

Approval Date: April 25, 2016

Code Cases will remain available for use until annulled by the applicable Standards Committee.

Case N-845-1
Qualification Requirements for Bolts and Studs
Section XI, Division 1

Inquiry: What alternative to the requirements of Mandatory Appendix VIII, Supplement 8, may be used for qualification requirements for bolts and studs?

Reply: It is the opinion of the Committee that as an alternative to the requirements of Mandatory Appendix VIII, Supplement 8, the following requirements may be used.

1 SCOPE

This Case is applicable to bolts or studs examined from either end or from the bore hole.

2 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.

2.1 GENERAL

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

(b) For examinations performed from the end of a bolt or stud, the specimens shall be full-scale sections that are sufficient to demonstrate the technique. For examinations from the bore, a segment may be used, provided it has sufficient length to demonstrate the technique.

(c) For each examination technique (e.g., bore hole, straight beam), the specimen set shall consist of at least three specimens having different diameters and lengths, as applicable.

(d) The specimen set shall contain typical geometric conditions that normally require discrimination from flaws (e.g., shank-to-thread transitions, head-to-shank transitions, bore hole geometry, or threads).

(e) The specimen set shall include typical scanning surface conditions (e.g., bore holes, grooves, transitions).

(f) The qualification specimens shall be ferritic forged material. Variations in materials shall be addressed by the process described in 5.

(g) The specimen set shall contain at least five circumferentially-oriented notches.

(h) The notch size shall not exceed the maximum depth and reflective area specified in Table 1.

(i) For examinations performed from the end of a bolt or stud, the specimen set shall contain notches at the minimum and maximum required metal paths representative of the examination volume. These notches shall be located within the examination volume.

(1) For examinations performed from the head surface of bolts with integral heads, the minimum metal path distance shall be demonstrated on a notch located in the head-to-shank region. When the examination is performed from the opposite surface, this notch can also be used to demonstrate the maximum metal path distance.

(2) Notches located within one diameter of the start of the examination volume are suitable for demonstrating the minimum metal path distances.

(3) Notches located within one diameter of the end of the examination volume are suitable for demonstrating the maximum metal path distances.

(j) For bore hole examinations, the specimen set shall contain a range of bore hole sizes and stud diameters sufficient to demonstrate the minimum and maximum metal paths.

(k) The specimen sets shall contain notches located on the outside-surface of the bolt or stud. The notch locations shall be within the required examination volume and coincident with geometric features that would challenge the discrimination capabilities of the technique (e.g., threaded surface, thread-to-shank transitions, head-to-shank transitions, or other geometric features).

(l) Additional notches may be included, provided they do not interfere with detection of required notches.

The Committee's function is to establish rules of safety, relating only to pressure integrity, governing the construction of boilers, pressure vessels, transport tanks and nuclear components, and inservice inspection for pressure integrity of nuclear components and transport tanks, and to interpret these rules when questions arise regarding their intent. This Code does not address other safety issues relating to the construction of boilers, pressure vessels, transport tanks and nuclear components, and the inservice inspection of nuclear components and transport tanks. The user of the Code should refer to other pertinent codes, standards, laws, regulations or other relevant documents.

Table 1
Maximum Notch Dimensions

Bolt or Stud Size	Depth, in. (mm) [Note (1)]	Reflective Area, in. ² (mm ²)
Greater than 4 in. (100 mm) diameter	0.157 (4)	0.059 (38)
2 in. (50 mm) diameter and greater, but not over 4 in. (100 mm) diameter	0.107 (2.7)	0.027 (17)

NOTE:

(1) For threaded surfaces, notch depth is measured from the bottom of the thread root to the bottom of the notch.

3 CONDUCT OF PERFORMANCE DEMONSTRATIONS

3.1 PERSONNEL QUALIFICATIONS

Specimen identification and notch locations shall be obscured, so as to maintain a “blind test.” A flaw shall be considered detected when the notch, as defined in 2.1, is found. To receive credit for detection, the following criteria must be satisfied:

(a) The notch response shall have a minimum peak-signal-to-peak-noise ratio of 2:1.

(b) The notch responses shall equal or exceed the reporting criteria specified in the procedure.

(c) The reported notch axial location correlation shall be within $\pm 1/2$ in. (± 13 mm) or $\pm 5\%$ of the bolt or stud length, whichever is greater.

(d) A false call is any call made by the candidate where a flaw is not present or the flaw is positioned outside the limits specified in (c) above.

3.2 BLIND PROCEDURE QUALIFICATIONS

Procedure qualifications shall include the following requirements:

(a) The specimen set shall include the equivalent of at least three personnel performance demonstration test sets. Successful personnel performance demonstrations may be combined to satisfy this requirement.

(b) Detectability of all flaws in the procedure qualification test set that are within the scope of the procedure shall be demonstrated.

(c) At least one successful personnel demonstration shall be performed.

(d) With the exception of the variables defined in 5.3, at least one personnel performance demonstration set is required for qualification of new essential variables. The acceptance criteria of 3.2 shall be met.

4 ACCEPTANCE CRITERIA

(a) Personnel are considered qualified if they detect a minimum of 80% of the flaws within the test set and have no more than one false call.

(b) Procedure and equipment qualification 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.

5 PROCEDURE DEMONSTRATION PRIOR TO EXAMINATION

Prior to examination, a procedure demonstration shall be performed that includes the following requirements:

5.1 CALIBRATION STANDARD REQUIREMENTS

(a) A calibration standard shall be used that has a similar material specification and product form to the bolt or stud to be examined.

(b) The calibration standard shall have similar geometrical features and scan surface to the bolt or stud to be examined.

(c) The calibration standard shall contain circumferential notches that do not exceed the maximum depth and reflective area requirements defined in Table 1.

(d) For examination performed from the end of the bolt or stud, the notch locations shall satisfy the requirements defined in 2.1(i) and 2.1(k).

(e) For bore-hole examinations, the calibration standard shall have the same outside diameter as the bolt or stud to be examined. The calibration standard shall have a bore hole with the same diameter as the bolt or stud to be examined.

The calibration standard shall contain at least one notch at the maximum metal path that satisfies the location requirements of 2.1(k).

5.2 DEMONSTRATION REQUIREMENTS

(a) Personnel performing the demonstration shall have satisfied the blind qualification requirements of this Case.

(b) The qualified examiner shall demonstrate that the entire examination system (i.e., procedure, equipment, and settings) is effective for the specific bolt or stud to be examined.

(c) The examiner shall demonstrate to a UT Level III, familiar with the examination techniques and procedure requirements, the examination system's ability to detect and locate all of the required notches as defined in 5.1 (e.g., minimum and maximum metal paths for examinations performed from the end and maximum metal paths for examinations performed from the bore) within the accuracy and sensitivity limits defined in ~~3.2(a) through 3.2(c)~~.

3.1(a) through 3.1(c). →

(d) Results of the demonstration shall be documented.

(e) The demonstration shall be performed prior to the start of any examination or series of examinations.

(f) The examiner shall demonstrate the same examination process that will be used on the bolt or stud (i.e., examination from the same surface or surfaces from which the examination will be performed).

5.3 PROCEDURE OPTIMIZATION

The following parameters of the demonstrated examination system may be modified to optimize the examination techniques for the bolt or stud configuration to be examined. If these modifications are required, the demonstration requirements defined in 5.2 shall be applied:

(a) search unit size and frequency to address material attenuation

(b) instrument settings to address changes in frequency (e.g., filtering, pulse width for instruments with square wave pulsers)

(c) bore-hole probe (e.g., fixture size, element size) to address variations in bore-hole diameters

5.4 PROCEDURE EXPANSION FOR QUALIFIED METAL PATHS

The following demonstration shall be performed when a bolt or stud to be examined requires metal paths that exceed the minimum or maximum demonstrated in 2 through 4. Demonstrations defined in 5 shall be performed to ensure the effectiveness of the examination system prior to use. If the extended metal path demonstration fails to satisfy the requirements of 5.2(c), the qualification process defined in 2 through 4 shall be performed for the new metal path.

CASES OF ASME BOILER AND PRESSURE VESSEL CODE

Approval Date:

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Case N-845
QUALIFICATION REQUIREMENTS FOR
BOLTS AND STUDS

Section XI, Division 1

Inquiry: What alternative to the requirements of Appendix VIII, Supplement 8, may be used for qualification requirements for bolts and studs?

Reply: It is the opinion of the Committee that as an alternative to the requirements of Appendix VIII, Supplement 8, the following requirements may be used.

1.0 SCOPE

This Case is applicable to bolts or studs examined from either end or from the bore hole.

2.0 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.

2.1 General

- (a) Specimens shall have sufficient volume to minimize spurious reflections that may interfere with the interpretation process.
- (b) For examinations performed from the end of a bolt or stud, the specimens shall be full-scale sections that are sufficient to demonstrate the technique. For examinations from the bore, a segment may be used provided it has sufficient length to demonstrate the technique.
- (c) For each examination technique (e.g., bore hole, straight beam), the specimen set shall consist of at least three specimens having different diameters and lengths, as applicable.
- (d) The specimen set shall contain typical geometric conditions that normally require discrimination from flaws (e.g., shank-to-thread transitions, head-to-shank transitions, bore hole geometry, or threads).
- (e) The specimen set shall include typical scanning surface conditions (e.g., bore holes, grooves, transitions).

- (f) The qualification specimens shall be ferritic forged material. Variations in materials shall be addressed by the process described in Paragraph 5.0.
- (g) The specimen set shall contain at least 5 circumferentially-oriented notches.
- (h) The notch size shall not exceed the maximum depth and reflective area specified in Table 1.
- (i) For examinations performed from the end of a bolt or stud, the specimen set shall contain notches at the minimum and maximum required metal paths representative of the examination volume.
 - (1) For examinations performed from the head surface of bolts with integral heads, the minimum metal path distance shall be demonstrated on a notch located in the head-to-shank region. When the examination is performed from the opposite surface, this notch can also be used to demonstrate the maximum metal path distance.
 - (2) Notches located within one diameter of the start of the examination volume are suitable for demonstrating the minimum metal path distances.
 - (3) Notches located within one diameter of the end of the examination volume are suitable for demonstrating the maximum metal path distances.
- (j) For bore hole examinations, the specimen set shall contain a range of bore hole sizes and stud diameters sufficient to demonstrate the minimum and maximum metal paths.
- (k) The specimen sets shall contain notches located on the outside surface of the bolt or stud. The notch locations shall be within the required examination volume and coincident with geometric features that would challenge the discrimination capabilities of the technique (e.g., threaded surface, thread-to-shank transitions, head-to-shank transitions, or other geometric features).
 - (l) Additional notches may be included, provided they do not interfere with detection of required notches.

Table 1
Maximum Notch Dimensions

Bolt or Stud Size	Depth, in. (mm) [Note (1)]	Reflective Area, sq. in. (mm ²)
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NOTE:

(1) For threaded surfaces, notch depth is measured from the bottom of the thread root to the bottom of the notch.

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**3.0 CONDUCT OF PERFORMANCE
DEMONSTRATIONS**

3.1 Personnel Qualifications

Specimen identification and notch locations shall be obscured, so as to maintain a “blind test.” A flaw shall be considered detected when the notch, as defined in 2.1, is found. To receive credit for detection, the following criteria must be satisfied.

- (a) The notch response shall have a minimum peak-signal-to-peak-noise ratio of 2:1.
- (b) The notch responses shall equal or exceed the reporting criteria specified in the procedure.
- (c) The reported notch axial location correlation shall be within $\pm\frac{1}{2}$ in. (± 13 mm) or $\pm 5\%$ of the bolt or stud length, whichever is greater.
- (d) A false call is any call made by the candidate where a flaw is not present or the flaw is positioned outside the limits specified in (c) above.

3.2 Blind Procedure Qualifications

Procedure qualifications shall include the following requirements.

- (a) The specimen set shall include the equivalent of at least three personnel performance demonstration test sets. Successful personnel performance demonstrations may be combined to satisfy this requirement.
- (b) Detectability of all flaws in the procedure qualification test set that are within the scope of the procedure shall be demonstrated.
- (c) At least one successful personnel demonstration shall be performed.
- (d) With the exception of the variables defined in 5.3, at least one personnel performance demonstration set is required for qualification of new essential variables. The acceptance criteria of 3.1 shall be met.

4.0 ACCEPTANCE CRITERIA

- (a) Personnel are considered qualified if they detect a minimum of 80% of the flaws within the test set and have no more than one false call.
- (b) Procedure and equipment qualification 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.

**5.0. PROCEDURE DEMONSTRATION
PRIOR TO EXAMINATION**

Prior to examination, a procedure demonstration shall be performed that includes the following requirements.

5.1 Calibration Standard Requirements

- (a) A calibration standard shall be used that has a similar material specification and product form to the bolt or stud to be examined.
- (b) The calibration standard shall have similar geometrical features and scan surface to the bolt or stud to be examined.
- (c) The calibration standard shall contain circumferential notches that do not exceed the maximum depth and reflective area requirements defined in Table 1.
- (d) For examinations performed from the end of the bolt or stud, the notch locations shall satisfy the requirements defined in 2.1(i) and (k).
- (e) For bore hole examinations, the calibration standard shall have the same outside diameter as the bolt or stud to be examined. The calibration standard shall have a bore hole with the same diameter as the bolt or stud to be examined.
 - (1) The calibration standard shall contain at least one notch at the maximum metal path that satisfies the location requirements of 2.1(k).

5.2 Demonstration Requirements

- (a) Personnel performing the demonstration shall have satisfied the blind qualification requirements of this Case.
- (b) The qualified examiner shall demonstrate that the entire examination system (i.e., procedure, equipment, and settings) is effective for the specific bolt or stud to be examined.
- (c) The examiner shall demonstrate to a UT Level III, familiar with the examination techniques and procedure requirements, the examination system’s ability to detect and locate all of the required notches as defined in 5.1 (e.g., minimum and maximum metal paths for examinations performed from the end and maximum metal paths for examinations performed from the bore) within the accuracy and sensitivity limits defined in 3.1(a) through (c).
- (d) Results of the demonstration shall be documented.
- (e) The demonstration shall be performed prior to the start of any examination or series of examinations.
- (f) The examiner shall demonstrate the same examination process that will be used on the bolt or stud

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(i.e., examination from the same surface or surfaces from which the examination will be performed).

(c) bore hole probe (e.g., fixture size, element size) to address variations in bore hole diameters

5.3 Procedure Optimization

The following parameters of the demonstrated examination system may be modified to optimize the examination techniques for the bolt or stud configuration to be examined. If these modifications are required, the demonstration requirements defined in 5.2 shall be applied.

- (a) search unit size and frequency to address material attenuation
- (b) instrument settings to address changes in frequency (e.g., filtering, pulse width for instruments with square wave pulsers)

5.4 Procedure Expansion for Qualified Metal Paths

The following demonstration shall be performed when a bolt or stud to be examined requires metal paths that exceed the minimum or maximum demonstrated in 2.0 through 4.0. Demonstrations defined in 5.0 shall be performed to ensure the effectiveness of the examination system prior to use. Procedure and personnel qualifications are required in accordance with 2.0 through 4.0.