(c) Simulators shall be calibrated at least every 6 months to verify compliance with the manufacturer's specification.

(d) A minimum of three pulses shall be used to represent a DAC curve at three different delay times over the DAC range within the ranges of 15% to 30%, 40% to 60%, and 70% to 110% of the maximum transit time to cover the thickness to be examined.

(e) The final calibration check after the finish of each examination shall include a calibration check on at least three of the basic reflectors in the basic calibration block.

(f) As an alternative to (e) above, the final calibration check may be made without the basic calibration block provided calibration checks include measuring the response from at least three reflectors (or multiples from a single reflector) that are located in a test medium at distances providing transit times in the ranges of 15% to 30%, 40% to 60%, and 70% to 110% of the maximum transit time to cover the thickness to be examined.

SUPPLEMENT 6 PULSE REPERTITION RATE

The ultrasonic instrument pulse repetition rate shall be sufficient to pulse the search unit at least six times within the time necessary to move one-half the transducer (piezoelectric element) dimension parallel to the direction of scan at maximum scanning speed. Alternatively, a dynamic calibration on multiple reflectors that is within ±2 dB of a static calibration may be used to verify an acceptable pulse repetition rate.

SUPPLEMENT 7 INSTRUMENT CALIBRATION

The requirements for Screen Height Linearity and Amplitude C0ntrol 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.

SUPPLEMENT 8 SCAN OVERLAP AND SEARCH UNIT OSCILLATION

(a) Each pass of the search unit shall overlap 50% of the transducer (piezoelectric element) dimension parallel to the direction of scan indexing. As an alternative, if the sound beam dimension parallel to the direction of scan indexing is measured in accordance with the Section V, Article 4 beam spread measurement rules, each pass of the search unit shall provide overlap of the minimum beam dimension determined from the Section V, Article 4 beam spread measurements.

(b) Oscillation of the search unit is permitted if it can be demonstrated that overlapping coverage is provided.

SUPPLEMENT 9 SCAN ANGLES

Two angle beams having nominal angles of 45 deg and 60 deg shall be used. An additional longitudinal wave beam having a nominal angle of 70 deg shall be used for vessel examination conducted from the inside diameter clad surface. The examination using the 70 deg beam shall cover the near surface to a depth of 1 in. (25 mm) in the required volume. For calibration of the 70 deg beam, a 1 1/2 in. (38 mm) deep minimum, 1/4 in. (3 mm) diameter maximum, side-drilled hole, drilled parallel to the clad interface shall be located with the center at 1/4 in. (6 mm) from the inside diameter clad surface or at the clad--base metal interface in the basic vessel calibration block. At least two additional 1/8 in. (3 mm) diameter maximum side-drilled holes shall be installed at 1/2 in. (13 mm) maximum increments to establish metal path calibration.

SUPPLEMENT 10 RECORDING CRITERIA

Angle beam reflectors that produce a response greater than 20% of the reference level shall be investigated. The maximum amplitude, location, and extent of these reflectors shall be recorded. The operator shall determine whether the indication originates from a flaw or is a geometric indication in accordance with Supplement 11. When the reflector is determined to be a flaw, the acceptance standards of Article IWA-3000 apply.

SUPPLEMENT 11 GEOMETRIC INDICATIONS

Ultrasonic indications of geometric and metallurgical origin shall be classified as follows.

(a) Indications that are determined to originate from surface configurations (such as weld root geometry) or variations in metallurgical structure of materials (such as weld-to-base metal interface) may be classified as geometric indications. Such indications need not be characterized as originating from flaws, and flaw sizing in accordance with Supplement 12 and comparison of the reflector causing the indication with the allowable flaw standards of Article IWA-3000 are not required. The maximum indication amplitude and the location and extent of the reflector causing a geometric indication shall be recorded. (For example: internal attachment, 200% DAC maximum amplitude, 1 in. (25 mm) above the weld center line, on the inside surface, from 90 deg to 95 deg)

(b) The following steps shall be taken to classify an indication as geometric.
IWA-2233  Eddy Current Examination

Eddy current examination shall be conducted in accordance with Section V, Article 8, 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 (Supplement 12) 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, 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, revert to the original schedule of successive inspections of IWB-2410 or IWC-2410, 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, as amended by the requirements of this Division. Certifications based on SNT-TC-1A, ANSI N45.2.6, or 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 Levels I, 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 also 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.

(e) 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
(c) Dissimilar metal welds shall be examined in two axial and two circumferential directions. Procedures and personnel qualified solely from the austenitic side of the weld may be used to perform examinations from either side of the weld. When examination from both sides is not possible, procedures and personnel qualified for single-side examination in accordance with Appendix VIII, Supplement 10, with all flaws on the opposite side of the weld, shall be used to examine the required volume.

(d) When using angle beam examination, overlaid welds shall be examined in two axial and two circumferential directions. When using straight beam examination, overlaid welds shall be examined from the accessible surface.
(b) If access is not available, the required examination volume shall be scanned to the extent and in the directions allowed by the physical restrictions. The limitations shall be documented in the record of examination. Examination coverage of the inner 15% t shall be in accordance with (a) above

shall met the following requirements:

shall be

shall be

orthogonal above

I-3310 NOZZLE-TO-SHELL WELD EXAMINATIONS CONDUCTED FROM THE INSIDE

(a) If the provisions of I-3300(b) cannot be met because of access restrictions, and the nozzle-to-shell weld is examined from the inside, the required examination volume shall be scanned in accordance with I-3300 (a) and (b) to the extent and in the directions allowed by the physical restrictions.

(b) The inner 15% t shall be examined

(1) in one radial direction from the vessel shell using procedures and personnel qualified in accordance with Appendix VIII, Supplement 4 for single-side access or from the nozzle bore using procedures and personnel qualified in accordance with Appendix VIII, Supplement 7; and

(2) in one circumferential direction using procedures and personnel qualified in accordance with the requirements of Appendix VIII, Supplement 4 for single-side access.

I-3400 REACTOR PRESSURE VESSEL NOZZLE-TO-SHELL WELDS

I-3410 EXAMINATIONS CONDUCTED FROM THE INSIDE

(a) The clad-to-base-metal interface and the adjacent examination volume to a depth of at least 15% t (measured from the clad-to-base-metal interface) shall be examined from four orthogonal directions, using procedures and personnel qualified in accordance with Appendix VIII, Supplements 4 and 6.

(b) When the examination volume defined in (a) cannot be effectively examined in all four directions, the examination shall be augmented by examination from the nozzle bore, using procedures and personnel qualified in accordance with Appendix VIII, Supplement 7.
(a) If the provisions of I-3300(b) cannot be met because of access restrictions, and the nozzle-to-vessel weld is examined from the outside, the required examination volume shall be scanned in accordance with I-3300 (a) and (b) to the extent and in the directions allowed by the physical restrictions.

(b) The inner 15% t shall be examined
   (1) in two opposing radial directions using procedures and personnel qualified in accordance with Appendix VIII, Supplement 4; or one radial direction using procedures and personnel qualified in accordance with Appendix VIII, Supplement 5, for single-side access; and
   (2) two opposing circumferential directions using procedures and personnel qualified in accordance with Appendix VIII, Supplement 5.

(c) The remaining 85% of the required examination volume shall be examined in at least one radial direction from
   (1) the nozzle bore, using procedures and personnel qualified in accordance with Appendix VIII, Supplement 7, or
   (2) the vessel shell, using procedures and personnel qualified for single-side examination in accordance with Appendix VIII, Supplement 6.
### APPENDIX VIII EXAMINATION

(b) Examination coverage shall be in accordance with I-3000.

(c) No other I-1000 or I-2000 requirements apply.

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#### TABLE I-2000-1

<table>
<thead>
<tr>
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<th>Reactor Vessel Flange and Attachment Welds I-2110(b)</th>
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