

Date Submitted: **DRAFT**

Submitted By: Michael E. Gothard

**SUBJECT:**

Code Case to Section XI, Division 1, Appendix VIII, Supplement 10, to include I.D. examination and allow use of alternative flaw mechanisms.

**FILE NUMBER:**

SG NDE

**CATEGORY-PRIORITY:**

Primary: S-N  
Secondary (if applicable): N/A

**PROPOSAL:**

Revise Appendix VIII Supplement 10 to include provisions for piping examination from the inside surface, allow use of alternative flaw mechanisms, and incorporate improvements in the performance demonstrations. The proposed implementing Code Case and Code Change are included. Applicability 1990 through 2000 Addenda.

**EXPLANATION:**

Supplement 10 as currently written addresses qualification for O.D. examination of piping welds. It does not address the inherent differences for qualification of I.D. examinations. Additionally, it requires that all flaws be cracks. It is not practical to implant realistic cracks in certain locations or orientations, so rules are provided for alternative flaw mechanisms. The proposed changes also incorporate improvements in the performance demonstrations gained from several years experience.

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## **Proposed Code Case and Code change to ASME Section XI, Appendix VIII, Supplement 10**

The following proposed Code action is the result of NRC, PDI, and EPRI attempts to consolidate the requirements contained in the current Code Appendix VIII rules and the NRC Final Rulemaking. Specific details are currently being addressed through joint meetings with NRC, PDI, and EPRI. The Code action is presented as both a Code Case and a Code Change because selected revisions are needed quickly to address implementation commitments and concerns.

The current Supplement 10 provides requirements for qualification of procedures, personnel, and equipment when examining dissimilar metal piping welds from the outside surface. This was addressed previously in a revision to Supplement 2. Primarily paragraphs 1.1 General, 1.1(b), 1.1(c), and 2.0 have been revised to address qualification from either surface.

The current Supplement 10 does not address requirements for dissimilar metal piping welds that contain supplemental corrosion resistant cladding (CRC). This was also addressed previously in a revision to Supplement 2. Paragraph 1.1 was revised to specifically exclude CRC. Owners who perform UT of CRC will continue to use their current programs under the auspices of ASME Section XI Para. I-2400 because the CRC is not considered a Supplement 2 pipe weld in Appendix VIII.

The current Supplement 10 requires that all flaws be cracks. This was also addressed previously in a revision to Supplement 2. However, in this instance the flaw implantation process produces an additional impediment because the sound beam must travel through weld material with a dendritic orientation that is incorrect. For this reason paragraph 1.1(d)(1) was modified to allow for the use of alternative flaw mechanisms under defined conditions.

This revision also incorporates lessons learned from hundreds of qualifications. For example, it requires a larger sample set size with 100% detection for procedure qualification, modifies the requirements for identifying flawed regions to candidates, and requires that each detected flaw be length sized. These revisions are contained in several individual paragraphs.

The following presents the noted changes in a two column format. The left most column is the current Code requirements from the 95 Edition, 96 Addenda. The right column presents the needed revisions.

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# **SUPPLEMENT 10 — QUALIFICATION REQUIREMENTS FOR DISSIMILAR METAL PIPING WELDS**

## **1.0 SPECIMEN REQUIREMENTS**

Qualification test specimens shall meet the requirements listed herein, unless a set of specimens is designed to accommodate specific limitations stated in the scope of the examination procedure (e.g., pipe size, weld joint configuration, access limitations). The same specimens may be used to demonstrate both detection and sizing qualification.

**1.1 General.** The specimen set shall conform to the following requirements.

(a) Specimens shall have sufficient volume to minimize spurious reflections that may interfere with the interpretation process.

(b) The specimen set shall include the minimum and maximum pipe diameters and thicknesses for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. Pipe diameters larger than 24 in. shall be considered to be flat. When a range of thicknesses is to be examined, a thickness tolerance of  $\pm 25\%$  is acceptable.

(c) The specimen set shall include examples of the following fabrication condition:

(1) geometric conditions that normally require discrimination from flaws (e.g., counterbore or weld root

This Supplement is applicable to austenitic piping welds examined from either the inside (I.D.) or outside (O.D.) surface. The applicable qualification criteria shall be satisfied separately. This Supplement is not applicable to piping welds containing supplemental corrosion resistant cladding applied to mitigate IGSCC.

, within 1/2 inch NPS,

(c) Taking into consideration the accessible scanning surface, the O.D. or I.D. specimen set shall include appropriate examples of the following fabrication conditions:

conditions, cladding, weld buttering, remnants of previous welds, adjacent welds in close proximity);

(2) typical limited scanning surface conditions (e.g., diametrical shrink, single-side access due to nozzle and safe end external tapers).

(d) All flaws in the specimen set shall be cracks.

(1) At least 50% of the cracks shall be in austenitic material. At least 50% of the cracks in austenitic material shall be contained wholly in weld or buttering material. At least 10% of the cracks shall be in ferritic material. The remainder of the cracks may be in either austenitic or ferritic material.

(2) At least 50% of the cracks in austenitic base material shall be either IGSCC or thermal fatigue cracks. At least 50% of the cracks in ferritic material shall be mechanically or thermally induced fatigue cracks.

(3) At least 50% of the cracks shall be coincident with areas described in (c) above.

**1.2 Detection Specimens.** The specimen set shall include detection specimens that meet the following requirements.

(a) Specimens shall be divided into grading units. Each grading unit shall include at least 3 in. of weld length. If a grading unit is designed to be unflawed, at least 1 in. of unflawed material shall exist on either side of the grading unit. The segment of weld length used in one grading unit shall not be used in another grading unit. Grading units need not be uniformly spaced around the pipe specimen.

(b) Detection sets shall be selected from Table VIII-S2-1. The number of unflawed grading units shall be at least twice the number of flawed grading units.

(c) Flawed grading units shall meet the following criteria for flaw depth, orientation, and type.

(1) All flaw depths shall be greater than 10% of the nominal pipe wall thickness. At least  $\frac{1}{3}$  of the flaws, rounded to the next higher whole number, shall have depths between 10% and 30% of the nominal pipe wall thickness. However, flaw depths shall exceed the nominal clad thickness when placed in cladding. At least  $\frac{1}{3}$  of the flaws, rounded to the next whole number, shall have depths greater than 30% of the nominal pipe wall thickness.

(2) At least 30% and no more than 70% of the flaws, rounded to the next higher whole number, shall be oriented axially. The remainder of the flaws shall be oriented circumferentially.

**1.3 Length Sizing Specimens.** The specimen set shall include length sizing specimens that meet the following requirements.

(a) All length sizing flaws shall be oriented circumferentially.

for O.D. scans, or O.D. reinforcement and safe end tapers for I.D. scans, as appropriate);

, clad surfaces, or counterbore within the scanning area, as appropriate).

For initial procedure qualification, detection sets shall include the equivalent of three personnel qualification sets. Extension of procedure qualifications to qualify new values of essential variables requires at least one personnel qualification set.

*distributed*

(b) The minimum number of flaws shall be ten.

(c) All flaw depths shall be greater than 10% of the nominal pipe wall thickness. At least  $\frac{1}{3}$  of the flaws, rounded to the next higher whole number, shall have depths between 10% and 30% of the nominal pipe wall thickness. However, flaw depth shall exceed the nominal clad thickness when placed in cladding. At least  $\frac{1}{3}$  of the flaws, rounded to the next whole number, shall have depths greater than 30% of the nominal pipe wall thickness.

**1.4 Depth Sizing Specimens.** The specimen set shall include depth sizing specimens that meet the following requirements.

(a) The minimum number of flaws shall be ten.

(b) Flaws in the sample set shall not be wholly contained within cladding and shall be distributed as follows:

Flaw Depth (% Wall Thickness)	Minimum Number of Flaws
10-30%	20%
31-60%	20%
61-100%	20%

The remaining flaws shall be in any of the above categories.

## 2.0

### CONDUCT OF PERFORMANCE DEMONSTRATION

The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to grading the results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.

**2.1 Detection Test.** Flawed and unflawed grading units shall be randomly mixed.

#### 2.2 Length Sizing Test

(a) The length sizing test may be conducted separately or in conjunction with the detection test.

(b) When the length sizing test is conducted in conjunction with the detection test, and less than ten circumferential flaws are detected, additional specimens shall be provided to the candidate such that at least ten flaws are sized. The regions containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region.

(c) For a separate length sizing test, the regions of each specimen containing a flaw to be sized shall be

When scanning from the O.D.,

When scanning from the I.D., flaw location and specimen identification shall be obscured to maintain a "blind test".

(a) Each reported flaw in the detection test shall be length sized. When only length sizing is being tested, the regions of each specimen containing a flaw to be sized may be identified to the candidate. The candidate shall determine the length of the flaw in each region.

identified to the candidate. The candidate shall determine the length of the flaw in each region.

### 2.3 Depth Sizing Test

(a) For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate.

(b) For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

## 3.0 ACCEPTANCE CRITERIA

**3.1 Detection Acceptance Criteria.** Examination procedures, equipment, and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls.

### 3.2 Sizing Acceptance Criteria

**A96** (a) Examination procedures, equipment, and personnel are qualified for length sizing the RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch.

**A96** (b) Examination procedures, equipment, and personnel are qualified for depth sizing when the RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 in.

For initial procedure qualification, depth sizing sets shall include the equivalent of three personnel qualification sets. Extension of procedure qualifications to qualify new values of essential variables requires at least one personnel qualification set.

The depth sizing test may be performed in conjunction with or separate from the detection test. When only depth sizing is being tested, the regions of each specimen containing a flaw to be sized may be identified to the candidate.

(a) Personnel demonstrations shall meet the requirements of Table VIII S2-1 for both detection and false calls.  
(b) Procedure qualifications shall demonstrate detectability of each flaw, within the scope of the procedure. Successful personnel demonstrations may be combined to satisfy the requirements for procedure qualification.