar area with the base (major length) aligned along the surface.

For clad pipe, the depth of a flaw is defined as shown in Figure IWB-3600-1. The wall thickness at the flaw location includes the thickness of the cladding.

C-2300 PROXIMITY TO CLOSEST FLAW

For multiple adjacent flaws, when the shortest distance between the flaws is within the proximity limits specified in IWA-3300, the adjacent flaws shall be bounded by a single rectangular or circumferential planar area in accordance with IWA-3300.

C-2400 FLAW ORIENTATION

Flaws that do not lie in either an axial or a circumferential plane should be projected onto these planes in accordance with the rules of IWA-3340. The axial and circumferential flaws obtained by these projections shall be analytically evaluated separately in accordance with this Appendix.

Figures C-2400-1, C-2400-2, and C-2400-3 illustrate flaw characterization for skewed flaws.

C-2500 DEFINITION OF PIPE STRESS

For the purpose of analysis, the flaw is to be considered in its pipe cross-section location. The stresses due to system loading shall be calculated at this location. The location-specific loading (forces and moments) can be obtained from the piping Design Report for each Service Level loading condition. The stresses to be used in the analytical evaluation are the unintensified pipe stress for membrane, bending (including torsion), and expansion (thermal and seismic anchor motion) defined as \( \sigma_m \), \( \sigma_b \), and \( \sigma_e \), or pipe hoop stress, \( \sigma_h \). The inclusion of torsion (torsion stress, \( \tau \)) in the method of combination of bending moments applies only when the torsion stress does not exceed 0.2 times the flow stress. The method of combination of bending moments including torsion shall be justified for higher levels of torsion stress.

(a) For circumferential flaws the unintensified stress can be calculated from the piping Design Report for each Service Level as follows

\[
\sigma_m = \frac{pD}{4t}
\]

\[
\sigma_b = \frac{DM_b}{2t}
\]
L-3300 ANALYTICAL EVALUATION PROCEDURES AND ALLOWABLE OPERATING PERIOD

The loadings in the Design Specification, plant specific loading cycles consistent with the plant design and operating practices, or actual plant operating data, shall be used, as appropriate, for analytical evaluations in this subarticle.

L-3310 ANALYTICAL EVALUATION PROCEDURES AND ALLOWABLE OPERATING PERIOD FOR FERRITIC STEEL COMPONENTS 4 in. (100 mm) OR GREATER IN THICKNESS

L-3311 Analytical Evaluation Procedures

(a) Nonmandatory Appendix A analytical evaluation procedures for fatigue crack growth may be used for ferritic steel components 4 in. (100 mm) or greater in thickness.

(b) The procedures in Article A-5000 may be used to calculate \( a_f \) and \( \ell_f \) for the postulated flaw in L-3200 during the evaluation period.

(c) The procedures in Article A-5000 may be used to calculate the minimum critical flaw sizes \( a_c \) and \( a_i \).

L-3312 Allowable Operating Period

(a) Calculate the operating periods \( P_n \) and \( P_o \) for the postulated flaw in L-3200 to grow to the allowable flaw depth corresponding to the acceptance criteria in IWB-3610(d) or IWB-3613, as applicable.

(b) The allowable operating period \( P \) is equal to the smaller of \( P_n \) or \( P_o \) in (a).

L-3320 ANALYTICAL EVALUATION PROCEDURES AND ALLOWABLE OPERATING PERIOD FOR FERRITIC STEEL COMPONENTS LESS THAN 4 in. (100 mm) THICK

These procedures and criteria are in the course of preparation. In the interim, the procedures and criteria of L-3310 may be applied.

L-3330 ANALYTICAL EVALUATION PROCEDURES AND ALLOWABLE OPERATING PERIOD FOR Austenitic PIPING

L-3331 Analytical Evaluation Procedures

(a) Nonmandatory Appendix C analytical evaluation procedures may be used for austenitic stainless steel piping.

(b) The procedures in C-3200 for fatigue crack growth may be used to calculate \( a_f \) and \( \ell_f \) for the postulated flaw in L-3200 during the evaluation period.

(c) The allowable flaw depths \( a_n \) and \( a_o \) shall be determined using the limit load procedures in Article C-5000 or EPFM procedures in Article C-6000 as applicable.

L-3332 Allowable Operating Period

(a) Calculate the operating periods \( P_n \) and \( P_o \) for the postulated flaw in L-3200 to grow to the allowable flaw depths defined in L-3331(c).

(b) The allowable operating period \( P \) is equal to the smaller of \( P_n \) or \( P_o \) in (a).

L-3340 ANALYTICAL EVALUATION PROCEDURES AND ALLOWABLE OPERATING PERIOD FOR FERRITIC PIPING

L-3341 Analytical Evaluation Procedures

(a) Nonmandatory Appendix C analytical evaluation procedures may be used for ferritic piping.

(b) The procedures in C-3200 for fatigue crack growth may be used to calculate \( a_f \) and \( \ell_f \) for the postulated flaw in L-3200.

(c) The allowable flaw depths \( a_n \) and \( a_o \) shall be determined using the limit load procedures in Article C-5000, EPFM procedures in Article C-6000, or LEFM procedures in Article C-7000, as applicable.

L-3342 Allowable Operating Period

(a) Calculate the operating periods \( P_n \) and \( P_o \) for the postulated flaw in L-3200 to grow to the maximum allowable flaw depth defined in L-3341(c).

(b) The allowable operating period \( P \) is equal to the smaller of \( P_n \) or \( P_o \) in (a).

L-3400 EXAMINATION PROVISIONS

L-3410 EXAMINATIONS

(a) The absence of any flaw larger than the applicable acceptance standard referenced in Table IWB-3410-1, at the location of concern, shall be verified by surface or volumetric examination. Otherwise, this Appendix is not applicable, and the flaw shall be analytically evaluated in accordance with IWB-3400.

(b) Examinations shall be conducted in accordance with IWA-2220, IWA-2230, or IWA-2240, as applicable.

L-3420 SUCCESSIVE EXAMINATIONS

The component shall be examined at the location of concern in accordance with the successive inspection schedule provisions in Table L-3420-1. The successive inspection period shall not exceed that specified in Table L-3420-1 or IWB-2410.
ARTICLE VIII-3000
QUALIFICATION REQUIREMENTS

VIII-3100 QUALIFICATION TEST REQUIREMENTS

VIII-3110 DETECTION

(a) Qualification test specimens shall meet the requirements of the appropriate Supplement listed in Table VIII-3110-1.

(b) Qualification test specimens may be segments of full-scale mock-ups or separate specimens cut from full-scale segments. Additional specimens can be generated by altering the flow direction or by changing reference points. Divulgence of full-scale mock-up identification to the candidate is acceptable, provided the flaw locations and specimen identification are not provided.

(c) The examination procedure, equipment, and personnel are qualified for detecting flaws upon successful completion of the performance demonstration specified in the appropriate Supplement listed in Table VIII-3110-1.

(d) For piping welds whose requirements are in course of preparation, the requirements of Mandatory Appendix III, as supplemented by Table I-2000-1, shall be met.

(e) For those supplements requiring the use of grading units, each flawed grading unit shall contain only one flaw.

VIII-3120 SIZING

(a) Qualification test specimens shall meet the requirements of the appropriate Supplement listed in Table VIII-3110-1.

(b) Qualification test specimens may be segments of full-scale mock-ups or separate specimens cut from full-scale segments. Additional specimens can be generated by altering the flow direction or by changing reference points. Divulgence of full-scale mock-up identification to the candidate is acceptable, provided the flaw locations (unless allowed by the specific supplement) and specimen identification are not provided.
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IWB-2420   SUCCESSIVE INSPECTIONS</strong></td>
<td><strong>IWC-2420   SUCCESSIVE INSPECTIONS</strong></td>
</tr>
</tbody>
</table>
| *(g)* If welded attachments are examined as a result of identified component support deformation, and the results of these examinations exceed the acceptance standards of Table IWB-3410-1, successive examinations shall be performed, if determined necessary, based on an evaluation by the Owner. The evaluation shall be documented and shall include the cause of the welded attachment damage if known. If the cause of the welded attachment damage could recur or is unknown, successive examinations shall be performed in accordance with the requirements of *(b)* above. **No successive examinations are required if either of the following applies:**  
  *(1)* There are no other welded attachments subject to the same apparent or root cause conditions.  
  *(2)* The degradation mechanism no longer exists. | **Delete the strikethrough text**  
  *(f)* If welded attachments are examined as a result of identified component support deformation and the results of these examinations exceed the acceptance standards of Table IWC-3410-1 successive examinations shall be performed, if determined necessary, based on an evaluation by the Owner. The evaluation shall be documented and shall include the cause of the welded attachment damage if known. If the cause of the welded attachment damage could recur or is unknown, successive examinations shall be performed in accordance with the requirements of *(b)* above. **No successive examinations are required if either of the following applies:**  
  *(1)* There are no other welded attachments subject to the same apparent or root cause conditions.  
  *(2)* The degradation mechanism no longer exists. | **Delete the strikethrough text** |
## PROPOSED CODE CHANGE

|--------------------------|------------------|
| **IWD-2420   SUCCESSIVE INSPECTIONS**  
  *(e)* If welded attachments are examined as a result of identified component support deformation and the results of these examinations exceed the acceptance standards of Article IWD-3000, successive examinations shall be performed, if determined necessary based on an evaluation by the Owner. The evaluation shall be documented and shall include the cause of the welded attachment damage if known. If the cause of the welded attachment damage could recur or is unknown, successive examinations shall be performed in accordance with the requirements of *(b)* above. No successive examinations are required if either of the following applies:  
  *(1)* There are no other welded attachments subject to the same apparent or root cause conditions.  
  *(2)* The degradation mechanism no longer exists. | **Delete the strikethrough text** |

Record No. 18-2391
APPENDIX I

SUPPLEMENT 7 — INSTRUMENT CALIBRATION
The requirements for Screen Height Linearity and Amplitude Control Linearity of Section V, Article 4 shall be met at intervals not to exceed three months for analog type instruments and one year for digital type instruments, or prior to first use thereafter.

APPENDIX III

III-3300 CALIBRATION CONFIRMATION
III-3310 INSTRUMENT
The requirements for Screen Height Linearity and Amplitude Control Linearity of Section V, Article 4 shall be met at intervals not to exceed three months for analog type instruments and one year for digital type instruments, or prior to first use thereafter.

EXISTING ASME V and XI APPENDIX I and III REQUIREMENTS

ASME V Article 4
T-461 INSTRUMENT LINEARITY CHECKS
The requirements of T-461.1 and T-461.2 shall be met at intervals not to exceed three months for analog type instruments and one year for digital type instruments, or prior to first use thereafter.
T-461.1 Screen Height Linearity. The ultrasonic instrument’s screen height linearity shall be evaluated in accordance with Mandatory Appendix I.
T-461.2 Amplitude Control Linearity. The ultrasonic instrument’s amplitude control linearity shall be evaluated in accordance with Mandatory Appendix II.

ASME BPVC.V-2017 ARTICLE 4

APPENDIX I
SUPPLEMENT 7 — INSTRUMENT CALIBRATION
The requirements for Screen Height Linearity and Amplitude Control Linearity of T-461, Article 4 of Section V, shall be met at the beginning and end of the weld examinations performed during one outage.

III-3300 CALIBRATION CONFIRMATION
III-3310 INSTRUMENT
Instrument calibration for screen height and amplitude control linearity shall be verified at the beginning and end of the weld examinations performed during one outage.