Date Distributed: June 20, 2012

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

SUBGROUP ON REPAIRS and ALTERATIONS SPECIFIC

AGENDA

Meeting of July 17, 2012
Columbus, Ohio

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614)888-8320
FAX: (614)847-1828

1. **Call to Order – 1:00 p.m.**

2. **Announcements**

3. **Adoption of the Agenda**

4. **Approval of Minutes of January 17, 2012 meeting**

5. **Review of the Roster (Attachment 1)**

6. **Action Items (Attachment 2)**

NB11-1001 ***Part 3, 3.3.4.9 SG R/A Specific*** **-** Tube plugging for fire tube boilers. (Attachment 2, pp. 1-2)

January 2011
Mr. James Pillow presented a progress report. It was announced that Linda Williamson will be assigned to take the lead on this item. A motion was made to open the floor for discussion in order to acquire feedback that can be taken back to Linda. The committee is in agreement that guidelines are needed in the code. More work regarding proposed guidelines will be done for the next meeting. Ms. Williamson has resigned her position with the state since the last meeting and Angelo Bramucci will now be the Chair on this item.

July 2011
A progress report was provided by George Galanes based on the SG notes. It was recommended to continue working on this from the perspective of providing guidance to control installation versus design guidance.

January 2012
A progress report was provided by Mr. Bramucci and a handout Mr. Ray Miletti. Mr. Wayne Jones and Mr. Ray Miletti were added to the task group for this action item.

July 2012
Mr. Bramucci is expected to report.

NB12-0801 ***Part 3, SG R/A Specific*** **-** Repair and alteration of Gasketed PHEs in the field. (Attachment 2, pp. 3-4)

January 2012
Mr. Edwards is expected to report.

NB12-2101 ***Part 3, 4.2 SG R/A Specific*** – A recommendation to change the reference in this section from 2001 to 2006. (Attachment 2, pp. 5-12)

July 2012
A report is expected.

7. New Business

8. Future Meetings

January 14-18, 2013, Mobile, Alabama
July 15-19, 2013, Columbus. OH

9. Adjournment

Respectfully Submitted,
Jim McGimpsey
Secretary
:rh

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SG on R/A-Specific

Member	Title	ExpirDate	Interest Category
Boseo, Brian		1/31/2015	NB Certificate Holders
Bramucci, Angelo		1/31/2013	Manufacturer
Cameron, Stuart		8/17/2013	Manufacturer
Galanes, PE, George W.		8/31/2012	Users
Jabal, Zyad		8/12/2014	Users
Jones, Wayne	Vice Chair	7/31/2014	Auth Inpection Agencies
McGimpsey, Jim	Secretary		
McManamon, Larry		1/31/2015	Organized Labor
Ortman, Edward		8/30/2013	Manufacturer
Pavlovicz, Frank		8/31/2012	Manufacturer
Pillow, James T.	Chair	8/31/2012	General Interest
Schaefer, Benjamin		2/28/2014	NB Certificate Holders
Sekely, James		8/31/2012	General Interest
Sperko, Walt		8/17/2013	General Interest
Valdez, Rick		8/12/2014	Manufacturer
Vallance, William		1/31/2015	Jurisdictional Authorities

Total Members: 15

ATTACHMENT 2

NB11-1001

Proposed addition

Part 3, Section 3.3.4.9 – Tube plugging Fire Tube Boilers

1. Plugging of tubes shall only be permitted where the tube plate stresses and the stay tube stresses have been checked with those allowed in the code of manufacture. The unsupported area between points of support shall take into account the increase in area as a result of the tube plug being added.
2. Consideration should be given to the effect on the combustion with reduced cross section for the products of combustion to pass. The maximum number of tubes permitted to be plugged shall be 5% of the total number of plain tubes in the pass affected.
3. Welded stay tubes shall not be plugged.
4. The plug shall not extend into the gas space by more than is permitted for the plain tubes.
5. If welded the plug shall be welded to the tube. Fillet welds of the plug to the tube and tube plate are not permitted.
6. Seal welding a leaking tube to the tube plate is permitted
7. Care shall be taken during the hydraulic pressure test when tapered tube plugs that are not welded are used. The pressure behind the plug may cause the plug to dislodge at like a projectile towards personnel.
8. Tube plugs should be fitted only after the leaking tube is drilled or pierced.

Statement of need

The fitting of tube plugs is considered by many in the industry to be a routine and minor repair. This depends somewhat on the actual design of the boiler in question and the specific points of support on the flat end plates. The front tube plate in the reversal chamber is subjected to the highest temperature in a fire tube boiler and is the most likely to suffer adverse effect from welded tube plugs.

Background information

About two to three years ago I was asked to provide an opinion concerning the use of tube plugs in fire tube boilers. I advised that the use of tube plugs was a boiler modification that would need to be approved after design calculations were done. Even then I considered the use of welded plugs in the reversal chamber ill-advised because of the increased likelihood of cracking. This cracking could affect the tube plate and lead to a more serious repair and failure.

The user did not heed these comments. Partly because of the time involved in getting the design checked, and the difficulty of doing this where detail engineering drawings do not exist. Further since there are no instructions regarding the manner in which the tube plugs are welded, these were not done very well.

The boiler over the last two years has had repeated repairs to leaking tubes with more and more tubes needing to be plugged. Increased tube plate cracking found in the ligaments. The costs in repairs and the boiler unavailability have affected the plant's production. The increased level of damage to the tube plate has compromised the boiler safety. The tube plugs have not provided the benefit that was expected. The decision has finally been taken to remove the tube plugs and replace the plain tubes. The concern now is that the damage to the tube plate may be sufficient to require a patch to be replaced which would not have been required had there been rules to ensure that the welded plugs were done in a manner that did not cause further cracking of the tube plate. Or had the calculations shown that the leaking tube should have been replaced in the first instance.

Gary Strobel
2010.11.12
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Gary Strobel
Leonine International
324 Fairgreen Close
Cambridge, ON
N1T 1T8
Canada

Phone – 519 729 2193
Fax – 416 849 0265
eMail – leonine@golden.net

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NB12-0801

Repairs and Alterations of Gasketed PHE's in the Field

By Mike Pischke

Introduction

This is intended to describe the current common industry practices of Plate Heat Exchanger (PHE) users regarding their operation, routine repairs and alterations. Because of the unique design of the PHE, the current ASME Pressure Vessel or NBIC Codes do not specifically address the design of PHE's, nor the potential alterations. The typical industries include, but not limited to the Power, Petrochemical, Maritime, HVAC, Bio-Pharmaceutical , and Food production.

Expansion and Contraction of Plate Packs

One of the primary benefits of the gasketed PHE is that the heating surface can be expanded or contracted in response to changes in fluid flow, process parameters, and/or ambient temperature variations. The plate packs are expanded or reduced due to the increase or decrease in heat transfer requirements, respectively. Also, because turbulence is necessary for effective heat transfer, the quantity of heat transfer plates are critical to ensure the proper flow rates and pressure drops during operation. This is adjusted by adding or subtracting the number of heat transfer plates. Users will often also add plates gradually as production demands are incrementally increased. This avoids the need for repeated and costly replacement of entire heat exchangers. They will also adjust the number based on seasonal temperature variations.

Code Implications: Although the Code does not specifically address the addition or removal of heat transfer plates, this has indirect Code implications. Adding or subtracting plates in no way affects the specific design parameters of Pressure and Temperature, but does change the volume of the heat exchanger and the heat transfer surface area. Unless someone counts every single plate in a PHE and compares it to the number listed on the Data Report, it would not be obvious that a change was made.

Gasket Replacement

The expected life of gaskets within a PHE plate pack may vary from one year to decades; based upon the gasket material selection, process fluid(s), operating parameters, and environmental conditions. Ideally, the gasket replacement coincides with the routine cleaning of the heat transfer plates. At this time, the entire plate pack is removed from the frame, the gaskets removed from the plates, then the plates are mechanically and/or chemically cleaned. The cleaned plates are then re-gasketed using new gaskets. Glued gaskets are typically removed using liquid nitrogen prior to cleaning. After re-gasketing, the plate pack is returned to the frame and typically hydrostatically or pneumatically tested at the MAWP.

Code Implications: Although the ASME Code does not directly address gaskets or gasket materials, the practical operating parameters are typically limited by the gasket material. Maximum operating temperatures are determined by the degradation rate of the gasket material, and the MAWP set by an adjusted test pressure when the particular gasket-heat transfer plate combination will begin to leak.

Heat Transfer Plate Replacement

Under normal operating conditions, heat transfer plates should last for decades in service. Heat transfer plates typically need to be replaced due to deformation from opening and closing, corrosion, fatigue, and/or fouling. When being replaced, they may be replaced using plates from a different manufacturer and even a different material from the original Code stamped unit. For example, if the original plates were made from 0.4mm thick, 304 stainless steel and they corroded over time due to chloride attacks, the user may choose to replace the corroded plates with something more resistant. Perhaps they would replace these plates with 316L plates and even increase the thickness to 0.5mm. This is a common practice.

Another common practice is to have multiple, identical PHE's in a chemical production facility and rotate out spare plate packs as the glued gaskets break down and need to be replaced over time. Spare plate packs with glued gaskets are kept in stock at the facility, waiting to be swapped out with the plates in production. This allows the chemical company's maintenance personnel to swap out a plate pack during a brief shut down period. The removed plate pack is re-conditioned by cleaning, removing the gaskets and gluing on new gaskets. These plate packs now become the new spares. This allows them to re-use the heat transfer plates which are often made from expensive materials such as nickel alloys, or titanium.

Code Implications: Heat Transfer plates and laser welded cassettes are considered UG-11 "Standard Pressure Parts" per Interpretations VIII-1-89-236 and VIII-1-95-21. There is also an Interpretation (VIII-81-89R) that allows the heat transfer plates to be made from non-Code material. Beyond these Interpretations, there are no rules regarding the material of the heat transfer plates. Because the heat transfer plates are contained between the frame plates, the strength of the PHE relies on the bolts and frame plates and never the strength of the heat transfer plates.

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NB 12-2101

Toledo
Refining Company

May 30, 2012

Shawn Tiedeken
Inspection Superintendent
Toledo Refining Company, LLC
1819 Woodville Road
Oregon, OH 43616

Secretary, NBIC Committee
The National Board of Boiler and Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, OH 43229
NBICinquiry@nationalboard.org

Re: Revision inquiry to 2011 National Board Inspection Code (NBIC), Part 3, Section 4, Subsection 4.2, Nondestructive Examination

Dear NBIC Committee Secretary,

National Board Inspection Code (NBIC), 2011 edition, Part 3, Section 4, Repairs and Alterations – Examination and Testing, Subsection 4.2 Nondestructive Examination, paragraph (b) states, " NDE personnel shall be qualified and certified in accordance with the requirements of the original code of construction. When this is not possible or practicable, NDE personnel may be qualified and certified in accordance with their employer's written practice. ASNT SNT-TC-1A, Recommended Practice Non-destructive Testing Personnel Qualification and Certification (~~2001~~ 2006 edition), or ASNT CP-189, Standard for Qualification and Certification of Nondestructive Testing Personnel (~~2001~~ 2006 edition), shall be used as a guideline for employers to establish their written practice."

It is recommended to revise the "2001 edition" requirements to state "2006 edition" requirements. (See Attachment 1)

This revision is being requested such that there will be consistency between the NBIC required editions of ASNT SNT TC-1A and those specified in the latest versions of ASME Section VIII, ASME Section V, B31.1 codes of construction. The following provides background requirements from the applicable codes of construction. The numbering of each code reference is consistent the attached references.

1. Within the 2010 with 2011 Addenda, ASME Boiler and Pressure Vessel Code, Section VIII, Rules for the Construction of Pressure Vessels, Table U-3, the 2006 edition is specified for both ASNT CP-189 and SNT-TC-1A.
2. In 2010 ed., ASME B31.1, Power Piping, Chapter VI, Inspection, Examination, and Testing, paragraph 136.3.2, NDE personnel are qualified and certified per a developed program consisting of training, on the job training, oral or written examination, vision acuity examination, and documented certification. As an alternative, Section V, ASME Boiler and Pressure Vessel Code, Section V, Article 1 can be used for the qualification of NDE personnel.

Toledo
Refining Company

3. 2010 with 2011 addenda, ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examination, Subsection A, Nondestructive Methods of Examination, Article 1, General Requirements, Paragraph T-120, General, sub paragraph (e) requires that NDE personnel are qualified and certified per their employer's written practice, which shall be in accordance with one of the following: (1), SNT-TC-1A (footnote 3) Personnel Qualification and Certification in Nondestructive Testing or (2) ANSI/ASNT CP-189 (footnote 3), ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel. Footnote 3 states that the 2006 edition is required for both SNT-TC-1A and ANSI/ASNT CP-189.
4. ASME B31.3, Process Piping Code, Section 342, Examination Personnel, Paragraph 342.1, it states that NDE personnel or "examiners" shall have training and experience commensurate with the needs of the examination type or method. The footnote reference specifies that SNT-TC-1A may be used as a guide to develop the training and respective experience requirements in performing the examination type or method. No year is specified.

In all the referenced code paragraphs, it is clear that the latest versions of the codes applicable to NBIC specify the 2006 edition of SNT-TC-1A and ANSI/ASNTCP-189.

Should there be any question, please do not hesitate to contact the undersigned at (419) 698-7445.

Sincerely,

Shawn J. Tiedeken
Inspection Superintendent
Toledo Refining Company, LLC

Attachment 1

PART 3, SECTION 4
REPAIRS AND ALTERATIONS — EXAMINATION AND TESTING

4.1 SCOPE

This section provides requirements and guidelines for performing examinations and tests for repairs and alterations to pressure-retaining items.

4.2 NONDESTRUCTIVE EXAMINATION

a) The nondestructive examination (NDE) requirements, including technique, extent of coverage, procedures, personnel qualification, and acceptance criteria, shall be in accordance with the original code of construction for the pressure-retaining item. Weld repairs and alterations shall be subjected to the same nondestructive examination requirements as the original welds. Where this is not possible or practicable, alternative NDE methods acceptable to the Inspector and the Jurisdiction where the pressure-retaining item is installed, where required, may be used.

b) NDE personnel shall be qualified and certified in accordance with the requirements of the original code of construction. When this is not possible or practicable, NDE personnel may be qualified and certified in accordance with their employer's written practice. ASNT SNT-TC-1A, *Recommended Practice Nondestructive Testing Personnel Qualification and Certification* (2001 edition), or ASNT CP-189, *Standard for Qualification and Certification of Nondestructive Testing Personnel* (2001 edition), shall be used as a guideline for employers to establish their written practice. The ASNT Central Certification Program (ACCP, Rev. 3, Nov. 1997) may be used to fulfill the examination and demonstration requirements of the employer's written practice. Provisions for training, experience, qualification, and certification of NDE personnel shall be described in the "R" Certificate Holder's written quality system.

4.3 PRESSURE GAGES, MEASUREMENT, EXAMINATION, AND TEST EQUIPMENT

The calibration of pressure gages, measurement, examination, and test equipment, and documentation of calibration shall be performed, as required, by the applicable standard used for construction.

4.4 EXAMINATION AND TEST FOR REPAIRS AND ALTERATIONS

The following requirements shall apply to all repairs and alterations to pressure-retaining items:

a) The integrity of repairs, alterations, and replacement parts used in repairs and alterations shall be verified by examination or test;

b) Testing methods used shall be suitable for providing meaningful results to verify the integrity of the repair or alteration. Any insulation, coatings, or coverings that may inhibit or compromise a meaningful test method shall be removed, to the extent identified by the Inspector;

c) The "R" Certificate Holder is responsible for all activities relating to examination and test of repairs and alterations;

d) Examinations and tests to be used shall be subject to acceptance of the Inspector and, where required, acceptance of the Jurisdiction.

Repair & Alteration

Reference 1

(10)
(a)

TABLE U-3
YEAR OF ACCEPTABLE EDITION OF REFERENCED STANDARDS IN THIS DIVISION

Title	Number	Year
Seat Tightness of Pressure Relief Valves	API Std. 527	1991 (R2007)(1)
Unified Inch Screw Threads (UN and UNR Thread Form)	ASME B1.1	Latest edition
Pipe Threads, General Purpose (Inch)	ANSI/ASME B1.20.1	Latest edition
Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250	ASME B16.1	2005
Pipe Flanges and Flanged Fittings	ASME B16.5	2009(2)
Factory-Made Wrought Buttwelding Fittings	ASME B16.9	Latest edition
Forged Fittings, Socket-Welding and Threaded	ASME B16.11	Latest edition
Cast Bronze Threaded Fittings, Classes 125 and 250	ASME B16.15	Latest edition
Metallic Gaskets for Pipe Flanges — Ring-Joint, Spiral-Wound, and Jacketed	ASME B16.20	Latest edition
Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500, and 2500	ASME B16.24	2006
Ductile Iron Pipe Flanges and Flanged Fittings, Class 150 and 300	ASME B16.42	1998 (R2006)
Large Diameter Steel Flanges, NPS 26 Through NPS 60	ASME B16.47	2006
Square and Hex Nuts (Inch Series)	ASME B18.2.2	Latest edition
Welded and Seamless Wrought Steel Pipe	ASME B36.10M	Latest edition
Guidelines for Pressure Boundary Bolted Flange Joint Assembly	ASME PCC-1	2010
Repair of Pressure Equipment and Piping	ASME PCC-2	2008
Pressure Relief Devices	ASME PTC 25	2008
Qualifications for Authorized Inspection	ASME QAI-1	Latest edition (3)
ASNT Central Certification Program	ACCP	Rev 7
ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel	ANSI/ASNT CP-189	2006
Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing	SNT TC 1A	2006
Standard Test Methods for Flash Point by Tag Closed Tester	ASTM D 56	Latest edition
Standard Test Methods for Flash Point by Pensky-Martens Closed Tester	ASTM D 93	Latest edition
Standard Guide for Preparation of Metallographic Specimens	ASTM E 3	2001 (R2007)
Pressure Relieving and Depressuring Systems	ANSI/API Std. 521	5th Ed., January 2007
Reference Photographs for Magnetic Particle Indications on Ferrous Castings	ASTM E 125	1963 (R2008)(1)
Hardness Conversion Tables for Metals	ASTM E 140	Latest edition
Standard Reference Radiographs for Heavy-Walled [2 to 4½-in. (51 to 114-mm)] Steel Castings	ASTM E 186	1998 (R2004)
Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels	ASTM E 208	2006
Standard Reference Radiographs for Heavy-Walled (4½ to 12-in. (114 to 305-mm)) Steel Castings	ASTM E 280	2010
Standard Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness	ASTM E 446	2010
Marking and Labeling Systems	ANSI/UL-969	1995

Repair & Alteration

Reference 2

Chapter VI
Inspection, Examination, and Testing

136 INSPECTION AND EXAMINATION

136.1 Inspection

136.1.1 General. This Code distinguishes between "examination" and "inspection." Inspection is the responsibility of the Owner and may be performed by employees of the Owner or a party authorized by the Owner, except for the inspections required by para. 136.2. Prior to initial operation, a piping installation shall be inspected to ensure compliance with the engineering design and with the material, fabrication, assembly, examination, and test requirements of this Code.

136.1.2 Verification of Compliance. Compliance with the requirements of this Code shall be verified by an Authorized Inspector when a Code stamp is required by Section I of the ASME Boiler and Pressure Vessel Code. The rules of this Code and the quality control system requirements of Appendix A-300 of Section I of the ASME Boiler and Pressure Vessel Code shall apply. The quality control system requirements are shown in Appendix J of this Code. The duty of the Inspector shall be as defined in PG-90, Section I, of the ASME Boiler and Pressure Vessel Code. Data Report Forms are included in the Appendix of ASME Section I for use in developing the necessary inspection records. The Inspector shall assure himself/herself that the piping has been constructed in accordance with the applicable requirements of this Code.

136.1.3 Rights of Inspectors. Inspectors shall have access to any place where work concerned with the piping is being performed. This includes manufacture, fabrication, heat treatment, assembly, erection, examination, and testing of the piping. They shall have the right to audit any examination, to inspect the piping using any appropriate examination method required by the engineering design or this Code, and to review all certifications and records necessary to satisfy the Owner's responsibility as stated in para. 136.1.1.

136.1.4 Qualifications of the Owner's Inspector

(A) The Owner's Inspector shall be designated by the Owner and shall be an employee of the Owner, an employee of an engineering or scientific organization, or of a recognized insurance or inspection company acting as the Owner's agent. The Owner's Inspector shall not represent nor be an employee of the piping manufacturer, fabricator, or erector unless the Owner is also the manufacturer, fabricator, or erector.

(B) The Owner's Inspector shall have not less than 10 years of experience in the design, manufacture, erection, fabrication, or inspection of power piping. Each year of satisfactorily completed work toward an engineering degree recognized by the Accreditation Board for Engineering and Technology shall be considered equivalent to 1 year of experience, up to 5 years total.

(C) In delegating the performance of inspections, the Owner is responsible for determining that a person to whom an inspection function is delegated is qualified to perform that function.

136.2 Inspection and Qualification of Authorized Inspector for Boiler External Piping

136.2.1 Piping for which inspection and stamping is required as determined in accordance with para. 100.1.2(A) shall be inspected during construction and after completion and at the option of the Authorized Inspector at such stages of the work as he/she may designate. For specific requirements see the applicable parts of Section I of the ASME Boiler and Pressure Vessel Code, PG-104 through PG-113. Each manufacturer, fabricator, or assembler is required to arrange for the services of Authorized Inspectors.

136.2.1.1 The inspections required by this Section shall be performed by an Inspector employed by an ASME accredited Authorized Inspection Agency.

136.2.2 Certification by stamping and Data Reports, where required, shall be as per PG-104, PG-105, PG-109, PG-110, PG-111, and PG-112 of Section I of the ASME Boiler and Pressure Vessel Code.

136.3 Examination

136.3.1 General. Examination denotes the functions performed by the manufacturer, fabricator, erector, or a party authorized by the Owner that include nondestructive examinations (NDE), such as visual, radiography, ultrasonic, eddy current, liquid penetrant, and magnetic particle methods. The degree of examination and the acceptance standards beyond the requirements of this Code shall be a matter of prior agreement between the manufacturer, fabricator, or erector and the Owner.

136.3.2 Qualification of NDE Personnel. Personnel who perform nondestructive examination of welds shall be qualified and certified for each examination method in accordance with a program established by the

Repair & Alteration

Reference 2

employer of the personnel being certified, which shall be based on the following minimum requirements:

(A) instruction in the fundamentals of the nondestructive examination method.

(B) on-the-job training to familiarize the NDE personnel with the appearance and interpretation of indications of weld defects. The length of time for such training shall be sufficient to ensure adequate assimilation of the knowledge required.

(C) an eye examination performed at least once each year to determine optical capability of NDE personnel to perform the required examinations.

(D) upon completion of (A) and (B) above, the NDE personnel shall be given an oral or written examination and performance examination by the employer to determine if the NDE personnel are qualified to perform the required examinations and interpretation of results.

(E) certified NDE personnel whose work has not included performance of a specific examination method for a period of 1 yr or more shall be recertified by successfully completing the examination of (D) above and also passing the visual examination of (C) above. Substantial changes in procedures or equipment shall require recertification of the NDE personnel.

As an alternative to the preceding program, the requirements of the ASME Boiler and Pressure Vessel Code, Section V, Article 1 may be used for the qualification of NDE personnel. Personnel qualified to AWS QC1 may be used for the visual examination of welds.

136.4 Examination Methods of Welds

136.4.1 Nondestructive Examination. Nondestructive examinations shall be performed in accordance with the requirements of this Chapter. The types and extent of mandatory examinations for pressure welds and welds to pressure retaining components are specified in Table 136.4. For welds other than those covered by Table 136.4, only visual examination is required. Welds requiring nondestructive examination shall comply with the applicable acceptance standards for indications as specified in paras. 136.4.2 through 136.4.6. As a guide, the detection capabilities for the examination method are shown in Table 136.4.1. Welds not requiring examination (i.e., RT, UT, MT, or PT) by this Code or the engineering design shall be judged acceptable if they meet the examination requirements of para. 136.4.2 and the pressure test requirements specified in para. 137. NDE for P-Nos. 3, 4, 5A, 5B, and 15E material welds shall be performed after postweld heat treatment unless directed otherwise by engineering design. Required NDE for welds in all other materials may be performed before or after postweld heat treatment.

136.4.2 Visual Examination. Visual examination as defined in para. 100.2 shall be performed in accordance with the methods described in Section V, Article 9, of the ASME Boiler and Pressure Vessel Code. Visual examinations may be conducted, as necessary, during the fabrication and erection of piping components to provide verification that the design and WPS requirements are being met. In addition, visual examination shall be performed to verify that all completed welds in pipe and piping components comply with the acceptance standards specified in (A) below or with the limitations on imperfections specified in the material specification under which the pipe or component was furnished.

(A) Acceptance Standards. The following indications are unacceptable:

(A.1) cracks — external surface.

(A.2) undercut on surface that is greater than $\frac{1}{32}$ in. (1.0 mm) deep.

(A.3) weld reinforcement greater than specified in Table 127.4.2.

(A.4) lack of fusion on surface.

(A.5) incomplete penetration (applies only when inside surface is readily accessible).

(A.6) any other linear indications greater than $\frac{3}{16}$ in. (5.0 mm) long.

(A.7) surface porosity with rounded indications having dimensions greater than $\frac{3}{16}$ in. (5.0 mm) or four or more rounded indications separated by $\frac{1}{16}$ in. (2.0 mm) or less edge to edge in any direction. Rounded indications are indications that are circular or elliptical with their length less than three times their width.

136.4.3 Magnetic Particle Examination. Whenever required by this Chapter (see Table 136.4), magnetic particle examination shall be performed in accordance with the methods of Article 7, Section V, of the ASME Boiler and Pressure Vessel Code.

(A) Evaluation of Indications

(A.1) Mechanical discontinuities at the surface will be indicated by the retention of the examination medium. All indications are not necessarily defects; however, certain metallurgical discontinuities and magnetic permeability variations may produce similar indications that are not relevant to the detection of unacceptable discontinuities.

(A.2) Any indication that is believed to be nonrelevant shall be reexamined to verify whether or not actual defects are present. Surface conditioning may precede the reexamination. Nonrelevant indications that would mask indications of defects are unacceptable.

(A.3) Relevant indications are those that result from unacceptable mechanical discontinuities. Linear indications are those indications in which the length is more than three times the width. Rounded indications are indications that are circular or elliptical with the length less than three times the width.

(A.4) An indication of a discontinuity may be larger than the discontinuity that causes it; however, the size of the indication and not the size of the discontinuity is the basis of acceptance or rejection.

Repair & Alteration

Reference 3

SUBSECTION A
NONDESTRUCTIVE METHODS OF EXAMINATION

ARTICLE 1
GENERAL REQUIREMENTS

T-110 SCOPE

(a) This Section of the Code contains requirements and methods for nondestructive examination (NDE), which are Code requirements to the extent they are specifically referenced and required by other Code Sections or referencing document. These NDE methods are intended to detect surface and internal imperfections in materials, welds, fabricated parts, and components. They include radiographic examination, ultrasonic examination, liquid penetrant examination, magnetic particle examination, eddy current examination, visual examination, leak testing, and acoustic emission examination. See Nonmandatory Appendix A of this Article for a listing of common imperfections and damage mechanisms, and the NDE methods that are generally capable of detecting them.

(b) For general terms such as *Inspection, Flaw, Discontinuity, Evaluation*, etc., refer to Mandatory Appendix I.

T-120 GENERAL

(a) Subsection A describes the methods of nondestructive examination to be used if referenced by other Code Sections or referencing documents.

(b) Subsection B lists Standards covering nondestructive examination methods which have been accepted as standards. These standards are nonmandatory unless specifically referenced in whole or in part in Subsection A or as indicated in other Code Sections or referencing document.

(c) Any reference to a paragraph of any Article in Subsection A of this Section includes all of the applicable rules in the paragraph.[1] In every case, reference to a paragraph includes all the subparagraphs and subdivisions under that paragraph.

(d) Reference to a standard contained in Subsection B is mandatory only to the extent specified.[2]

(e) For those documents that directly reference this Article for the qualification of NDE personnel, the qualification shall be in accordance with their employer's written practice which must be in accordance with one of the following documents:

(1) SNT-TC-1A,[3] Personnel Qualification and Certification in Nondestructive Testing; or

(2) ANSI/ASNT CP-189,[3] ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

(f) National or international central certification programs, such as the ASNT Central Certification Program (ACCP), may be alternatively used to fulfill the examination requirements of the documents listed in T-120(e) as specified in the employer's written practice.

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[1] For example, reference to T-270 includes all the rules contained in T-271 through T-277.3.

[2] For example, T-233 requires that Image Quality Indicators be manufactured and identified in accordance with the requirements or alternatives allowed in SE-747 or SE-1025, and Appendices, as appropriate for the style of IQI to be used. These are the only parts of either SE-747 or SE-1025 that are mandatory in Article 2.

[3] SNT-TC-1A (2006 Edition), "Personnel Qualification and Certification in Nondestructive Testing;" and ANSI/ASNT CP-189 (2006 Edition), "ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel;" published by the American Society for Nondestructive Testing, 1711 Arlingate Lane, P.O. Box 28518, Columbus, OH 43228-0518.

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(c) *Progressive Sampling for Examination.* The provisions of para. 341.3.4 are applicable.

(d) *Welds to Be Examined.* The locations of welds and the points at which they are to be examined by spot radiography shall be selected or approved by the Inspector.

341.5.2 Hardness Tests. The extent of hardness testing required shall be in accordance with para. 331.1.7 except as otherwise specified in the engineering design.

341.5.3 Examinations to Resolve Uncertainty. Any method may be used to resolve doubtful indications. Acceptance criteria shall be those for the required examination.

342 EXAMINATION PERSONNEL

342.1 Personnel Qualification and Certification

Examiners shall have training and experience commensurate with the needs of the specified examinations.[1] The employer shall certify records of the examiners employed, showing dates and results of personnel qualifications, and shall maintain them and make them available to the Inspector.

342.2 Specific Requirement

For in-process examination, the examinations shall be performed by personnel other than those performing the production work.

343 EXAMINATION PROCEDURES

Any examination shall be performed in accordance with a written procedure that conforms to one of the methods specified in para. 344, including special methods (see para. 344.1.2). Procedures shall be written as required in the BPV Code, Section V, Article 1, T-150. The employer shall certify records of the examination procedures employed, showing dates and results of procedure qualifications, and shall maintain them and make them available to the Inspector.

344 TYPES OF EXAMINATION

344.1 General

344.1.1 Methods. Except as provided in para. 344.1.2, any examination required by this Code, by the engineering design, or by the Inspector shall be performed in accordance with one of the methods specified herein.

344.1.2 Special Methods. If a method not specified herein is to be used, it and its acceptance criteria shall be specified in the engineering design in enough detail to permit qualification of the necessary procedures and examiners.

344.1.3 Definitions. The following terms apply to any type of examination:

100% examination: complete examination of all of a specified kind of item in a designated lot of piping[2]

random examination:[3] complete examination of a percentage of a specified kind of item in a designated lot of piping[2]

spot examination:[3] a specified partial examination of each of a specified kind of item in a designated lot of piping,[2] e.g., of part of the length of all shop-fabricated welds in a lot of jacketed piping

random spot examination:[3] a specified partial examination of a percentage of a specified kind of item in a designated lot of piping[2]

344.2 Visual Examination

344.2.1 Definition. Visual examination is observation of the portion of components, joints, and other piping elements that are or can be exposed to view before, during, or after manufacture, fabrication, assembly, erection, examination, or testing. This examination includes verification of Code and engineering design requirements for materials, components, dimensions, joint preparation, alignment, welding, bonding, brazing, bolting, threading, or other joining method, supports, assembly, and erection.

344.2.2 Method. Visual examination shall be performed in accordance with the BPV Code, Section V, Article 9. Records of individual visual examinations are not required, except for those of in-process examination as specified in para. 344.7.

344.3 Magnetic Particle Examination

Examination of castings is covered in para. 302.3.3. Magnetic particle examination of welds and of components other than castings shall be performed in accordance with BPV Code, Section V, Article 7.

[1] For this purpose, SNT-TC-1A, Recommended Practice for Nondestructive Testing Personnel Qualification and Certification, may be used as a guide.

[2] A designated lot is that quantity of piping to be considered in applying the requirements for examination in this Code. The quantity or extent of a designated lot should be established by agreement between the contracting parties before the start of work. More than one kind of designated lot may be established for different kinds of piping work.

[3] Random or spot examination will not ensure a fabrication product of a prescribed quality level throughout. Items not examined in a lot of piping represented by such examination may contain defects which further examination could disclose. Specifically, if all radiographically disclosable weld defects must be eliminated from a lot of piping, 100% radiographic examination must be specified.

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