nonrelevant shall be reexamined to verify whether actual defects are present. Nonrelevant indications which would mask indications of defects are unacceptable. Surface conditioning may precede the reexamination. Relevant indications are those which result from imperfections and have a major dimension greater than 1/16 in. (1.5 mm). Linear indications are those whose length is more than three times the width. Rounded indications are those which are circular or elliptical with the length less than three times the width.

(c) Acceptance Standards. The following relevant indications are unacceptable:

1. linear indications greater than 1/16 in. (1.5 mm) long for materials less than 1/8 in. (16 mm) thick, greater than 1/8 in. (3 mm) long for materials from 1/8 in. (16 mm) thick to under 2 in. (50 mm) thick, and 3/16 in. (5 mm) long for materials 2 in. (50 mm) thick and greater;

2. rounded indications with dimensions greater than 1/8 in. (3 mm) for thicknesses less than 5/64 in. (16 mm) and greater than 3/16 in. (5 mm) for thicknesses 5/64 in. (16 mm) and greater;

3. four or more relevant indications in a line separated by 1/16 in. (1.5 mm) or less edge to edge;

4. ten or more relevant indications in any 6 in.² (4,000 mm²) of surface with the major dimension of this area not to exceed 6 in. (150 mm) taken in the most unfavorable orientation relative to the indications being evaluated.

NB-2580 EXAMINATION OF BOLTS, STUDS, AND NUTS

NB-2581 Required Examination

All bolting material shall be visually examined in accordance with NB-2582. In addition, nominal sizes greater than 1 in. (25 mm) shall be examined by either the magnetic particle method in accordance with NB-2583 or the liquid penetrant method in accordance with NB-2584. In addition, nominal sizes greater than 2 in. (50 mm) but not over 4 in. (100 mm) shall be examined by the ultrasonic method in accordance with NB-2585 and nominal sizes greater than 4 in. (100 mm) shall be examined by the ultrasonic method in accordance with both NB-2585 and NB-2586.
NB-2582 Visual Examination

The final surfaces of threads, shanks, and heads shall be visually examined for workmanship, finish, and appearance in accordance with the requirements of ASTM F788 for bolting material and ASTM F812 for nuts. The visual examination personnel shall be trained and qualified in accordance with the Material Organization's Quality System Program or the Certificate Holder's Quality Assurance Program. These examinations are not required to be performed either in accordance with procedures qualified to NB-5100 or by personnel qualified in accordance with NB-5500.

NB-2583 Magnetic Particle Examination (for Ferritic Steel Bolting Material Only)

NB-2583.1 Examination Procedure. All bolts, studs, and nuts greater than 1 in. (25 mm) nominal bolt size shall be examined by the magnetic particle method in accordance with ASTM A275. If desired, the supplier may perform liquid penetrant examination in accordance with NB-2584 instead of magnetic particle examination. Such examination shall be performed on the finished component after threading or on the materials stock at approximately the finished diameter before threading and after heading (if involved). This examination shall be performed on all accessible surfaces.

NB-2583.2 Evaluation of Indications.

(a) All indications shall be evaluated in terms of the acceptance standards. Linear indications are those indications in which the length is more than three times the width. Rounded indications are those which are circular or elliptical with the length equal to or less than three times the width.

(b) All indications are not necessarily relevant: leakage

NB-2584 Liquid Penetrant Examination

NB-2584.1 Examination Procedure. All bolts, studs, and nuts greater than 1 in. (25 mm) nominal bolt size shall be examined by a liquid penetrant method in accordance with the methods of Section V, Article 6. Such examination shall be performed on the finished component after threading or on the materials stock at approximately the finished diameter before threading and after heading (if involved).

NB-2584.2 Evaluation of Indications. All indications shall be evaluated in terms of the acceptance standards. Linear indications are those indications in which the length is more than three times the width. Rounded indications are those which are circular to elliptical with the length equal to or less than three times the width. All penetrant indications are not necessarily relevant. Surface imperfections such as machining marks and scratches may produce indications that are nonrelevant to the detection of unacceptable discontinuities. Broad areas of pigmentation, which could mask indications of defects, are unacceptable. Indications with major dimensions of 1/16 in. (1.5 mm) or less are not relevant. Any indication that is believed to be nonrelevant, and that is larger than acceptable, shall be considered to be a defect and shall be reexamined after light surface conditioning. Any area of pigmentation also shall be reexamined after recleaning or light surface conditioning, as appropriate. Any indication observed during such reexamination shall be considered relevant and shall be evaluated in terms of the acceptance standards.

NB-2584.3 Acceptance Standard. Linear nonaxial indications are unacceptable. Linear axial indications greater than 1 in. (25 mm) long are unacceptable.

NB-2585 Ultrasonic Examination for Sizes Greater Than 2 in. (50 mm)

NB-2585.1 Ultrasonic Method. Examination shall be carried out by the straight beam, radial-scan method in accordance with Section V, Article 23, SA-388.

NB-2585.2 Examination Procedure. Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure require the use of other frequencies to assure adequate penetration or better resolution. The search unit shall not exceed 1 in.² (650 mm²) area.

NB-2585.3 Calibration of Equipment. Calibration sensitivity shall be established by adjustment of the instrument so that the first back reflection is 75% to 90% of full-screen height.
NB-2585.4 **Acceptance Standard.** Any discontinuity that causes an indication in excess of 20% of the height of the first back reflection or any discontinuity that prevents the production of a first back reflection of 50% of the calibration amplitude is not acceptable.

NB-2586 **Ultrasonic Examination for Sizes Over 4 in. (100 mm)**

In addition to the requirements of NB-2585, all bolts, studs, and nuts over 4 in. (100 mm) nominal bolt size shall be ultrasonically examined over the entire surface of each end before or after threading in accordance with the following requirements.

**NB-2586.1 Ultrasonic Method.** Examination shall be carried out by the straight beam, longitudinal-scan method.

**NB-2586.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz with a search unit having a circular cross section with a diameter not less than 1/2 in. (13 mm) nor more than 1 1/8 in. (29 mm).

**NB-2586.3 Calibration of Equipment.** Calibration shall be established on a test bar of the same nominal composition and diameter as the production part and a minimum of one-half of the length. A 3/8 in. (10 mm) diameter by 3 in. (75 mm) deep flat-bottom hole shall be drilled in one end of the bar and plugged to full depth. A distance–amplitude curve shall be established by scanning from both ends of the test bar.

**NB-2586.4 Acceptance Standard.** Any discontinuity that causes an indication in excess of that produced by the calibration hole in the reference specimen as corrected by the distance–amplitude curve is not acceptable.

**NB-2587 Time of Examination**

Acceptance examinations shall be performed after the final heat treatment required by the basic material specification.

**NB-2588 Elimination of Surface Defects**

Unacceptable surface defects on finished bolts, studs, and nuts are not permitted, and are cause for rejection.

**NB-2589 Repair by Welding**

Weld repairs of bolts, studs, and nuts are not permitted.

**NB-2586.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure require the use of other frequencies to assure adequate penetration or better resolution. The search unit shall have a circular cross section with a diameter not less than 1/2 in. (13 mm) nor more than 1 1/8 in. (29 mm).

**NB-2587 Time of Examination**

Acceptance examinations shall be performed after the final heat treatment required by the basic material specification.

**NB-2588 Elimination of Surface Defects**

Unacceptable surface defects on finished bolts, studs, and nuts are not permitted, and are cause for rejection.

**NB-2589 Repair by Welding**

Weld repairs of bolts, studs, and nuts are not permitted.

**NB-2586.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure require the use of other frequencies to assure adequate penetration or better resolution. The search unit shall have a circular cross section with a diameter not less than 1/2 in. (13 mm) nor more than 1 1/8 in. (29 mm).

**NB-2587 Time of Examination**

Acceptance examinations shall be performed after the final heat treatment required by the basic material specification.

**NB-2588 Elimination of Surface Defects**

Unacceptable surface defects on finished bolts, studs, and nuts are not permitted, and are cause for rejection.

**NB-2589 Repair by Welding**

Weld repairs of bolts, studs, and nuts are not permitted.

**NB-2586.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure require the use of other frequencies to assure adequate penetration or better resolution. The search unit shall have a circular cross section with a diameter not less than 1/2 in. (13 mm) nor more than 1 1/8 in. (29 mm).

**NB-2587 Time of Examination**

Acceptance examinations shall be performed after the final heat treatment required by the basic material specification.

**NB-2588 Elimination of Surface Defects**

Unacceptable surface defects on finished bolts, studs, and nuts are not permitted, and are cause for rejection.

**NB-2589 Repair by Welding**

Weld repairs of bolts, studs, and nuts are not permitted.

**NB-2586.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure require the use of other frequencies to assure adequate penetration or better resolution. The search unit shall have a circular cross section with a diameter not less than 1/2 in. (13 mm) nor more than 1 1/8 in. (29 mm).
the requirements of Section IX, QW-214.1. The removal of chemical analysis samples shall conform with Section IX, QW-453 for the minimum thickness for which the Welding Procedure Specification is qualified.

**NF-2432.2 Requirements for Chemical Analysis.** The chemical elements to be determined, the composition requirements of the weld metal, and the recording of results of the chemical analysis shall be in accordance with (a) through (c).

(a) Welding material of ferrous alloy A-No. 8 (Section IX, Table QW-442) shall be analyzed for the elements listed in Table NF-2432.2(a)-1 and for any other elements specified either in the welding material specification referenced by the Welding Procedure Specification or in the Welding Procedure Specification.

(b) The chemical composition of the weld metal or filler metal shall conform to the welding material specification for elements having specified percentage composition limits. Where the Welding Procedure Specification contains a modification of the composition limits of SFA or other referenced welding material specifications, or provides limits for additional elements, these composition limits of the Welding Procedure Specification shall apply for acceptability.

(c) The results of the chemical analysis shall be reported in accordance with NCA-3862.1. Elements listed in Table NF-2432.2(a)-1 but not specified in the welding material specification or Welding Procedure Specification shall be reported for information only.

**NF-2433 Delta Ferrite Determination**

A determination of delta ferrite shall be performed on A-No. 8 weld material (Section IX, Table QW-442) backing filler metal (consumable inserts); bare electrode, rod, or wire filler metal; or weld metal, except that delta ferrite determinations are not required for SFA-5.4, Type 16-8-2, or A-No. 8 weld filler metal to be used for weld metal cladding.

**NF-2433.1 Method.** Delta ferrite determinations of welding material, including consumable insert material, shall be made using a magnetic measuring instrument and weld deposits made in accordance with (b). Alternatively, the delta ferrite determinations for welding materials may be performed by the use of chemical analysis of NF-2432 in conjunction with Figure NF-2433.1-1.

(a) Calibration of magnetic instruments shall conform to AWS A4.2.

**Table NF-2432.2(a)-1 Welding Material Chemical Analysis**

<table>
<thead>
<tr>
<th>Materials</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cr-Ni stainless materials</td>
<td>C, Cr, Mo, Ni, Mn, Si,Cb</td>
</tr>
</tbody>
</table>

(b) The weld deposit for magnetic delta ferrite determination shall be made in accordance with NF-2432.1(c).

(c) A minimum of six ferrite readings shall be taken on the surface of the weld deposit. The readings obtained shall be averaged to a single Ferrite Number (FN).

**NF-2440 STORAGE AND HANDLING OF WELDING MATERIAL**

Suitable storage and handling of electrodes, flux, and other welding materials shall be maintained. Precautions shall be taken to minimize absorption of moisture by fluxes and cored, fabricated, and coated electrodes.

**NF-2500 EXAMINATION AND REPAIR OF MATERIAL**

**NF-2510 EXAMINATION AND REPAIR OF MATERIAL OTHER THAN BOLTING**

Material for supports shall be examined in accordance with the material specification. Defects may be repaired as permitted by the material specification.

**NF-2520 REQUIRED EXAMINATION AND ACCEPTANCE STANDARDS FOR CLASS 1 SPRINGS**

Spring coils for Class 1 variable, constant, and sway brace standard supports shall be examined after coiling by either the magnetic particle or liquid penetrant method. Linear indications shall be removed by grinding and blending. If the depth of the ground area exceeds 3% of the bar diameter or thickness, the spring coil shall be rejected.

**NF-2530 REQUIRED EXAMINATION AND ACCEPTANCE STANDARDS FOR COILED WIRE ROPE USED AS A SPRING**

Coiled wire rope used as a spring shall be visually examined after coiling and shall be free from kinks, loose strands, loose wires, or broken protruding wires.

**NF-2580 EXAMINATION OF BOLTING MATERIAL AND RODS**

The word rods as used in this subarticle is intended to cover rods that are threaded. It also includes forged piston rods if they are threaded for a portion of their length. It does not apply to unthreaded bar stock.

**NF-2581 Required Examinations**

**NF-2581.1 Class 1 Supports.** All bolting material and rods shall be visually examined in accordance with NF-2582. In addition, nominal sizes greater than 2 in.
(50 mm) shall be examined by either the magnetic particle or liquid penetrant method in accordance with NF-2583. In addition, nominal sizes greater than 4 in. (100 mm) shall be ultrasonically examined in accordance with NF-2584.

**NF-2581.2 Class 2, 3, and MC Supports.** Bolts, studs, and nuts shall be examined in accordance with the requirements of the material specification and NF-2582.

**NF-2582 Visual Examination**

The final surfaces of threads, shanks, and heads shall be visually examined for workmanship, finish, and appearance in accordance with the requirements of ASTM F788 for bolting material and ASTM F812 for nuts. The visual examination personnel shall be trained and qualified in accordance with the Material Organization’s Quality System Program or the Certificate Holder’s Quality Assurance Program. These examinations are not required to be performed either in accordance with procedures qualified to NF-5100 or by personnel qualified in accordance with NF-5500.

**NF-2583 Magnetic Particle or Liquid Penetrant Examination**

All bolting material and rods greater than 2 in. (50 mm) nominal size for Class 1 supports shall be examined by a magnetic particle method or a liquid penetrant method. Such examination shall be performed on the finished bolting material after threading or on the material stock at approximately the finished diameter before threading and after heading (if involved). Linear nonaxial indications are unacceptable. Linear axial indications greater than 1 in. (25 mm) in length are unacceptable.
NF-2584  Ultrasonic Examination for Sizes Greater Than 4 in. (100 mm)

All bolting material and rods greater than 4 in. (100 mm) nominal size for Class 1 supports shall be ultrasonically examined over the entire cylindrical surface prior to threading in accordance with the requirements of the following subparagraphs.

NF-2584.1 Ultrasonic Method. Examination shall be carried out by the straight beam, radial scan method.

NF-2584.2 Examination Procedure. Examination shall be performed at a nominal frequency of 2.25 MHz with a search unit not to exceed 1 in. (650 mm²) area.

NF-2584.3 Calibration of Equipment. Calibration sensitivity shall be established by adjustment of the instrument so that the first back reflection is 75% to 90% of full screen height.

NF-2584.4 Acceptance Standards. Any discontinuity that causes an indication in excess of 20% of the height of the first back reflection or any discontinuity which prevents the production of a first back reflection of 50% of the calibration amplitude is not acceptable.

NF-2586  Repair by Welding

Weld repairs of bolting material and rods are not permitted.

NF-2600  MATERIAL MANUFACTURER’S QUALITY SYSTEM PROGRAMS

(19) NF-2610  DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS

(a) Except as provided in (b), Material Organizations shall have a Quality System Program that meets the requirements of NCA-3800.

(b) The requirements of NCA-3862 shall be met as required by NF-2130. The other requirements of NCA-3800 and NCA-4200 need not be used by Material Organizations for small products, as defined in (c), for brazing material, and for material that is allowed by this Subsection to be furnished with a Certificate of Compliance. For these products, the Certificate Holder’s Quality Assurance Program (NCA-4100) shall include measures to provide assurance that the material is furnished in accordance with the material specification and the requirements of this Subsection.

(c) For the purpose of this paragraph, small products are defined as given in (1) through (3)

(1) pipe, tube, pipe fittings, and flanges of 2 in. (50 mm) nominal size and less
(2) bolting material, including studs, nuts, and bolts
(3) structural material with a nominal cross sectional area of 2 in² (1300 mm²) and less

(d) When impact testing is required in accordance with NF-2300, the material not exempted by NF-2311 shall be furnished with Certified Material Test Reports in accordance with NCA-3862.

(e) Structural materials, which are permitted by this Section to be furnished with a Certificate of Compliance, may be repaired by welding using welders, documentation, and examination requirements specified in SA-6 and need not meet the requirements of NCA-4257.3.

(f) Materials manufactured to a Material Specification prohibiting weld repair without user approval do not require documentation to indicate that weld repairs have not been performed.
NG-2577.3 Magnetic Particle or Liquid Penetrant Examination. Magnetic particle or liquid penetrant examination shall be performed after the final heat treatment required by the material specification. Repair weld areas shall be examined after postweld heat treatment when a postweld heat treatment is performed, except that repair welds in P-No. 1 material, 2 in. (50 mm) nominal thickness and less, may be examined prior to postweld heat treatment. For cast products with machined surfaces, all accessible finished machined surfaces, except threaded surfaces, shall also be examined by magnetic particle or liquid penetrant methods.

NG-2578 Elimination of Surface Defects

Elimination of surface defects shall be in accordance with NG-2538.

NG-2579 Repair by Welding

The Material Organization may repair castings by welding after removing the material containing defects. The depth of the repair is not limited. A cored hole or access hole may be closed by the Material Organization by welding in accordance with the requirements of this paragraph, provided the hole is closed by filler metal only. If the hole is closed by welding in a metal insert, the welding shall be in accordance with the requirements of Article NG-4000 by a Certificate of Authorization Holder.

NG-2579.1 Defect Removal. The defect shall be removed or reduced to an imperfection of an acceptable size by suitable mechanical or thermal cutting or gouging methods, and the cavity prepared for repair. When thermal cutting is performed, consideration shall be given to preheating the material.

NG-2579.2 Qualification of Welding Procedures and Welders. The welding procedure and welders or welding operators shall be qualified in accordance with Article NG-4000 and Section IX.

NG-2579.3 Blending of Repaired Areas. After welding, the surface shall be blended uniformly into the surrounding surface.

NG-2579.4 Examination of Repair Welds. Each repair weld shall be examined by the magnetic particle method (NG-2545) or by the liquid penetrant method (NG-2546). In addition, repair welds in cavities the depth of which exceeds the lesser of 3/16 in. (10 mm) or 10% of the section thickness shall be radiographed in accordance with NG-2573. The radiographic method and acceptance standards of NG-2573 shall apply except that weld slag, including elongated slag, shall be considered as inclusions under Category B of the applicable reference radiographs. The total area of all inclusions, including slag inclusions, shall not exceed the limits of the applicable severity level of Category B of the reference radiographs.

NG-2579.5 Heat Treatment After Weld Repair. After repair, the casting shall be heat-treated in accordance with NG-4620, except that the heating and cooling limitations of NG-4623 do not apply.

NG-2579.6 Material Report Describing Defects and Repairs. Each repair weld exceeding in depth either 3/16 in. (10 mm) or 10% of the section thickness shall be described in the Certified Material Test Report. The Certified Material Test Report shall include a chart for each repaired casting which shows the location and size of the repaired cavity, the welding material identification, the welding procedure, the heat treatment, and the examination results, including radiographs.

NG-2580 Examination of Threaded Structural Fasteners

NG-2581 Required Examinations

Threaded structural fasteners shall be visually examined in accordance with NG-2582. In addition, externally threaded structural fasteners greater than 3/8 in. (10 mm) and greater and nuts greater than 1 in. (25 mm) shall be examined by either the magnetic particle or liquid penetrant method in accordance with NG-2583. In addition, nominal sizes greater than 1/2 in. (13 mm) but not over 4 in. (100 mm) shall be examined by ultrasonic methods in accordance with NG-2584, and nominal sizes greater than 4 in. (100 mm) shall be examined by ultrasonic methods in accordance with both NG-2584 and NG-2585.

NG-2582 Visual Examination

The final surfaces of threads, shanks, and heads of externally threaded structural fasteners less than 3/8 in. (10 mm) and nuts 1 in. (25 mm) and smaller shall be visually examined for workmanship, finish, and appearance in accordance with the requirements of ASTM F788 for threaded structural fasteners and ASTM F812 for nuts prior to plating or other surface protection-type treatments. The visual examination personnel shall be trained and qualified in accordance with the Material Organization's Quality System Program or the Certificate Holder's Quality Assurance Program. These examinations are not required to be performed in accordance with procedures qualified to NG-5100 or by personnel qualified in accordance with NG-5500.

NG-2583 Magnetic Particle or Liquid Penetrant Examination

Externally threaded structural fasteners greater than 3/8 in. (10 mm) and greater and nuts greater than 1 in. (25 mm) shall be examined by a magnetic particle method (NG-2545) or a liquid penetrant method (NG-2546). Such examination shall be performed on the finished threaded structural fastener after threading and prior to plating or other surface protection type treatments. On threaded surfaces no relevant indications are permitted. Relevant indications include any linear indications or rounded indications...
greater than $\frac{1}{16}$ in. (1.5 mm). Indications, caused by a particular manufacturing method, that may appear to be relevant, such as the crest of rolled threads or root of cut threads, may be shown to be nonrelevant and acceptable by prior process qualification or destructive metallographic examination. On all other accessible surfaces, no linear indications or rounded indications greater than $\frac{1}{16}$ in. (1.5 mm) are permitted, except that linear axial indications less than one diameter or 1 in. (25 mm) in length are permitted.

**NG-2584 Ultrasonic Examination for Sizes Greater Than $\frac{1}{2}$ in. (13 mm)**

All threaded structural fasteners greater than $\frac{1}{2}$ in. (13 mm) nominal bolt size shall be ultrasonically examined over the entire cylindrical surface prior to threading, in accordance with the requirements of the following subparagraphs.

**NG-2584.1 Ultrasonic Method.** Examination shall be carried out by the straight beam, radial scan method.

**NG-2584.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure necessitate the use of a 1 MHz frequency in order to assure adequate penetration, with a search unit not to exceed 1 in.$^2$ (650 mm$^2$) area.

**NG-2584.3 Calibration of Equipment.** Calibration sensitivity shall be established by adjustment of the instrument so that the first back reflection is 75% to 90% of full screen height.

**NG-2584.4 Acceptance Standards.** Any imperfection which causes an indication in excess of 20% of the height of the first back reflection or any imperfection which prevents the production of a first back reflection of 50% of the calibration amplitude is not acceptable.

**NG-2585 Ultrasonic Examination for Sizes Over 4 in. (100 mm)**

In addition to the requirements of NG-2584, all threaded structural fasteners over 4 in. (100 mm) shall be ultrasonically examined over the entire surface of each end before or after threading in accordance with the requirements of the following subparagraphs.

**NG-2585.1 Ultrasonic Method.** Examination shall be carried out by the straight beam, longitudinal mode scan method.

**NG-2585.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure necessitate the use of a 1 MHz frequency in order to assure adequate penetration with a search unit having a circular cross section with a diameter not less than $\frac{1}{2}$ in. (13 mm) nor more than $\frac{1}{16}$ in. (29 mm).

**NG-2585.3 Calibration of Equipment.** Calibration shall be established on a test bar of the same nominal composition and diameter as the production part and a minimum of one-half of the length. A $\frac{3}{8}$ in. (10 mm) diameter $\times$ 3 in. (75 mm) deep flat bottom hole shall be drilled in one end of the bar and plugged to full depth.

**NG-2585.4 Acceptance Standards.** Any imperfection which causes an indication in excess of 50% of that produced by the calibration hole in the reference specimen, which causes an indication in excess of 20% of the height produced by scanning from both ends of the test bar.

**Surface defects may be eliminated by grinding or machining, provided the final dimension of the affected portion meets the requirements of the design and the area is reexamined by the magnetic particle or liquid penetrant method in accordance with NG-2583.**

**NG-2600 MATERIAL ORGANIZATIONS’ QUALITY SYSTEM PROGRAMS**

**NG-2610 DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS**

(a) Except as provided in (b) below, Material Organizations shall have a Quality System Program that meets the requirements of NCA-3800.

(c) For the purpose of this paragraph, small products are defined as given in the following:

(1) pipe, tube (except heat exchanger tube), pipe fittings, and flanges 2 in. nominal pipe size (DN 50) and less

(2) threaded structural fastener material, including studs and nuts of 1 in. (25 mm) nominal diameter and less

(3) bars with a nominal cross-sectional area of 1 in.$^2$ (650 mm$^2$) and less
scale, or dents may produce indications that are not relevant. Any indication in excess of the acceptance standards believed to be nonrelevant shall be regarded as a defect until it is reexamined to verify whether actual defects are present. Nonrelevant indications and broad areas of pigmentation that would mask indications of defects are unacceptable. Surface conditioning may precede the reexamination. Relevant indications are those that result from mechanical discontinuities. Linear indications are those whose length is more than 3 times the width. Rounded indications are those that are circular or elliptical with the length less than 3 times the width. Indications with major dimensions greater than \( \frac{1}{16} \) in. (1.5 mm) are considered relevant.

(c) Acceptance Standards. The following relevant indications are unacceptable:

1. Any linear indications greater than \( \frac{1}{16} \) in. (1.5 mm) long for materials less than \( \frac{1}{8} \) in. (16 mm) thick, greater than \( \frac{1}{16} \) in. (3 mm) long for materials from \( \frac{1}{8} \) in. (16 mm) thick to under 2 in. (50 mm) thick, and \( \frac{1}{64} \) in. (5 mm) long for materials 2 in. (50 mm) thick and greater.
2. Rounded indications with dimensions greater than \( \frac{1}{8} \) in. (3 mm) for thicknesses less than \( \frac{1}{8} \) in. (16 mm) and greater than \( \frac{1}{64} \) in. (5 mm) for thicknesses \( \frac{1}{8} \) in. (16 mm) and greater.
3. Four or more relevant indications in a line separated by \( \frac{1}{16} \) in. (1.5 mm) or less edge-to-edge.
4. Ten or more relevant indications in any 6 in.\(^2\) (4 000 mm\(^2\)) of surface with the major dimension of this area not to exceed 6 in. (150 mm) taken in the most unfavorable orientation relative to the indications being evaluated.

WB-2577 Magnetic Particle Examination (for Ductile Cast Iron)

(a) Castings of magnetic material shall be examined, if required, on all accessible surfaces by a magnetic particle method in accordance with Section V of the Code.

(b) Evaluation of Indications. All indications shall be evaluated in terms of the acceptance standards. Mechanical discontinuities intersecting the surface are indicated by retention of the examination medium. All indications are not necessarily defects since certain metallurgical discontinuities and magnetic permeability variations may produce indications that are not relevant. Any indication in excess of the acceptance standards that is believed to be nonrelevant shall be regarded as a defect until it is reexamined to verify whether actual defects are present. Nonrelevant indications that would mask indications of defects are unacceptable. Surface conditioning may precede the reexamination. Relevant indications are those that result from unacceptable mechanical discontinuities and have a major dimension greater than \( \frac{1}{16} \) in. (1.5 mm). Linear indications are those whose length is more than 3 times the width. Rounded indications are those that are circular or elliptical with the length less than 3 times the width.

(c) Acceptance Standards. The following relevant indications are unacceptable:

1. Linear indications greater than \( \frac{1}{16} \) in. (1.5 mm) long for materials less than \( \frac{1}{8} \) in. (16 mm) thick, greater than \( \frac{1}{64} \) in. (3 mm) long for materials from \( \frac{1}{8} \) in. (16 mm) thick to under 2 in. (50 mm) thick, and \( \frac{1}{64} \) in. (5 mm) long for materials 2 in. (50 mm) thick and greater.
2. Rounded indications with dimensions greater than \( \frac{1}{8} \) in. (3 mm) long for materials from \( \frac{1}{8} \) in. (16 mm) thick to under 2 in. (50 mm) thick, and \( \frac{1}{64} \) in. (5 mm) long for materials 2 in. (50 mm) thick and greater.
3. Four or more relevant indications in a line separated by \( \frac{1}{16} \) in. (1.5 mm) or less edge-to-edge.
4. Ten or more relevant indications in any 6 in.\(^2\) (4 000 mm\(^2\)) of surface with the major dimension of this area not to exceed 6 in. (150 mm) taken in the most unfavorable orientation relative to the indications being evaluated.

WB-2580 Examination of Bolts, Studs, and Nuts

WB-2581 Required Examination

All bolting material shall be visually examined in accordance with WB-2582. In addition, nominal sizes greater than 1 in. (25 mm) shall be examined by either the magnetic particle method in accordance with WB-2583 or the liquid penetrant method in accordance with WB-2584. In addition, nominal sizes greater than 2 in. (50 mm) but not over 4 in. (100 mm) shall be examined by the ultrasonic method in accordance with WB-2585 and nominal sizes greater than 4 in. (100 mm) shall be examined by the ultrasonic method in accordance with both WB-2585 and WB-2586.

WB-2582 Visual Examination

The final surfaces of threads, shanks, and heads shall be visually examined for workmanship, finish, and appearance in accordance with the requirements of ASTM F778 for bolting material and ASTM F812 for nuts. The visual examination personnel shall be trained and qualified in accordance with the Material Organization’s Quality Assurance Program. These examinations are not required to be performed either in accordance with procedures qualified to WB-2500 or by personnel qualified in accordance with WB-5500.

WB-2583 Magnetic Particle Examination (for Ferritic Steel Bolting Material Only)

WB-2583.1 Examination Procedure. All bolts, studs, and nuts greater than 1 in. (25 mm) nominal bolt size shall be examined by the magnetic particle method in accordance with ASTM A275. If desired, the supplier may perform liquid penetrant examination in accordance with WB-2584 instead of magnetic particle examination. Such examination shall be performed on the finished
component after threading or on the materials stock at approximately the finished diameter before threading and after heading (if involved). This examination shall be performed on all accessible surfaces.

**WB-2583.2 Evaluation of Indications.**

(a) All indications shall be evaluated in terms of the acceptance standards. Linear indications are those indications in which the length is more than three times the width. Rounded indications are those which are circular or elliptical with the length equal to or less than three times the width.

(b) All indications are not necessarily relevant: leakage of magnetic fields and permeability variations may produce indications that are not relevant to the detection of unacceptable discontinuities. Indications with major dimensions of \(\frac{1}{16}\) in. (1.5 mm) or less are not relevant.

(c) Any indication that is believed to be nonrelevant, and that is larger than acceptable, shall be considered to be a defect and shall be reexamined after light surface conditioning.

(d) Any indication observed during such reexamination shall be considered relevant and shall be evaluated in terms of the acceptance standards.

(e) As an alternative to magnetic particle reexamination, other nondestructive examination means (such as liquid penetrant examination for surface discontinuities) may be used to determine relevancy.

**WB-2583.3 Acceptance Standard.** Linear nonaxial indications are unacceptable. Linear axial indications greater than 1 in. (25 mm) long are unacceptable.

**WB-2584 Ultrasonic Examination for Sizes Greater Than 2 in. (50 mm)**

All bolts, studs, and nuts greater than 2 in. (50 mm) nominal bolt size shall be ultrasonically examined over the entire cylindrical surface prior to threading in accordance with the following requirements.

**WB-2585 Ultrasonic Examination for Sizes Over 4 in. (100 mm)**

In addition to the requirements of **WB-2585**, all bolts, studs, and nuts over 4 in. (100 mm) nominal bolt size shall be ultrasonically examined over the entire surface of each end before or after threading in accordance with the following requirements.

**WB-2586 Ultrasonic Examination for Sizes Over 4 in. (100 mm)**

**WB-2585.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure require the use of other frequencies to assure adequate penetration or better resolution. The search unit shall not exceed 1 in.\(^2\) (650 mm\(^2\)) area.

**WB-2585.3 Calibration of Equipment.** Calibration sensitivity shall be established by adjustment of the instrument so that the first back reflection is 75% to 90% of full-screen height.

**WB-2585.4 Acceptance Standard.** Any discontinuity produces an indication in excess of 20% of the height of the first back reflection or any discontinuity that prevents detection of a first back reflection of 50% of the calibration amplitude is not acceptable.

**WB-2586 Ultrasonic Method.** Examination shall be carried out by the straight beam, longitudinal-scan method.
**WB-2586.4 Acceptance Standard.** Any discontinuity that causes an indication in excess of that produced by the calibration hole in the reference specimen as corrected by the distance–amplitude curve is not acceptable.

**WB-2587 Time of Examination**

Acceptance examinations shall be performed after the final heat treatment required by the basic material specification.

**WB-2588 Elimination of Surface Defects**

Unacceptable surface defects on finished bolts, studs, and nuts are not permitted, and are cause for rejection.

**WB-2589 Repair by Welding**

Weld repairs of bolts, studs, and nuts are not permitted.

**WB-2600 MATERIAL ORGANIZATION’S QUALITY SYSTEM PROGRAMS**

**WB-2610 DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS**

(a) Except as provided in (b) below, Material Organizations shall have a Quality System Program or an Identification and Verification Program, as applicable, which meets the requirements of WA-3800.

(b) The requirements of NCA-3860 and NCA-4256 shall be met as required by WB-2130 and WB-2150, respectively. The other requirements of WA-3800 need not be used by Material Organizations for small products, as defined in (c) below, and for material which is allowed by this Subsection to be furnished with a Certificate of Compliance. For these products, the Certificate Holder’s Quality Assurance Program (Article WA-4000) shall include measures to provide assurance that the material is furnished in accordance with the material specification and with the applicable requirements of this Subsection.

(c) For the purpose of this paragraph, small products are defined as given in (1) through (4) below:

(1) pipe, tube, pipe fittings, and flanges NPS 2 (DN 50) and less;
(2) bolting material, including studs, nuts, and bolts of 1 in. (25 mm) nominal diameter and less;
(3) bars with a nominal cross-sectional area of 1 in.² (650 mm²) and less; and
(4) material for valves with inlet pipe connections of NPS 2 (DN 50) and less.

**WB-2700 DIMENSIONAL STANDARDS**

Dimensions of standard items shall comply with the standards and specifications listed in Article WA-7000.
accordance with WD-2558 or WD-2559, as applicable. Examinations shall be performed in two opposite circumferential directions using the angle beam technique.

**WD-2552.2 Reference Specimens.**

(a) The reference specimen shall be of the same nominal diameter and thickness and of the same nominal composition and heat treated condition as the product that is being examined. The standard defects shall be axial notches or grooves on the outside and the inside surfaces of the reference specimen and shall have a length of approximately 1 in. (25 mm) or less, a width not to exceed 1/16 in. (1.5 mm), and a depth not greater than the larger of 0.004 in. (0.10 mm) or 5% of the nominal wall thickness. The reference specimen may be the product being examined.

(b) The reference specimen shall be long enough to simulate the handling of the product being examined through the examination equipment. When more than one standard defect is placed in a reference specimen, the defects shall be located so that indications from each defect are separate and distinct without mutual interference or amplification.

**WD-2552.3 Checking and Calibration of Equipment.**

The proper functioning of the examination equipment shall be checked and the equipment shall be calibrated by the use of the reference specimens, as a minimum:

(a) at the beginning of each production run of a given size and thickness of a given material.

(b) after each 4 hr or less during the production run.

(c) at the end of the production run.

(d) at any time that malfunctioning is suspected.

If during any check it is determined that the testing equipment is not functioning properly, all of the product that has been tested since the last valid equipment calibration shall be reexamined.

**WD-2553 Radiographic Examination**

The radiographic examination shall be performed in accordance with Section V, Article 2, as modified by WD-5111, using the acceptance requirements of WD-5320.

**WD-2555 Magnetic Particle Examination**

The magnetic particle examination shall be performed in accordance with the requirements of WD-2545.

**WD-2556 Liquid Penetrant Examination**

The liquid penetrant examination shall be performed in accordance with the requirements of WD-2546.

**WD-2557 Time of Examination**

Time of acceptance examination, including that of repair welds, shall be in accordance with WD-2537.

**WD-2558 Elimination of Surface Defects**

Surface defects shall be removed by grinding or machining provided the following requirements are met:

(a) The depression, after defect elimination, is blended uniformly into the surrounding surface.

(b) After defect elimination, the area is reexamined by the method that originally disclosed the defect to assure that the defect has been removed or reduced to an imperfection of acceptable size.

(c) If the elimination of the defect reduces the thickness of the section below the minimum required to satisfy the rules of Article WD-3000, the product shall be repaired in accordance with WD-2559.

**WD-2559 Repair by Welding**

Repair welding of base material defects shall be in accordance with WD-2539. Repair welding of seam defects shall be made in accordance with WD-4450.

**WD-2580 EXAMINATION OF BOLTING**

**WD-2581 Required Examinations**

Bolting shall be visually examined in accordance with WD-2582. In addition, externally threaded bolting 3/8 in. (10 mm) and greater and nuts greater than 1 in. (25 mm) shall be examined by either the magnetic particle or liquid penetrant method in accordance with WD-2583. In addition, nominal sizes greater than 1/2 in. (13 mm) but not over 4 in. (100 mm) shall be examined by ultrasonic methods in accordance with WD-2584, and nominal sizes greater than 4 in. (100 mm) shall be examined by ultrasonic methods in accordance with both WD-2584 and WD-2585.

**WD-2582 Visual Examination**

The final surfaces of threads, shanks, and heads shall be visually examined for workmanship, finish and appearance in accordance with the requirements of ASTM F788 for bolting material and ASTM F812 for nuts. The visual examination personnel shall be trained and qualified in accordance with the Material Organization’s Quality System Program or the Certificate Holder’s Quality Assurance Program. These examinations are not required to be performed either in accordance with procedures qualified to WD-5100 or by personnel qualified in accordance with WD-5500.

**WD-2583 Magnetic Particle or Liquid Penetrant Examination**

Externally threaded bolting 3/8 in. (10 mm) and greater and nuts greater than 1 in. (25 mm) shall be examined by a magnetic particle method (WD-2545) or a liquid penetrant method (WD-2546). Such examination shall be performed on the finished bolting after threading and prior to plating or other surface protection type treatments. On threaded surfaces, no relevant indications are permitted. Relevant indications include any linear...
indications or rounded indications greater than 7/16 in. (1.5 mm). Indications, caused by a particular manufacturing method, that may appear to be relevant, such as the crest of rolled threads or root of cut threads, may be shown to be nonrelevant and acceptable by prior process qualification or destructive metallographic examination. On all other accessible surfaces, no linear indications or rounded indications greater than 7/16 in. (1.5 mm) are permitted, except that linear axial indications less than one diameter or 1 in. (25 mm) in length are permitted.

**WD-2584  Ultrasonic Examination for Sizes Greater Than 7/2 in. (13 mm)**

All bolting greater than 7/2 in. (13 mm) nominal bolt size shall be ultrasonically examined over the entire cylindrical surface prior to threading, in accordance with the requirements of the following subparagraphs.

**WD-2584.1 Ultrasonic Method.** Examination shall be carried out by the straight beam, radial scan method.

**WD-2584.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure necessitate the use of a 1 MHz frequency in order to assure adequate penetration, with a search unit not to exceed 1 in.² (650 mm²) area.

**WD-2584.3 Calibration of Equipment.** Calibration sensitivity shall be established by adjustment of the instrument so that the first back reflection is 75% to 90% of full-screen height.

**WD-2584.4 Acceptance Standards.** Any imperfection that causes an indication in excess of 20% of the height of the first back reflection or any imperfection that prevents the production of a first back reflection of 50% of the calibration amplitude is not acceptable.

**WD-2585  Ultrasonic Examination for Sizes Over 4 in. (100 mm)**

In addition to the requirements of WD-2584, all bolting greater than 4 in. (100 mm) shall be ultrasonically examined over the entire surface of each end before or after threading in accordance with the requirements of the following subparagraphs.

**WD-2585.1 Ultrasonic Method.** Examination shall be carried out by the straight beam, longitudinal mode scan method.

**WD-2585.2 Examination Procedure.** Examination shall be performed at a nominal frequency of 2.25 MHz unless variables such as production material grain structure necessitate the use of a 1 MHz frequency in order to assure adequate penetration with a search unit having a circular cross section with a diameter not less than 7/2 in. (13 mm) nor more than 1 1/8 in. (29 mm).

**WD-2585.3 Calibration of Equipment.** Calibration shall be established on a test bar of the same nominal composition and diameter as the production part and a minimum of one-half of the length. A 7/8 in. (10 mm) diameter x 3 in. (75 mm) deep flat bottom hole shall be drilled in one end of the bar and plugged to full depth. A distance-amplitude correction curve shall be established by scanning from both ends of the test bar.

**WD-2586  Elimination of Surface Defects**

Surface defects may be eliminated by grinding or machining, provided the final dimension of the affected portion meets the requirements of the design and the area is reexamined by the magnetic particle or liquid penetrant method in accordance with WD-2583.

**WD-2600  MATERIAL ORGANIZATIONS’ QUALITY SYSTEM PROGRAMS**

**WD-2610  DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS**

(a) Except as provided in (b) below, Material Organizations shall have a Quality System Program that meets the requirements of WA-3800.

(b) The requirements of NCA-3862 shall be met as required by WD-2130. The other requirements of WA-3800 need not be used by Material Organizations for small products, as defined in (c), and for material that

(c) For the purpose of this paragraph, small products are defined as given in the following:

(1) pipe, tube (except heat exchanger tube), pipe fittings, and flanges 2 in. nominal pipe size (DN 50) and less

(2) bolting material, including studs, nuts, and bolts of 1 in. (25 mm) nominal diameter and less

(3) bars with a nominal cross-sectional area of 1 in.² (650 mm²) and less