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THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD SUBGROUP REPAIRS AND ALTERATIONS

MINUTES

Meeting of July 16th, 2019
Kansas City, MO

These minutes are subject to approval and are for the committee use only. They are not to be duplicated or quoted for other than committee use.

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614)888-8320
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1. **Call to Order**

Chairman Brian Boseo called the meeting to order at 8:00 AM.

2. **Introduction of Members and Visitors**

The attendees are identified on the attendance sign in sheet (**Attachment 1**). With the attached attendance listing, a quorum was established.

3. **Announcements**

Announcements were made to the Subgroup by Secretary, Terrence Hellman.
Mr. Hellman presented on the new letter ballot system on the National Board Business Center.

4. **Adoption of the Agenda**

   a. The Agenda was amended by the following:
      i. Added – Action Item 19-55
      ii. Added – PM's to all Interpretation and Action Items
      iii. Removed – Action Item 18-85 (This Item moved to SC R&A Agenda)

The above revisions were made to the agenda and a motion was made to adopt the agenda as revised. The motion was seconded and unanimously approved

5. **Approval of the Minutes of the January 15th, 2019 Meeting**

A motion was made to approve the minutes from the January 15th, 2019 NBIC meeting. The motion was seconded and unanimously approved.

6. **Review of Rosters**

   a. **Membership Nominations**

   - Paul Shanks – SG Repairs and Alterations (Interest Category – AIA); see Attachment 2 for resume
   - Robert Underwood – SG Repairs and Alterations (Interest Category – AIA) ; see Attachment 3 for resume
   - Timothy McBee – SG Repairs and Alterations (Interest Category – AIA) ; see Attachment 4 for resume

The Subgroup discussed the nominees and a motion was made to recommend all three join the Subgroup Repairs and Alterations. The motion was seconded and unanimously approved.

7. **Interpretations**

Mr. Rob Trout informed the Subgroup of the Interpretations Task Group and how Interpretation Items dealing with Part 3 will be worked on at the new Task Group level and reported directly to the Repair and Alterations Subcommittee. Chairman Boseo decided to skip all Interpretation Items except Item Number 19-26.

New Interpretation Requests:

Item Number: 19-26	NBIC Location: Part 3, 3.3.2	Attachment 5

General Description: Clarification on welding repairs on appendages

Subgroup: Repairs and Alterations

Task Group: P. Shanks – PM

Explanation of Need: The original submitter of this item will sometimes need to perform a welding repair on an appendage (not on the tank itself) in order for the complete process of refurbishment to be done for their customers' expectations. There appears to be no direct reference to these types of minor welding repairs for the refurbishment process in the NBIC code.

Meeting Action: This Item was not settled at the TG Interpretation meeting. P. Shanks revised the proposal for consideration at the Subgroup meeting. A motion was made, seconded, and unanimously approved to accept the revised proposal to respond to the Inquirer that nameplates are not to be removed without AI involvement/presence.

8. Action Items

Item Number: NB15-1405	NBIC Location: Part 3, 1.2	Attachment 6

General Description: Impact testing of P-11B Material

Subgroup: SG Repairs and Alterations

Task Group: N. Carter (PM), P. Davis, G. Galanes, P. Shanks

January 2019 Meeting Action: Progress Report: On 01/15/2019, this item was put back on the SG R&A Agenda and a new task group was formed.

Meeting Action: Mr. Galanes presented that this is a Progress Report.

Item Number: NB16-1502	NBIC Location: Part 3	No Attachment

General Description: Develop supplement for repairs and alterations based on international construction standards

Subgroup: SG Repairs and Alterations

Task Group: International Repair Supplement Task Group, Chuck Withers (PM)

January 2019 Meeting Action: Progress Report: Mr. Withers was not present and could not present the item.

Meeting Action: T. Hellman presented that an email will be sent to Mr. Withers (PM) to see if there is any status updates on this Item. Progress Report.

Item Number: 17-134	NBIC Location: Part 3, Section 5	No Attachment

General Description: Proposed Revision for registration of Form R-1 with the National Board containing ASME pressure part data reports attached.

Subgroup: Repairs and Alterations

Task Group: P. Shanks (PM), Rob Troutt, Joel Amato, Kathy Moore, Paul Edwards

January 2019 Meeting Action: Progress Report: P. Shanks gave a progress report.

Meeting Action: Progress Report: P. Shanks gave a progress report.

Item Number: 18-12	NBIC Location: Part 3	Attachment 7

General Description: Adding Weld Buildup to WM #6

Subgroup: SG Repairs and Alterations

Task Group: John Siefert PM, George Galanes

January 2019 Meeting Action: Mr. George Galanes presented that this Item was opened at the January 2018 meeting and the proposed revision to Welding Method 6 to limit weld build up to 100 square inches on only Grade 91 tubes. A motion was made to put the proposal out to Subgroup Repairs & Alterations and Subcommittee Repairs & Alterations for Review and Comment. The motion was unanimously approved.

Meeting Action: Mr. John Siefert presented background information and a proposal to have this item sent to SubGroup and SubCommittee R&A for a Letter Ballot Vote with a concurrent Review and Comment Letter Ballot to Main Committee. A motion was made, seconded, and unanimously approved.

Item Number: 18-13	NBIC Location: Part 3	Attachment 8

General Description: Weld Methods 7 addition for dissimilar weld metal-Gr. 91.

Subgroup: SG Repairs and Alterations

Task Group: John Siefert PM, George Galanes

January 2019 Meeting Action: Mr. George Galanes presented that this Item was opened at the January 2018 meeting and the proposed addition of a Welding Method 7. Welding Method 7 is being introduced to permit dissimilar metal weld repair with no PWHT between Grade 91 boiler tubes to austenitic steels and low alloy ferritic steels. This action permits DMW of Grade 91 tubes within the boiler setting following welding method 6 with no PWHT. A motion was made to put the proposal out to Subgroup Repairs & Alterations and Subcommittee Repairs & Alterations for Review and Comment. The motion was unanimously approved.

Meeting Action: Mr. John Siefert presented background information and a proposal to have this item sent to SubGroup and SubCommittee R&A for a Letter Ballot Vote with a concurrent Review and Comment Letter Ballot to Main Committee. A motion was made, seconded, and unanimously approved.

Item Number: 18-65	NBIC Location: Part 3, Section 3	Attachment 9

General Description: Draft rules for "used" material in repairs and/or alterations.

Subgroup: SG Repairs and Alterations

Task Group: Jamie Walker – PM, Marty Toth, Pat Becker, Michael Quisenberry, Issac Osborn, Paul Shanks, B. Underwood

January 2019 Meeting Action: Progress Report: Mr. J. Walker presented a progress report. As a result of Interpretation Item 18-30, the SG decided to open this Item to draft rules for "used" material utilized in repairs and/or alterations. The Subgroup discussed referencing Interpretation 01-28 and possibly revising the NBIC to address the allowance of "used" material w/concurrence of the Jurisdiction and the AIA.

Meeting Action: Progress Report: Mr. J. Walker presented a progress report.

Item Number: 18-66	NBIC Location: Part 3, Section 5	No Attachment

General Description: Move Report Forms to a new Supplement

Subgroup: SG Repairs and Alterations

Task Group: Marty Toth – PM, Ben Schaefer

January 2019 Meeting Action: Progress Report: B. Schaefer presented a Progress Report on ongoing work to move the Reports of Repair and their instructions to a new Supplement.

Meeting Action: Progress Report: B. Schaefer presented a Progress Report on 3 potential options being considered to move the Reports of Repair and their instructions to a new Supplement.

Item Number: 18-75	NBIC Location: Part 3	Attachment 10

General Description: Flush patches in stayed and un-stayed areas of tubesheets

Subgroup: SG Repairs and Alterations

Task Group: Michael Quisenberry (PM), Kathy Moore, Marty Toth, Rick Sturm

January 2019 Meeting Action: M. Quisenberry presented a revision to Part 3, Section 3, paragraph 3.3.4.6 incorporating verbiage from Supplement 1.2.11.2 for historic boilers to address flush patches and using NDE alternatives to volumetric methods. A motion was made and unanimously approved to have this proposal submitted via Letter Ballot for Review and Comment to Subgroup Repairs & Alterations and Subcommittee Repairs & Alterations.

Meeting Action: M. Quisenberry presented that this Item did not pass Letter Ballot due to lack of votes, but there was no negative comments or disapproval votes. After discussion, a revised proposal was presented as a "short" option to revise the text in paragraph 3.4.6. A straw vote on the "original" proposal vs the revised "short" proposal was taken, with the "short" option winning (8-5). A motion to accept the revised proposal was made, seconded, and unanimously approved.

Item Number: 18-100	NBIC Location: Part 3, 3.3.2	Attachment 11

General Description: Revision adding heat exchanger tubes with an outside diameter of ¾" or smaller to NBIC Part 3.3.2 Routine Repairs

Subgroup: Repairs and Alterations

Task Group: David Martinez (PM)

January 2019 Meeting Action: Progress Report: Mr. Martinez reported on a this item and presented interpretations (98-04 and 98-29) that may satisfy the revision request, however after a presentation from TEiC regarding the use of explosive welding of tubes to be considered as a routine repair, Mr. Martinez recommend this be considered progress report to continue working to address explosive welding as a Routine Repair.

Meeting Action: Mr. Martinez presented background. Mr. Sperko commented that ASME Section IX Committee has a similar Code Case in progress, expected to pass (ASME Code Case 17-28-13). The proposal was revised based on discussion. A motion to accept the proposal as revised was made, seconded, and unanimously approved.

Item Number: 18-102	NBIC Location: Part 3, Table 2.3	Attachment 12

General Description: Revise Table 2.3 in Part 3 to add the listed SWPSs that were revised by the AWS B2 Committee in 2018

Subgroup: Repairs and Alterations,

Task Group: Jim Sekely (PM)

January 2019 Meeting Action: Mr. Sekely presented a proposed addition of 8 SWPS into Table 2.3 that were revised by the AWS B2 Committee in 2018. A motion was made and unanimously approved to accept the Code addition.

Meeting Action: Mr. Hellman presented new SWPS's to be added to Table 2.3. A motion was made, seconded, and unanimously approved.

New Items:

Item Number: 19-11	NBIC Location: Part 3, 9.1	Attachment 13

General Description: Clarify Definition of Authorized Nuclear Inspection Agency (ANIA)

Subgroup: Repairs and Alterations

Task Group: Chuck Withers – PM, Paul Edwards

Explanation of Need: An ANIA cannot be an Inservice AIA since Endorsements for nuclear inspectors are issued only to new construction AIA's. The requirements for qualified Authorized Nuclear Inspectors/Supervisors are clearly specified in NB-263, RCI-1. Therefore revision to the Glossary definition is needed to clarify this requirement for the NR Accreditation Program.

Meeting Action: Mr. Edwards presented changes to paragraph 1.6.3 in lieu of changes to the glossary that better clarified the definition of an ANIA. The proposal was motioned, seconded, and unanimously approved.

Item Number: 19-12	NBIC Location: Part 3, 1.6.3 b)	Attachment 14

General Description: Paragraph 1.6.3 – revise text to clarify Quality Assurance Program reqs

Subgroup: Repairs and Alterations

Task Group: Paul Edwards

Explanation of Need: Revise text to clarify Quality Assurance Program requirements for NR Cert holders.

Meeting Action: Mr. Edwards presented that the proposal passed the NR TaskGroup Letter Ballot. A motion to accept the proposal was made, seconded, and unanimously approved.

Item Number: 19-13	NBIC Location: Part 3, 1.6.6.2 s), 1.6.7.2 s), & 1.6.8.2 s)	Attachment 15

General Description: Revise text to clarify responsibilities for performing audits

Subgroup: Repairs and Alterations

Task Group: Paul Edwards

Explanation of Need: Revise text to clarify responsibilities for performing audits between the Certificate Holder and the AIA.

Meeting Action: Mr. Edwards presented that the proposal revised and passed the NR TaskGroup unanimously. A motion to accept the proposal was made, seconded, and unanimously approved.

Item Number: 19-15	NBIC Location: Part 3, 3.3.5.2 a)	Attachment 16

General Description: ASME Section VIII Division 2 Class 1/Class 2 Distinction

Subgroup: Repairs and Alterations

Task Group: Paul Shanks – PM

Explanation of Need: Engineering certification for repairs is an unnecessary cost when engineering certification is not required by the original code of construction.

Meeting Action: Mr. Shanks presented. After discussion, the proposal was revised a motion to accept the revised proposal was made, seconded, and unanimously approved.

Item Number: 19-16	NBIC Location: Part 3, 3.3.2 e)	Attachment 17

General Description: Reword to provide clarity; contradictory requirement Part 3; 3.2.2 e)

Subgroup: Repairs and Alterations

Task Group: Tom White – PM

Explanation of Need: This wording of this clause is causing confusion. The original submitter has had multiple instances where owners have requested to purchase welded replacement parts directly and read this clause with the belief that they can purchase a replacement part for in some cases a welded pressure part for an ASME Section I boiler and safe money by having the fabricator not Hydro test as per Section

I even when it was not impractical to have the testing performed.

Meeting Action: Progress Report: Mr. White presented and referenced Interpretations 04-05 and 04-11. After discussion, a motion to accept the proposal was resended to continue to work on this Item.

Item Number: 19-24 **NBIC Location: Part 3, S6.16.4 b) 1)** **Attachment 18**

General Description: Supplement 6 to record the "R" number assigned to either R-1 or R-2.

Subgroup: Repairs and Alterations

Task Group: Kathy Moore – PM

Explanation of Need: Paragraph S6.16.4 b) 1) currently only requires "R-1" forms to be registered with the National Board, however the paragraph should be for EITHER R-1 Forms OR R-2 Forms.

Meeting Action: Ms. Moore presented the proposal. A motion to accept the proposal was made, seconded, and unanimously approved.

Item Number: 19-31 **NBIC Location: Part 3, Table 2.3** **Attachment 19**

General Description: Part 3 - Table 2.3 - Thickness Range Corrections

Subgroup: Repairs and Alterations

Task Group: Jim Sekely – PM

Explanation of Need: Thickness listed in Table 2.3 had different values than the AWS Standards.

Meeting Action: Mr. Hellman presented corrections to Table 2.3. R. Trout discussed his preference to have Table 2.3 revised to include only the AWS Standard numbers sorted by process and P number. Mr. Trout to open new Item for revision. The proposal as presented was motioned , seconded, and unanimously approved.

Item Number: 19-32 **NBIC Location: Part 3, 3.3.2 & 3.4.4** **Attachment 20**

General Description: Heater treater and or re-heater fire tubes

Subgroup: Repairs and Alterations

Task Group: Rick Valdez – PM

Explanation of Need: When heater treaters and some other similar equipment is constructed in accordance with section VIII div.1 an item called a fire tube is often removable (bolted) and should be part of the code boundary. In use these items are consumables and are replaced often with items not bearing the code markings or manufactured to code practices. This practice places the users and public in jeopardy and should be curtailed.

Meeting Action: Mr. Valdez presented and motioned for a vote. The motion was seconded and a vote was taken on the proposal. Mr. Valdez was the only approval vote. 10 members of the SG voted with a disapproval and 1 member abstained. The Item Failed and this Item was Closed with No Action.

Item Number: 19-43	NBIC Location: Part 3, 1.6.6.2, 1.6.7.2, & 1.6.8.2	Attachment 21

General Description: ISO/IEC-17025 Edition referenced in NR Section of Part 3

Subgroup: Repairs and Alterations

Task Group: Paul Edwards – PM

Explanation of Need: References to "ISO/IEC-18025:2005" need to be changed to "ISO/IEC-18025:2017" to align with ASME Section III requirements in the following paragraphs: 1.6.6.2 m) 1), 1.6.6.2 m) 4) a), 1.6.6.2 m) 5) a), 1.6.7.2 m) 1), 1.6.7.2 m) 4) a), 1.6.7.2 m) 5) a), 1.6.8.2 m) 1), 1.6.8.2 m) 4) a), and 1.6.8.2 m) 5) a)

Meeting Action: Mr. Edwards presented that the proposal was revised and passed the NR TaskGroup unanimously. A motion to accept the proposal was made, seconded, and unanimously approved.

Item Number: 19-47	NBIC Location: Part 3, 1.5.1 k)	No Attachment

General Description: Specify Welding, NDE and Heat Treatment requirements in 1.5.1 of Part 3

Subgroup: Repairs and Alterations

Task Group: Ray Miletti – PM

Explanation of Need: The Quality Control Elements of "welding, NDE, and Heat Treatment" need to have clear controls. Currently the paragraph really only references welding. NDE and Heat Treatment are only referenced by the last sentence in the paragraph, "Similar responsibility for nondestructive examination and heat treatment shall be described in the manual." Minimum controls or requirements for NDE or Heat Treatment need to be expressed in order for these elements to be auditable.

Meeting Action: Progress Report: Mr. Miletti presented that this Item is still being worked on. Progress Report

Item Number: 19-48	NBIC Location: Part 3, 1.5.1 l) & m)	No Attachment

General Description: Calibration, Examinations and Tests - 1.5.1 of Part 3

Subgroup: Repairs and Alterations

Task Group: Brian Boseo – PM, Paul Davis

Explanation of Need: A review of all QC Elements in Section 1.5.1 in Part 3 of the NBIC needs to be done to verify that auditable controls and minimum requirements are understood and referenced within an "R" Cert. Holder's Quality System.

Meeting Action: Progress Report: Mr. Miletti presented that this Item is still being worked on. Progress Report

Item Number: 19-50	NBIC Location: Part 3, 3.3.4.3 e) 3) l)	Attachment 22

General Description: Revising Part 3, 3.3.4.3 e) 3) l) to match rules of ASME PCC-2

Subgroup: Repairs and Alterations

Task Group: Paul Shanks – PM,. David Martinez

Explanation of Need: There are a couple of typos in the paragraph as it does not match up with the rules of ASME PCC-2 for External Weld Metal Buildup.

Meeting Action: Mr. Edwards presented and the motion to accept the proposal was made, seconded, and unanimously approved.

Item Number: 19-52	NBIC Location: Part 3, 4.2 a)	Attachment 23

General Description: Part 3, Section 4 - 4.2 a) Alternative NDE requirements

Subgroup: Repairs and Alterations

Task Group: Brian Boseo – PM

Explanation of Need: Clarification is needed that if alternative NDE methods acceptable to the Inspector and Jurisdiction meet ALL the requirements listed elsewhere in Section 4 of Part 3. New verbiage is adding ", provided all other requirements of this section are met." to the last sentence.

Meeting Action: Mr. T. Hellman presented and the motion to accept the proposal was made, seconded, and unanimously approved.

Item Number: 19-55	NBIC Location: Part 3, Section 4	Attachment 24

General Description: Change the maximum test pressure requirement when performing liquid pressure tests of repair activities.

Subgroup: Repairs and Alterations

Task Group: Robert Underwood – PM

Explanation of Need: To change the maximum test pressure requirement when performing liquid pressure tests of repair and alteration activities. This proposal was initially part of item NB16-2603, which proposed changes to 4.4.1 a) 1) and 4.4.2 a) 1). However, only the changes to 4.4.1 a) 1) made it into the 2019 NBIC.

Meeting Action: Mr. Underwood presented and the motion to accept the proposal was made, seconded, and unanimously approved.

9. Future Meetings

Chairman, Mr. Boseo, reviewed the future NBIC meetings with the SubGroup:

- January 13th -16th, 2020 – San Diego, CA
- July 13th-16th, 2020 – Louisville, KY

10. Adjournment

A motion was made to adjourn the meeting at 3:30 p.m. The motion was seconded and unanimously approved.

Respectfully submitted,

Terrence Hellman
SG Repairs and Alterations Secretary

NBIC Subgroup R&A Attendance - 7/16/2019

First Last	Email	Company	Phone #	Signature	Attending Reception?
Frank Johnson	fjkeck22@aol.com	Johnson Welding	419 386-8450		
Marty Toth	mtoth@boiscotraininggroup.com	ECS Consulting ~~Boiler Supply Company~~	615 504-9064		✓
David Martinez	david.martinez@fmglobal.com	FM Global	703 262-6311		✓
Brian Boseo	brian_boseo@graycor.com	Graycor	630 684-7300		✓
Brian Morelock	morelock@eastman.com	Eastman Chemical Company	423 229-1205		
Walter Sperko	sperko@asme.org	Sperko Engineering Services	336 674-0600		
Benjamin Schaefer	bschaefer@aep.com	AEP	614 716-1843		✓
Rick Valdez	rvaldez@prim.com	ARB, INC.	661 331-6024		✓
Wayne Jones	Wayne.Jones@tuvsud.com	ARISE	251 937-6225		
Ray Miletti	RLMILETTI@BABCOCK.COM	Babcock & Wilcox	330 860-2589		✓
James Pillow	jgpillow@comcast.net		860 539-9160		
James Sekely	jsekely@comcast.net	Consultant	412 389-5567		
Robby Troutt	rob.troutt@tdlr.texas.gov	State of Texas	512 539-5720		✓
Joel Amato	joel.amato@state.mn.us	State of Minnesota	651 284-5137		✓
Tom White	Thomas.white@nrg.com	NRG Energy	281 782-4972		✓
Kathy Moore	kathymoore@joemoorecompany.com	Joe Moore & Company	919 832-1665		✓
Nathan Carter	nathan_carter@hsb.com	Hartford Steam Boiler	860 722-5750		
Jamie Walker	jwalker@hayesmechanical.com	Hayes Mechanical	773 292-2707		✓
Michael Quisenberry	michael@allentri.com	Allen Tri-State	806 316-7174		✓
John Siefert	jsiefert@epri.com	EPRI	704 595-2886		✓
Terrence Hellman	thellman@nationalboard.org	The National Board	614 431-3234		
Rick Sturm	rsturm@utah.gov	state of Utah	801-554-9600		✓

NBIC Subgroup R&A Attendance - 7/16/2019

First Last	Email	Company	Phone #	Signature	Attending Reception?
Timothy McKee	Timothy.McKee@dnvgl.com	ARISE	717-412-9300		
Paul Davis	paul.davis22@woodplc.com	AFWNAC	412-327-7420		✓
Eric Cutlip	evcutlip@babcock.com	B&W	330-860-2637		✓
Robert McGuire	robert.b.mcguire@ge.com	GE	860-719-2912		✓
Paul Shanks	Paul.Shanks@onecis.com	ONECIS	832-316-4249		
Louis Dutra	LDutra@BaycityBoiler.com	Bay City Boiler	925-348-2881		✓
Eric Feeney	efeeney@teiservices.com	TEI CONSTRUCTION	704-512-9086		✓
Marty Russell	MRussell@TEISERVICES.com	TEI CONSTRUCTION	864-345-5422		✓
Bryan Toth	TOTHBM@WESTINGHOUSE.com	STONE & WEBSTER	828-305-1218		
Paul Edwards	EDWARDSPW@ASME.ORG	STONE & WEBSTER	617-483-5315		✓
Pat Becker	pabecker@babcock.com	B&W	330-860-2807		✓
Dawn Holt	drholt@babcock.com	B&W	330-860-1080		✓
Monte Bost	Monte_bost@hsb.ct	HSB	937-620-3676		✓
Robert Underwood	robert_underwood@hsb.com	HSB	618-593-6231		No
Linn W. Moedinger	linnwm@supernet.com	Strasburg RR - Sponsor	717-575-4478		✓
Scott Chestnut	stchestnut@marathonpetroleum.com	Marathon Petroleum	425-398-6361		No
George Galonis	ggalonis@dinamictechnicalservices.com	DTS	815-634-2727		✓

Name: Paul T Shanks

Education

Lancaster University

2001 – 2005

MEng (Hons) Mechanical Engineering

National Board

December 2017

Authorized inspector Commission Corse (AI)

Experienced with following specifications

ASME VIII div.1, IX, VIII div.2, PED, SDB-63, Navsea 250/1500

Location

Houston, TX

Years with Bureau Veritas

4 Years

Total Years of Experience

12 years

Lead technical consultant within the BV/OnecCIS technical staff I have direct responsibility in assisting authorized inspectors and supervisors in understanding the requirements and needs of any and all design and repair code utilized by our clients. I frequently work directly with certificate holders in determining the best code compliant technical solutions to the challenges posed in the pressure equipment market place.

I hold PED Level 3 status and conduct design reviews directly and audit design reviews for level 2 staff as required.

I am key contact for all code calculation questions including those that fall outside normal code scope- for example FEA.

I have been the BV/OneCIS representative for NBIC meetings since January of 2017 currently scheduled to start attending ASME code meetings as of July 2018.

My ASME and general engineering technical knowledge has been used directly to win new business by verification of support, expertise and competence.

Prior to joining Bureau Verities I worked for three (3) years working in a government sponsored exchange program between B&W Barberton and Rolls Royce submarines. The role required me to specialize in the manufacturing engineering of components for nuclear steam raising plant.

As I was embedded within another business I had to use a diplomatic skill set to build relationships that enabled the free flow of technical information as well as allow influence over design decisions and none conformance resolution.

Name: Paul T Shanks

	A key point of emphasis for me was ensuing that decisions made during fabrication would not adversely affect the ship yard equipment installation or the production of the through life safety case which influences maintenance procedures, the key input being the results from inspections and the repairs made when required. The output of this role was a variety of daily, weekly and milestone related formal reports as well as video conferences and email. Prior to this I worked for five (5) years in engineering directly designing pressure vessels, pressure accessories as well as load bearing structures and a range of hydraulic closure devices, manipulation systems as well as specifying engineering plant systems. I have been involved with Engineering design, material selection and evaluation based on metallurgical properties and specific design requirements, inspection of machining, welding, dimensions. This has been involving Pressure Vessels, Pressure Accessories and various safety accessories manufactured with ferrous and non-ferrous materials. Throughout my career I have worked alongside welding engineers selecting the most appropriate weld methods for given joints as well as non-destructive examination engineers to select the best combination of inspection methods to find the likely defects present in welds.

Name: Paul T Shanks

Project Experience

I was responsible for the technical specification of a 2 megawatt electric furnace suitable for heat treating a variety nuclear steam raising plant. The furnace included heating and cooling gas recirculation flow through components and a control system capable of keeping temperature deltas below 100^{o}F.

Employment History

OneCIS a Bureau Veritas company, Technical Consultant

June 2014 to present

Rolls Royce PLC

Manufacturing Engineering Liaison - embedded within Babcock & Wilcox Barberton

May 2011- May 2014

Rolls Royce Submarines, Design Engineer

December 2009 – April 2011

Wellman Hunt Graham, Head of Engineering

November 2009 – December 2009

Powder Systems Limited, Lead Design Engineer

August 2006 - October 2009

OneCIS Insurance Company

ROBERT V. UNDERWOOD

256 Oakhurst Circle, O'Fallon, MO • robert_underwood@hsb.com • 618-593-6231

Qualifications

Over twenty years of extensive experience, strong knowledge and expertise in ASME Boiler & Pressure Vessel Code and National Board Inspection Code. Holder of National Board "AI" Commission, "B", "R", "N", and "I" Endorsements. Member of NBIC Sub Group Historical.

Experience

The Hartford Steam Boiler Inspection and Insurance Company

1995-1998, 2000 – Present

- Authorized Inspector Supervisor 2010-Present.
- Authorized Inspector/Nuclear Inspector 1995 -2010.
- Assigned as Authorized Nuclear Inservice Inspector at Callaway Nuclear Plant from 2007-2010.
- Provide technical support to assigned ASME/NB Certificate Holders in the Midwest Region.
- Provide classroom training on NBIC and ASME Construction Codes to new employees.
- Presenter of NBIC Public Seminars

L.E.S., Inc., Wyoming, Illinois – Quality Engineer

1998-2000

- Responsible for design and quality of ASME Section IV heating boiler/systems.

United States Navy – Nuclear Machinist Mate

1985-1995

- Responsible for operation and maintenance of mechanical engine room equipment in support of a naval nuclear propulsion plant.
- Supervised subordinates in the planning, scheduling, and performance of preventative maintenance and repairs to engine room equipment.
- Qualified as Engine Room Supervisor.
- Qualified as QA Inspector and Supervisor.

Education

2016 – Present	Thomas Edison State College – BSAST Nuclear Engineering Technology Program
1986-1987	United States Navy Nuclear Power Program

Tim McBee
53N 600 East Rd
Herrick, Illinois 62431
Home: (618) 428-5473
Cell: (217) 412-9300
Timothy.McBee@tuvsud.com

QUALIFICATIONS

Knowledgeable in the design, operation, maintenance and inspection of industrial gas and coal fired boilers, pressure vessels and power piping systems to ASME and National Board Inspection Code requirements.

National Board Inservice and New Construction Commissions with "B" and "R" endorsements.

AWS CWI #05060641

Prior Ultrasonic Inspection Level 1 certified to SNT-TC-1A and ALL Tri-R Inc. procedure.

Prior Liquid Penetrant Inspection certified to ALL Tri-R Inc. procedure

Operate and maintain heavy equipment.

Proficient computer skills.

Safety training, Confined space, lockout-tagout, first line break, hot work and personal protective equipment.

Positive Attitude, team player, leader. Willing to learn new skills to meet the company's needs.

EXPERIENCE

2017 to present – ARISE – Authorized Inspector/Code Inspector Supervisor. Duties include supervising, educating, mentoring and auditing assigned inspectors. Performing preaudit activities and reviews with assigned clients.

2011 to present – ARISE – Inservice Inspector, Repair Inspector and New Construction Commissioned Inspector. Duties include internal and external inspections of jurisdictional boilers and pressure vessels, inspection of repairs and alterations to NBIC requirements and inspection of new construction items to ASME Code.

1989 to 2011 - All Tri-R Inc. - 5 years as the Quality Control Manager. Duties include the following: Monitoring and implementing revisions to the Quality Control Program. Training and supervising Quality Control Inspectors and PWHT technicians. Approve and monitor materials, personnel, weld procedures, workmanship, NDE and PWHT requirements per ASME Sect I, IV,V, VIII-1, IX, B31.1, B31.3 and repair/alteration methods accepted by the Authorized Inspector, Jurisdiction and The National Board.

7 years as a Quality Control Inspector. Duties include inspecting materials and workmanship per ASME Sect I, IV, V, VIII-1, IX, B31.1, B31.3 and repair methods approved by the National Board.

4 years as a pipefitter/welder foreman. Supervise repair and fabrication of pressure vessels and piping per ASME codes.

4 years as a pipefitter/welder. Duties included repair and fabrication of pressure vessels and piping per ASME codes.

1987 - Marley Pump Company - inspector - integrity testing of waste water vessels. Gettysburg, Penn.

1985 - 1987 Don Heil farms - machinery repair and operations on a 1,000 acre row crop farm - Norborne, Mo. (part-time)

EDUCATION

2017 – 48 hr. National Board Inspector Supervisor (B) endorsement prep course and exam – Columbus, OH.

2011 – 72 hr. National Board New Construction Commission prep course and exam – Columbus, OH.

2005 - 40 hr. prep course for AWS CWI exam - St. Louis MO.

1999 - 40 hr. ultrasonic testing Level 1 course - Scott Zimmerman with Quality Testing - Decatur, IL.

1997 - 40 hr. course on management training - Don Butler and Associates - Decatur, IL.
1987-1989 - Attended Central Missouri State University. 2 yrs. aviation technology courses. Studies included private pilot, aircraft power plants, transport aircraft systems and applied electricity.

1987 - Graduated From Richmond High School. Studies included Vo-ag classes composed leadership training, business management and farm equipment fabrication and repair.

1986 - Attended Lex-La-Ray Vo-tech, Lexington Mo. 1yr. welding course

PERSONAL

Birthdate - March 19, 1969. I've been married twenty nine years to Linda and have four children, Mark - 28 years old, Stephanie - 26 years old, Emily - 18 years old and Hannah - 17 years old. I'm a member of First Baptist Church in Shelbyville Illinois where I have served as a teacher and deacon.

HOBBIES

In my spare time, I enjoy hunting, boating and vacationing with my family.

REFERENCES

Ron Occhino – ARISE District Manager, Proctor, MN. (218) 310-5849

Charles Foor – Former Supervisor of Quality Control, Richmond, MO. (816) 506-0375

Tim Yankee – Pastor of First Baptist Church, Shelbyville, IL. (231) 510-2529

Interpretation IN19-26

Proposed Interpretation

Inquiry:	IN19-26
Source:	Doug Biggar
Subject:	NBIC Part 3 Section Part 3, 3.3.2
Edition:	[Current/all]
General Description:	Repair of none pressure boundary parts
Question 1:	If a welding repair is done to an appendage of a horizontal ASME LPG pressure vessel such as a faulty leg or the raised data plate holder, is this considered routine and are we exempt to have an inspector present to witness it and/or fill out a specialized form?
Reply 1:	No inspector needs to be present as the welding is not performed on any part of the pressure vessel directly related to its performance under pressure.
Question 2:	What is the minimum length of an appendage we can weld onto without being an ASME/NBIC certified welder (only a standard welding ticket)?
Reply 2:	1/4”
Committee’s Question 1:	Are refurbishment activities such as shot blasting, thread cleaning and painting considered within the scope of the NBIC?
Committee’s Reply 1:	No
Rationale 1:	These activities should not affect the pressure retaining integrity of the item, per the introduction to the NBIC that (maintenance) is the function of the NBIC. Reasonably these activities fall outside the scope of the NBIC
Committee’s Question 2:	When welding activities are conducted on materials which are not pressure retaining items of a Pressure Retaining Item and those welding activities do not affect the original design of the Pressure Retaining Item including applied loads, is said welding within the scope of the NBIC?
Committee’s Reply 2:	No, provided the deposited weld metal does not extend onto pressure retaining materials
Rationale:2	Assumed intent-TBC by committee
Committee’s Question 3:	
Committee’s	

Reply 3:	
Rationale:3	Paragraph 5.11 requires that, subject to the approval of the Jurisdiction, an Inspector shall make witness to such activities.
Rationale:	NBIC Part 3, Introduction, Section 3.3.2 e), 3.3.3, 3.4.4 & 5.11
NBIC Vote	

Include in response letter: NA

Rationale:

Having emailed the enquirer to determine the scope of their typical operations it was clear that there was a general misunderstanding about the purpose of the NBIC, the proposed questions are overly specific and as sure fail to grasp the crux of the issue hence the question re-write. Q3 was added to ensure that no misunderstand occurs. With the exception of a very hardline reading on Section 3.3.2 a) the NBIC addresses in the main body and the introduction the pressure retaining capability of the item and not work conducted elsewhere.

Sections 3.3.2 e), 3.3.3 & 3.4.4 address working (welding / replacing) on components which have a pressure retaining function. Pipes, tubes, heads, shell, and tube sheet are mentioned, integral parts without pressure retaining function such as legs and davit arms are not addressed.

Section 3.3.3 a) can be read as "Weld repairs ~~or replacement of pressure parts or~~ of (sic) attachments that have failed in a weld or in the base material;"

Section 5.11 requires Inspector witnessing and Jurisdiction approval for nameplate removal/replacement.

Item NB15-1405 (*formally IN14-0401*)

The following is a history of record number NB15-1405, formally inquiry record 14-0401, found in NBIC committee Minutes from inception in 2014.

January 2014 **(see attachment "A")**	**Main Committee Minutes:** **IN14-0401 - *Part 3, 1.2*** - Question 1: The NBIC Part 3 paragraph 1.2 states that a repair shall be carried out "insofar as possible to the section and edition of the ASME code most applicable to the work planned." If a vessel is constructed using SA-517-E (P-11B) material to ASME Section VIII Div. 1, where production and weld procedure impact tests were required during construction, would a repair to a crack in the shell require production and weld procedure impact testing under the NBIC? Proposed Reply 1: Yes. (No attachment) Question 2: If the answer to Question 1 is yes and there was no SA-517-E material from the original lot available, would the repair require the addition of new base material (e.g. a flush patch around the area of the crack) so that production impact tests could be performed with the original base metal to the new base metal? Proposed Reply 1: Yes. Question 3: If the vessel described in Question 1 was to be altered by adding an SA-675 (P-1) pump flange to the shell, would production and weld procedure impact tests be required using the same lot P-1 and P-11B base materials as used in the alteration? Proposed Reply 1: Yes. January 2014 A task group of Walt Sperko, Bob Wielgoszinski (PM), and George Galanes will work on this inquiry. **SC RA Minutes:** January 2014 Bob Wielgoszinski presented a document request for interpretation associated with welded repairs to UHT vessels. A task group of Walt Sperko, Bob Wielgoszinski (PM), and George Galanes will work on this inquiry. **SG RA Specific Minutes:** January 2014 Bob Wielgoszinski presented a document request for interpretation associated with welded repairs to UHT vessels. A task group of Walt Sperko, Bob Wielgoszinski (PM), and George Galanes will work on this inquiry.
January 2015 **(see attachment "B")**	**Main Committee Minutes** **Item Number: IN14-0401 NBIC Location: Part 3, 1.2 Attachment Pages 72-73** **General Description:** Interpretation questions regarding requirements for production impact tests after repair or alteration of a vessel **Subgroup:** Repairs and Altterations **Task Group:** Unknown **Meeting Action:** Mr. Galanes gave a report. The Subcommittee on Repairs and Alterations voted unanimously close this interpretation with no response. The Subcommittee on Repairs and Alterations opened a new action item NB15-1405 to

	address production impact tests. Mr. Wielgoszinski explained the subject of the interpretation and the new action item. The NBIC Committee voted unanimously to close this interpretation with no response. **SC RA Minutes:** January 2015 Mr. Wielgoszinski provided a report. After consideration, Mr. Wielgoszinski decided to withdraw the inquiry and requested a new item to address impact testing of P11B material. A motion was made to close this interpretation and open up an action Item. The new action item will be: **NB15-1405 Part 3-Impact testing of P-11B Material, SC R and A** (From IN14-0401) A task group was formed with Bob Wielgoszinski, as project manager and member Ben Schaefer, Walt Sperko, Monty Bost, and Dave Ford. (Attachment Pages 8-9)
July 2015	**No report. Not included on MC or RA agendas.**
January 2016	**No minutes available.**
July 2016	**No report. Not included on MC or RA agendas.**
January 2017	**No report. Not included on MC or RA agendas.**
July 2017	**No report. Not included on MC or RA agendas.**
January 2018	**No report. Not included on MC or RA agendas.**

Attachment "A"
This is the original request for interpretation in January 2014.

Request for Interpretation

Robert V. Wielgoszinski
Hartford Steam Boiler of CT

Item	IN 14-0401
Purpose	Code Interpretation & possible revision to present Code rules
Scope:	Repairs and alterations to vessels constructed of ferritic materials with tensile properties enhanced by heat treatment, i.e. Part UHT material.
Background	During the construction of liquid propane vessels it is typical to use SA-517 Gr. E (P-No. 11B) for use as heads and shells for propane transport tanks. The ASME Code requires the base materials, welding materials, and the WPS's to be qualified with impact tests. Also, the Code requires production impact testing to be performed. This is where the actual vessel material, actual filler materials, are welded with the actual WPS to be used in production, and the weld coupon is impact tested to meet the specified results of Section VIII. To do so, the Manufacturer of the vessel is sure to purchase enough extra base and filler material to perform these tests. When repairs / alterations are made to these vessels the NBIC requires the rules of the original construction Code to be followed. As such, any new material to be added to a vessel or any WPS's used or any filler metal used for the repair must then be impact tested and meet the results stated in Section VIII. Also, production impacts must therefore be made since this is a mandatory Section VIII requirement. This is usually accomplished by making a weld coupon out of existing material cut from the vessel and welding it to the new material to be added to the vessel, and then impact testing specimens from that coupon. But, not all repairs / alterations lend themselves the ability to take existing material from the vessel. If a small nozzle is added to the vessel, only a few inches of material is taken from the vessel. Or say a crack is to be weld repaired or there is weld metal build up to be made on some worn or wasted area. Then there is no extra material to be taken away from the vessel to run coupons for production impacts. Strict interpretation of the ASME Code would now require a piece of steel to be removed to run production impacts and then a flush patch installed over the area removed. Some individuals look at the words in NBIC, Part 3, Section 1, paragraph 1.2, where it says, "…the standard governing the original construction shall conform, insofar as possible…" gives one the leeway to not require production impacts because it's not possible. Others indicated that it is possible but not practical to cut perfectly good material out of a vessel when there is no need to. And others will say that the ASME clearly requires existing material to be removed to run impact tests. One thing is clear though, and that is there is lack of uniformity in applying these rules. So we are looking to the NBIC to provide some guidance in this matter. The Jurisdiction in this case is the US DOT, and 49CFR Chapter 1 § 180.413(a)(1) states that the NBIC is to be followed for repairs and modifications. DOT is also looking to the NBIC for clarification.

	Depending on the responses to the inquiry it may be prudent revise the Code to be more specific in this area of UHT materials.
Proposed Questions	**Question 1:** The NBIC Part 3 paragraph 1.2 states that a repair shall be carried out "insofar as possible to the section and edition of the ASME code most applicable to the work planned." If a vessel is constructed using SA-517-E (P-11B) material to ASME Section VIII Div. 1, where production and weld procedure impact tests were required during construction, would a repair to a crack in the shell require production and weld procedure impact testing under the NBIC? **Proposed Reply 1:** Yes. **Question 2:** If the answer to Question 1 is yes and there was no SA-517-E material from the original lot available, would the repair require the addition of new base material (e.g. a flush patch around the area of the crack) so that production impact tests could be performed with the original base metal to the new base metal? **Proposed Reply 1:** Yes. **Question 3:** If the vessel described in Question 1 was to be altered by adding an SA-675 (P-1) pump flange to the shell, would production and weld procedure impact tests be required using the same lot P-1 and P-11B base materials as used in the alteration? **Proposed Reply 1:** Yes.

Attachment "B"
This is the attachment that was included in the NBIC Minutes from the January 2015 meeting. It is identical to the original inquiry except for the new item number assigned as a revision.

Action Item NB15-1405 from Request for Interpretation

Robert V. Wielgoszinski
Hartford Steam Boiler of CT

Item	NB15-1405 *(was IN 14-0401)*
Purpose	~~Code Interpretation &~~ possible revision to present Code rules
Scope:	Repairs and alterations to vessels constructed of ferritic materials with tensile properties enhanced by heat treatment, i.e. Part UHT material.
Background	During the construction of liquid propane vessels it is typical to use SA-517 Gr. E (P-No. 11B) for use as heads and shells for propane transport tanks. The ASME Code requires the base materials, welding materials, and the WPS's to be qualified with impact tests. Also, the Code requires production impact testing to be performed. This is where the actual vessel material, actual filler materials, are welded with the actual WPS to be used in production, and the weld coupon is impact tested to meet the specified results of Section VIII. To do so, the Manufacturer of the vessel is sure to purchase enough extra base and filler material to perform these tests. When repairs / alterations are made to these vessels the NBIC requires the rules of the original construction Code to be followed. As such, any new material to be added to a vessel or any WPS's used or any filler metal used for the repair must then be impact tested and meet the results stated in Section VIII. Also, production impacts must therefore be made since this is a mandatory Section VIII requirement. This is usually accomplished by making a weld coupon out of existing material cut from the vessel and welding it to the new material to be added to the vessel, and then impact testing specimens from that coupon. But, not all repairs / alterations lend themselves the ability to take existing material from the vessel. If a small nozzle is added to the vessel, only a few inches of material is taken from the vessel. Or say a crack is to be weld repaired or there is weld metal build up to be made on some worn or wasted area. Then there is no extra material to be taken away from the vessel to run coupons for production impacts. Strict interpretation of the ASME Code would now require a piece of steel to be removed to run production impacts and then a flush patch installed over the area removed. Some individuals look at the words in NBIC, Part 3, Section 1, paragraph 1.2, where it says, "...the standard governing the original construction shall conform, <u>insofar as possible</u>..." gives one the leeway to not require production impacts because it's not possible. Others indicated that it is possible but not practical to cut perfectly good material out of a vessel when there is no need to. And others will say that the ASME clearly requires existing material to be removed to run impact tests. One thing is clear though, and that is there is lack of uniformity in applying these rules. So we are looking to the NBIC to provide some guidance in this matter. The

	Jurisdiction in this case is the US DOT, and 49CFR Chapter 1 § 180.413(a)(1) states that the NBIC is to be followed for repairs and modifications. DOT is also looking to the NBIC for clarification. Depending on the responses to the inquiry it may be prudent revise the Code to be more specific in this area of UHT materials.
Proposed Questions	**Question 1:** The NBIC Part 3 paragraph 1.2 states that a repair shall be carried out "insofar as possible to the section and edition of the ASME code most applicable to the work planned." If a vessel is constructed using SA-517-E (P-11B) material to ASME Section VIII Div. 1, where production and weld procedure impact tests were required during construction, would a repair to a crack in the shell require production and weld procedure impact testing under the NBIC? **Proposed Reply 1:** Yes. **Question 2:** If the answer to Question 1 is yes and there was no SA-517-E material from the original lot available, would the repair require the addition of new base material (e.g. a flush patch around the area of the crack) so that production impact tests could be performed with the original base metal to the new base metal? **Proposed Reply 1:** Yes. **Question 3:** If the vessel described in Question 1 was to be altered by adding an SA-675 (P-1) pump flange to the shell, would production and weld procedure impact tests be required using the same lot P-1 and P-11B base materials as used in the alteration? **Proposed Reply 1:** Yes.

Subject	Code Revision to Part 3, 2.5.3.6
File Number	NB18-12 **Prop. on Pg.** 2
Proposed Revision	1
Statement of Need	The revision is to Welding Method 6 to allow for weld build-up limited to 100 square inches on only Grade 91 tube OD surfaces for local erosion or mechanical damage.

Project Manager	John Siefert/G. Galanes

SubGroup Negatives	**SG Meeting Date**

Background;
Welding Method 6 was successfully introduced into the NBIC, part 3 to permit butt weld repair with no PWHT. This action permits weld build-up of the Grade 91 tubes within the boiler setting and same limitations to repair erosion or mechanical damage without the need for complete tube replacement. To ensure adequate controls, the size of the repair are using a weld overlay is limited to 100 square inches.

The size limitation for the weld build-up repair of 100 square inches is predicated on similar language which appears in Part 3 Supplements 2 and 4. For weld build-up repairs, section 2.5.3.6 c) 5) f) does not limit the F-No. 43 filler materials because the need for the weld build-up may be due to corrosion or erosion. In these examples, it may be necessary to use an optimized filler material which is otherwise prohibited in section 2.5.3.6 c) 5) d) for full thickness repairs.

The rev 4 version addressed a single comment received from the comment ballot ending in early March 2019. This comment is "*Subpara. a) needs clarification regarding "the attachment material may be dissimilar" comment, as WM-6 does not allow for welding of anything other than P-15E Grp. 1, Gr. 91 to itself (ref. a) 1)). Allowing for dissimilar material repairs at the integral attachment interface would require qualification of a new PQR and generation of a new WPS, which WM-6 does not provide for.*"

Item 18-12
2.5.3.6 WELDING METHOD 6

This welding method provides requirements for welding only Grade 91 tube material within the steam boiler setting. When using this welding method, the following applies:

a) This method is limited to butt welds, weld build-up repairs, or attachment weld to ~~in tubing~~ NPS 5 (DN 125) or less in diameter and ½ in. (13 mm) or less in wall thickness for which the applicable rules of the original code of construction did not require notch toughness testing;

b) Application shall be limited to only boiler tube repairs at a location internal to the boiler setting;

c) Upon the completion of weld repair, the repair area shall be kept above the dew point temperature so that condensation does not form on the repair surface before returned to service or a moisture-barrier coating shall be applied to the surface.

1) The material shall be limited to P-No 15E, Group 1, Grade 91, creep strength enhanced ferritic steel (CSEF).

2) The welding shall be limited to the SMAW and/or GTAW processes, manual or automatic, using suitably controlled maintenance procedures to avoid contamination by hydrogen producing sources. The surface of the metal shall be free of contaminants and kept dry.

3) The welding procedure qualification test coupon shall be P-No 15 E, Group 1, Grade 91.

4) Qualification thickness limits of base metal and weld deposit thickness shall be in accordance with ASME Section IX, QW-451.

5) The Welding Procedure Specification (WPS) shall be qualified in accordance with the requirements of ASME Section IX. No postweld heat treatment shall be applied to the test coupon. Additionally, the WPS shall include the following requirements:

a. The minimum preheat for the GTAW process shall be 200°F (100°C). The minimum preheat for the SMAW process shall be 300°F (150°C). The preheat temperature shall be checked to ensure the minimum preheat temperature is maintained during welding and until welding is completed. The maximum interpass temperature shall be 550°F (290°C).

b. When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW-process is specified any limits in filler size is to be shown on the WPS.

c. Regardless of the welding process (SMAW and/or GTAW), only the use of stringer beads shall be permitted.

d. The filler metal shall be limited to an austenitic, nickel-base filler metal ~~having a designation F-No. 43~~ to those assigned to F-number 43 in Section IX, QW-432 and limited to the following consumables: ERNiCr-3, ENiCrFe-3,

ENiCrFe-2, ASME B&PV Code Cases 2733 and 2734 (e.g. EPRI P87); or
e. A martensitic, iron-base filler metal to those assigned to F-number 4 or F-number 6 in ASME Section IX, QW-432 ~~having a designation F-No. 4 or F-No. 6~~ and limited to the following consumables: E8015-B8, E8018-B8 or ER80S-B8.
f. For weld build-up repairs due to wastage, the filler metal shall be limited to those assigned to F-number 43 in ASME Section IX, QW-432.

Subject Code Revision to Part 3, 2.5.3.6

File Number NB18-13 **Prop. on Pg.** 2

Proposed Revision Statement of Need

The revision is to add a new Welding Method 7 to allow for dissimilar metal welding of Grade 91 to austenitic steels and low alloy steels in a boiler setting and limited to butt welds, in accordance with approved welding method 6.

Project Manager John Siefert/G. Galanes

SubGroup Negatives **SG Meeting Date**

Background;
Welding Method 7 is being introduced to permit dissimilar metal weld repair with no PWHT between Grade 91 boiler tubes to austenitic steels and low alloy ferritic steels. This action permits DMW of Grade 91 tubes within the boiler setting following welding method 6 with no PWHT.

NB Item 18-13

2.5.3.7 WELDING METHOD 7

This repair method provides requirements for dissimilar metal welding (DMW) of Grade 91 tube material to either austenitic or low alloy ferritic steel tubing within the steam boiler setting. When using this welding method, the following applies:

a) This method is limited to butt welds in tubing NPS 5 (DN 125) or less in diameter and ½ in. (13 mm) or less in wall thickness for which the applicable rules of the original code of construction did not require notch toughness testing;

b) Application shall be limited to only boiler tube repairs at a location internal to the boiler setting;

c) Upon the completion of weld repair, the repair area shall be kept above the dew point temperature so that condensation does not form on the repair surface before returned to service or a moisture-barrier coating shall be applied to the surface.

For DMW of Grade 91 to austenitic steel steel tubing;

1) The materials shall be limited to P-No 15E, Group 1, Grade 91, creep strength enhanced ferritic steel (CSEF) joined to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45, as permitted for welded construction by the applicable rules of the original code of construction.

2) The welding shall be limited to the SMAW and GTAW processes, manual or automatic, using suitably controlled maintenance procedures to avoid contamination by hydrogen producing sources. The surface of the metal shall be free of contaminants and kept dry.

3) The welding procedure qualification test coupon shall be P-No 15 E, Group 1, Grade 91 joined to either P-No. 8, P-No. 42, P-No. 43, or P-No. 45 and as required for the repair application.

4) Qualification thickness limits of base metal and weld deposit thickness shall be in accordance with ASME Section IX, QW-451.

5) The Welding Procedure Specification (WPS) shall be qualified in accordance with the requirements of ASME Section IX. No postweld heat treatment shall be applied to the test coupon. Additionally, the WPS shall include the following requirements:

a). The minimum preheat for the GTAW process shall be 200°F (100°C). The minimum preheat for the SMAW process shall be 300°F (150°C). The preheat temperature shall be checked to ensure the minimum preheat temperature is maintained during welding and until welding is completed.

The maximum interpass temperature shall be 550°F (290°C).

b). When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW-process is specified any limits in filler size is to be shown on the WPS.

c). Regardless of the welding process (SMAW or GTAW), only the use of stringer beads shall be permitted.

d). The filler metal shall be limited to an austenitic, nickel-base filler metal to those assigned to F-number 43 in ASME Section IX, QW-432 and limited to the following consumables: ERNiCr-3 (e.g., Filler Metal 82), ENiCrFe-3 (e.g., INCONEL Welding Electrode 182), ENiCrFe-2 (e.g., INCO-WELD A), ASME B&PV Code Cases 2733 and 2734 (e.g. EPRI P87);
~~e. A martensitic, iron-base filler metal having a designation F-No. 4 or F-No. 6 and limited to the following consumables: E8015-B8, E8018-B8 or ER80S-B8.~~

For DMW of Grade 91 to low alloy (P-No 5A) steel tubing:

1) The materials shall be limited to P-No 15E, Group 1, Grade 91, creep strength enhanced ferritic steel (CSEF) joined to P-No. 5A steel.

2) The welding shall be limited to the SMAW and/or GTAW processes, manual or automatic, using suitably controlled maintenance procedures to avoid contamination by hydrogen producing sources. The surface of the metal shall be free of contaminants and kept dry.

3) The welding procedure qualification test coupon shall be P-No 15 E, Group 1, Grade 91 joined to P-No. 5A steels.

4) Qualification thickness limits of base metal and weld deposit thickness shall be in accordance with ASME Section IX, QW-451.

5) The Welding Procedure Specification (WPS) shall be qualified in accordance with the requirements of ASME Section IX. No postweld heat treatment shall be applied to the test coupon. Additionally, the WPS shall include the following requirements:

(a). The minimum preheat for the GTAW process shall be 200°F (100°C). The minimum preheat for the SMAW process shall be 300°F (150°C). The preheat

temperature shall be checked to ensure the minimum preheat temperature is maintained during welding and until welding is completed. The maximum interpass temperature shall be 550°F (290°C).

(b). When the SMAW process is specified for a fill pass layer, the electrode diameter is restricted to a maximum size of 1/8 in. (3.2 mm). When the GTAW-process is specified any limits in filler size is to be shown on the WPS.

(c). Regardless of the welding process (SMAW or GTAW), only the use of stringer beads shall be permitted.

(d). The filler metal shall be limited to a martensitic, iron-base filler metal to those assigned to F-number 4 or F-number 6 in ASME Section IX, QW-432 and limited to the following consumables: E8015-B8, E8018-B8 or ER80S-B8.

NBIC ACTION ITEM 18-65:

Proposed new paragraph

3.2.2 f) Replacement parts that will be subject to internal or external pressure comprised of PRI's that have been in service, or deemed as used material, shall be verified as being acceptable by the "R" Certificate Holder prior to their installation. These shall conform to the requirements of the original Code of Construction for installation in a PRI being considered for repair or alteration. Materials of this nature shall be of similar construction, and at a minimum meet all Code requirements of materials being replaced, e.g; chemical, physical, minimum thickness, and should be provided with supporting documentation attesting to such. Where supporting documentation cannot be provided or is not available, replacement material shall be verified as being acceptable by the "R" Certificate Holder and Inspector prior to its installation. Such verification, at a minimum, shall consist of initial visual inspection along with laboratory analysis (chemical, physical, minimum thickness), and may be supplemented using one or a combination of the examination and test methods shown in Part 3 Section 4, paragraph 4.4.1 (for repairs) or 4.4.2 (for alterations). Upon verification and acceptance, those replacement items being proposed for use shall be installed in accordance with the requirements of the NBIC, along with concurrence from the Authorized Inspection Agency, and the Jurisdiction where applicable.

Action Item 18-30: Inquiry (Original)

Inquirer: Veera Kommisetti veera_kommisetti@oxy.com
Question: Does the NBIC prohibit interchanging the convection section of one OSTG with another OSTG?

Background information: Occidental of Oman has installed about 85 Nos OTSG (Once through steam generator) in one of oil concession. All OTSG are of similar configuration and they comprise of two main parts i.e. Radiant section and Convection section. Now, OTSGs have aged and Occidental intends to replace a few tubes of the convection section, which require dismantling of the convection section and shipping to repair shop ("R" stamp holder) for repair. We have shipped two convection sections of OTSG 100 and OTSG 200 to a fabrication shop and after repair we intend to use convection sections of OTSG 100 on OTSG 200 due to operational constraints.

Proposed Inquiry:

Committee's Question:

Does the NBIC allow for replacement parts of like construction originally installed in an in-service PRI to be used in a PRI having like materials of similar construction?

Committee's Reply:

Yes, provided the replacement parts are installed in accordance with the requirements of the NBIC, and if applicable, with concurrence from the Jurisdiction and the Authorized Inspection Agency.

Justification:

Ref. Interpretation 07-06, 01-28, 95-15

INTERPRETATION 07-06

Subject: Part 3
2007 Edition

Question: Is it permissible for pressure parts having been in service from one pressure retaining item to be installed in another pressure retaining item as a replacement part for a repair or alteration?

Reply: Yes, provided the pressure parts are installed in accordance with the requirements of the NBIC, and if applicable, with concurrence from the Jurisdiction.

INTERPRETATION 01-28

Subject: RC-1040 Materials
2001 Edition with 2002 Addendum

Question: Is it prohibited to use material that has been previously in service for replacement material for a repair if that material otherwise conforms to the requirements of the original Code of Construction?

Reply: No, provided the use of the material has the concurrence of the Jurisdiction and Authorized Inspection Agency.

INTERPRETATION 95-15

Subject: R-307 Replacement of Pressure Parts
1992 Edition with the 1994 Addenda

Question: Is it permissible to use an assembly from an inservice pressure vessel as a replacement part for the repair/alteration of a second vessel?

Reply: Yes, provided the intended repair/alteration has the concurrence of the jurisdiction and the Authorized Inspection Agency.

3.3.4.6 PATCHES

a) Flush Patches

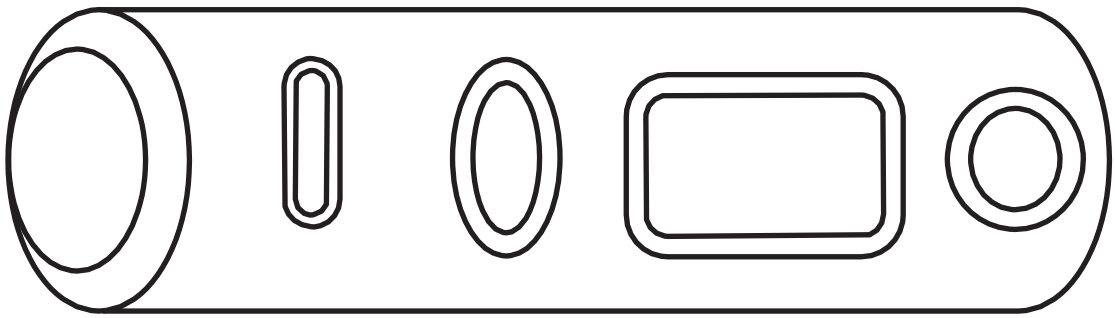
1) The weld around a flush patch shall be a full penetration weld and the accessible surfaces shall be ground flush where required by the applicable original code of construction. Examples of ~~flush welded~~ welded flush patches are shown in NBIC Part 3, Figure 3.3.4.6-a. ~~The welds shall be subjected to the nondestructive examination method used in the original code of construction or an alternative acceptable to the Inspector~~ and, where required, the Jurisdiction. Nondestructive examination will be performed in accordance with the requirements from NBIC Part 3, Section 4.2.~~.~~

2) Before installing a flush patch, ~~the~~ ~~the~~ defective material ~~should~~ ~~should~~ shall be removed until sound material is reached. The patch ~~should~~ ~~should~~ shall~~shall~~ be ~~rolled~~ formed to the proper shape or curvature. The edges ~~should~~ ~~should~~ shall~~shall~~ align without overlap. In stayed areas, the weld seams should come between staybolt rows or riveted seams. Patches shall be made from a material whose composition and thickness meet the intended service. Patches may be any shape or size. If the patch is rectangular, a minimum radius of not less than three times the material thickness shall be provided at the corners. Square corners are not permitted. The completed welds shall meet the requirements of the original code of construction.

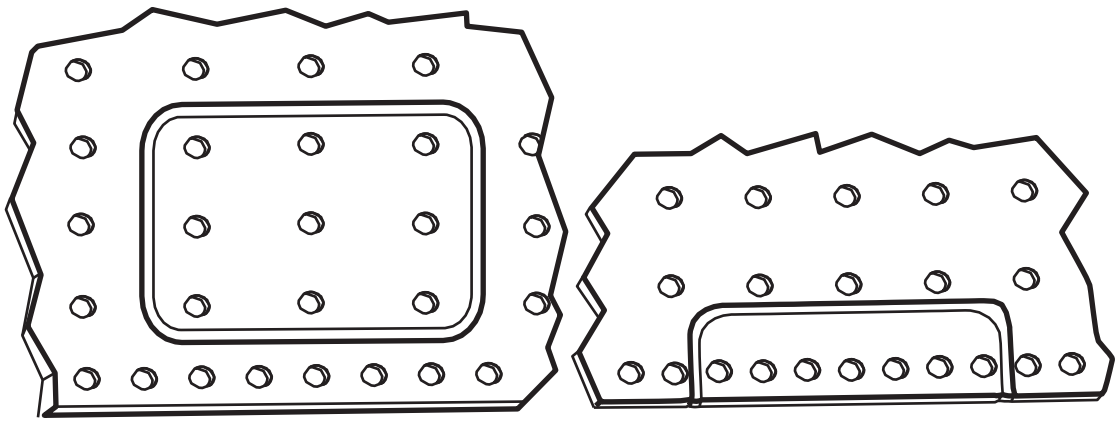
b) Tube Patches

In some situations it is necessary to weld a flush patch on a tube, such as when replacing tube sections and accessibility around the complete circumference of the tube is restricted, or when it is necessary to repair a small bulge. This is referred to as a window patch. Suggested methods for window patches are shown in NBIC Part 3, Figure 3.3.4.6-b.

FIGURE 3.3.4.6-a
FLUSH PATCH CONFIGURATIONS IN UNSTAYED AREAS



FLUSH PATCHES IN STAYED AREAS



Background for Interpretation 18-100

Task Group PM – David Martinez;

Task Group members: Marty Russel and Nathan Carter

Item Number: 18-100 NBIC Location: Part 3, 3.3.2 Attachment Page 44

General Description: Revision adding (plugging) heat exchanger tubes with an outside diameter of ¾" or smaller to NBIC Part 3.3.2 Routine Repairs

Subgroup: Repairs and Alterations

Task Group: David Martinez (PM)

January 2019 Meeting Action: Progress Report: Mr. Martinez reported on this item and presented interpretations (98-04 and 98-29) that may satisfy the revision request, however after a presentation from TEiC regarding the use of explosive welding of tubes to be considered as a routine repair, Mr. Martinez recommend this be considered progress report to continue working to address explosive welding as a Routine Repair.

3.3.2 ROUTINE REPAIRS

a) Routine repairs are repairs for which the requirements for in-process involvement by the Inspector and stamping by the "R" Certificate Holder may be waived as determined appropriate by the Jurisdiction and the Inspector. All other applicable requirements of this code shall be met. Prior to performing routine repairs, the "R" Certificate Holder should determine that routine repairs are acceptable to the Jurisdiction where the pressure-retaining item is installed;

b) The Inspector, with the knowledge and understanding of jurisdictional requirements, shall be responsible for meeting jurisdictional requirements and the requirements of this code;

c) The "R" Certificate Holder's Quality System Program shall describe the process for identifying, controlling, and implementing routine repairs. Routine repairs shall be documented on Form R-1 with this statement in the Remarks section: "Routine Repair";

d) Alternative welding methods without postweld heat treatment as described in NBIC Part 3, 2.5.3 shall not be used for routine repairs.

(Example of proposed additional category to examples of Routine Repairs – paragraph e)

e) The following repairs may be considered as routine repairs and shall be limited to these categories:

1) Welded repairs or replacements of valves, fittings, tubes, or pipes NPS 5 (DN 125) in diameter and smaller, or sections thereof, where neither postweld heat treatment nor

NDE other than visual is required by the original code of construction. This includes their attachments such as clips, lugs, skirts, etc., but does not include nozzles to pressure-retaining items;

2) The addition or repair of nonload bearing attachments to pressure-retaining items where postweld heat treatment is not required;

3) Weld buildup of wasted areas in heads, shells, flanges and fittings not exceeding an area of 100 in.2 (64,520 mm2) or a thickness of 25% of nominal wall thickness or 1/2 in. (13 mm), whichever is less;

4) Corrosion resistance weld overlay not exceeding 100 in.2 (64,520 mm2); ~~and~~

5) Seal welding a mechanical connection for leak tightness where by-design, the pressure retaining capability is not dependent on the weld for strength and requires no postweld heat treatment; and

6) Plugging of heat exchanger tubes ¾ in. outside diameter and smaller when explosive plugging is used as method of plugging tubes.

Background Interpretation

INTERPRETATION 15-04

Subject: Part 3, Section 3

Edition: 2015

Question: Is explosion welding of plugs into leaking heat exchanger tubes considered a repair per the NBIC Part 3?

Reply: Yes.

Support for Consideration of the Proposed Action

ASME Section IX – 2019 (Addresses Procedure and Performance Qualification for Explosion Welding heat exchanger tubes to tubesheets, but not the plug to the tube)

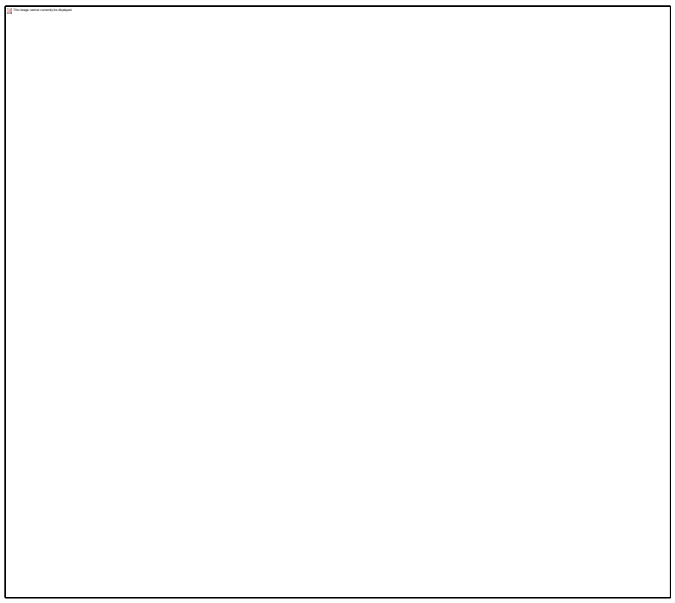
QW-193 TUBE-TO-TUBESHEET TESTS
When the applicable Code Section requires the use of this paragraph for tube-to-tubesheet demonstration mockup qualification, QW-193.1 through QW-193.1.3 shall apply.

QW-193.1 Procedure Qualification Specimens. Ten mockup welds are required for qualifying each tube-to tubesheet welding procedure. The mockup assembly shall essentially duplicate the tube-to-tubesheet weld joint design to be used in production, within the limits of the essential variables of QW-288. The mockup test assembly shall be prepared with the tubesheet element having a thickness not less than the lesser of the thickness of the production tubesheet or 2 in. (50 mm). For tube-to-tubesheet welds to clad tubesheets, the cladding or overlay may be represented by a base material with a chemical composition that is essentially equivalent to the cladding composition. All welds in the mockup assembly shall be subjected to the following tests and shall meet the applicable acceptance criteria.

QW-193.1.1 Visual Examination. The accessible surfaces of the welds shall be examined visually with no magnification required. The welds shall show complete fusion, be free from visual cracks or porosity indications,
and have no evidence of burning through the tube wall.

QW-193.1.2 Liquid Penetrant. The liquid penetrant examination shall meet the requirements of Section V, Article 6. The weld surfaces shall meet the requirements of QW-195.2.

QW-193.1.3 Macro-Examination. The mockup welds shall be sectioned through the center of the tube for macro-examination. The four exposed surfaces shall be smoothed and etched with a suitable etchant (see QW-470) to give a clear definition of the weld and heat-affected zone. Using a magnification of 10X to 20X, the exposed cross sections of the weld shall confirm
(a) minimum leak path dimension required by the design
(b) no cracking
(c) complete fusion of the weld deposit into the tubesheet and tube wall face



QW-410.83 A change in the type of explosive or a change in the energy content greater than ±10%.

QW-410.84 A change in the distance between the explosive charge and the tubesheet face greater than ±10%.

QW-410.85 A change in the specified clearance between the tube and the tubesheet greater than ±10%.

QW-193.2 Performance Qualification Specimens.
A minimum of five mockup tube-to-tubesheet welds are required to qualify each welder or welding operator. The same rules as those applicable for procedure qualification (QW-193.1) shall be followed, with the following additional requirements and exceptions:
(a) The essential variables in QW-387 shall apply.
(b) Essential performance qualification variables applicable for each welding process listed in QW-350 or QW-360 shall also be observed in addition to the variables of Table QW-388.
(c) Postweld heat treatment may be omitted.

Only one mockup weld is required to renew a welder's or welding operator's qualification when that qualification has expired or has been revoked per the requirements of QW-322.1.

Logic to consider motion for approval:

- Explosion welding to plug leaking tubes is supported by qualified written welding procedures and welder qualification procedures compared to other mechanical tube-plugging methods that are performed with no NBIC guidance.
- Explosion welding does not rely on fusion to join the two materials. It is a pressure weld in which the explosive force joins the two materials. Unlike fusion welding that is allowed in other examples of Routine Repairs, there is no heat affected zone, and PWHT is not needed nor required.
- The majority, if not all explosion tube plugging is performed on tubes ¾" and smaller, and typically under emergency conditions. No Inspector involvement would be required if this specific category was added to the categories of Routine Repairs
- The explosion tube-plugging method for tubes ¾" and smaller would be more cost and schedule effective and is proven to be a reliable method for plugging leaking heat exchanger tubes for owners and users.

Note: The only realistic test upon completion of explosion tube-plugging is a pressure test.

NB Item # 18-102 **Update NBIC Part 3, Table 2.3 (01-16-2019)**

Revise Table 2.3 adding the listed SWPSs that were revised by the AWS B2 Committee in 2018.

PROPOSED REVISION

TABLE 2.3

Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, E7018, in the As-Welded or PWHT Condition, Primarily Plate and Structural Applications.	**B2.1-1-016: 2018**
Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, E6010, in the As-Welded or PWHT Condition, Primarily Plate and Structural Applications.	**B2.1-1-017: 2018**
Standard Welding Procedure Specification (SWPS) for CO_2 Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, E70T-1C and E71T-1C, in the As-Welded, Primarily Plate and Structural Applications.	**B2.1-1-019: 2018**
Standard Welding Procedure Specification (SWPS) for 75% Ar/25%CO_2 Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, E70T-1M and E71T-1M, in the As-Welded or PWHT Condition, Primarily Plate and Structural Applications.	**B2.1-1-020: 2018**
Standard Welding Procedure Specification (SWPS) for Gas Tungsten Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, ER70S-2 and E7018, in the As-Welded or PWHT Condition, Primarily Plate and Structural Applications.	**B2.1-1-021: 2018**
Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, E6010 (Vertical Uphill) Followed by E7018, in the As-Welded or PWHT Condition, Primarily Plate and Structural Applications.	**B2.1-1-022: 2018**
Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8, Group 1) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, in the As-Welded Condition, Primarily Plate and Structural Applications.	**B2.1-8-023: 2018**
Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8" [3 mm] through 1-1/2 inch [38 mm] Thick, E6010 (Vertical Downhill) Followed by E7018, in the As-Welded or PWHT Condition, Primarily Plate and Structural Applications.	**B2.1-2-026: 2018**
Standard Welding Procedure Specification (SWPS) for Self-Shielded Flux Cored Arc Welding of Carbon Steel (M-1 or P-1, Groups 1 and 2), 1/8 inch [3 mm] through 1/2 inch [13 mm] Thick, E71T-11, in the As-Welded Condition, Primarily Plate and Structural Applications	B2.1-1-027:2018

AWS B2.1-1-016:2018
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April 10, 2018

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2nd Edition

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Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

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Foreword

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The American Welding Society and the Welding Research Council have joined in a cooperative effort to generate standard welding procedures for industry. The need for pretested welding procedures that are supported by adequate test data and that satisfy the technical requirements for the commonly used construction codes and specifications has been expressed by many individuals and organizations. The purpose of a welding procedure qualification is to provide test data for assessing the properties of a weld joint.

This Standard Welding Procedure Specification is an outgrowth of the coordinated work of the Welding Procedures Committee of the Welding Research Council and the AWS B2 Committee on Procedure and Performance Qualification. The Welding Procedures Committee has provided the data documented on the Summary of Procedure Qualification Records.

The welding terms used in this specification shall be interpreted in accordance with the definitions given in the latest edition of AWS A3.0M/A3.0, *Standard Welding Terms and Definitions; Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*

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This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 inch [3 mm] through 1-1/2 inch [38 mm], using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This SWPS was developed primarily for plate and structural applications.

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This Standard Welding Procedure Specification is an outgrowth of the coordinated work of the Welding Procedures Committee of Welding Research Council and the AWS B2 Committee on Procedure and Perfonnance Qualification. The Welding Procedures Committee has provided the data documented on the Summary of Procedure Qualification Records.

The welding terms used in this specification shall be interpreted in accordance with the definitions given in the latest edition of AWS A3.0M/A3.0, *Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying.*

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This SWPS is the first revision of AWS 82.1-1-021-94. All references to ASME "S" material numbers have been deleted from this edition. A Standard Units of Measure clause was added, and the Safety clause was updated. Metric conversions were updated and Annex A on requesting an official interpretation on an AWS standard is included.

A vertical line in the margin or underlined text in clauses, tables, or figures indicates an editorial or technical change from the previous edition.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, B2 Committee on Procedure and Perfomrnnce Qualification, American Welding Society, 8669 NW 36 St, # 130, Miami, FL 33166.

American Welding Society®

AWS 82.1-8-023:2018
An American National Standard

Approved by the
American National Standards Institute
April 10, 2018

Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8 Group 1) 1/8 inch [3 mm] through 1-1/2 inch [38 mm] Thick, in the As-Welded Condition, Primarily Plate and Structural Applications

2nd Edition

Supersedes AWS B2.1-8-023-94R

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for austenitic stainless steel in the thickness range of 1/8 inch [3 mm] through 1-1/2 inch [38 mm], using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This SWPS was developed primarily for plate and structural applications.

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American Welding Society®

AWS 82.1-1-026:2018
An American National Standard

Approved by the
American National Standards Institute
April 10, 2018

Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2) 1/8 inch [3 mm] through 1-1/2 inch [38mm] Thick, E6010 (Vertical Downhill) Followed by E7018, in the As-Welded or PWHT Condition, Primarily Plate and Structural Applications

2nd Edition

Supersedes AWS B2.l-l-026-94R

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American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

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This SWPS is the first revision of AWS 82.1-1-026-94. All references to ASME "S" material numbers have been deleted from this edition. A Standard Units of Measure clause was added, and the Safety clause was updated. Metric conversions were updated and Annex A on requesting an official interpretation on an AWS standard is included.

A vertical line in the margin or underlined text in clauses, tables, or figures indicates an editorial or technical change from the previous edition.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, 82 Committee on Procedure and Performance Qualification, American Welding Society, 8669 NW 36 St, # 130, Miami, FL 33166.

American Welding Society®

AWS B2.1-1-027:2018
An American National Standard

Approved by the
American National Standards Institute
February 16, 2018

Standard Welding Procedure Specification (SWPS) for Self-Shielded Flux Cored Arc Welding of Carbon Steel (M-1 or P-1, Groups 1 and 2), 1/8 inch [3 mm] through 1/2 inch [13 mm] Thick, E71T-11, in the As-Welded Condition, Primarily Plate and Structural Applications

4th Edition

Supersedes AWS B2.1-1-027:2011

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 inch [3 mm] through 1/2 inch [13 mm], using self-shielded flux cored arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove and fillet welds. This SWPS was developed primarily for plate and structural applications.

American Welding Society®

Foreword

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This Welding Procedure Specification is an outgrowth of the coordinated work of the Welding Procedures Committee of WRC and the Committee on Welding Qualification of the AWS. The Welding Procedures Committee has provided the data documented by a Summary of Procedure Qualification Records.

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This SWPS is the third revision of AWS B2.1-1-027. All references to ASME "S" material numbers have been deleted. A Standard Units of Measure clause was added and the Safety clause was updated. Metric conversions were updated and Annex A on requesting an official interpretation on an AWS standard is included. Reference to A5.36/A5.36M and Classification E71T11-AZ-CS3 and AWS D15.1 *Railroad welding Specification for Cars and Locomotives* was added.

A vertical line in the margin or underlined text in clauses, tables, or figures indicates an editorial or technical change from the previous edition.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary of the AWS B2 Committee on Procedure and Performance Qualification, at American Welding Society, 8669 NW 36 St, # 130, Miami, FL 33166.

Added for information only

Item 19-11 – Hellman – 7-15-2019

Location: Section 9 of Parts 1, 2, 3 and 4

Explanation of Need: Review the use of "Authorized Nuclear Inspection Agency" within the NBIC.

Background: An ANIA can not be an Inservice AIA since Endorsements for nuclear inspectors are issued only to new construction AIA's. The requirements for qualified Authorized Nuclear Inspectors/Supervisors are clearly specified in NB-263, RCI-1. Therefore revision to the Glossary definition is needed to clarify this requirement for the NR Accreditation Program.

Proposed Revision:

1.6.3 PREREQUISITES FOR ISSUING A NATIONAL BOARD "NR" CERTIFICATE OF

AUTHORIZATION

Before an organization can obtain a National Board "NR" Certificate of Authorization, the organization shall:

a) Have and maintain an inspection agreement with an Authorized Nuclear Inspection Agency accepted in accordance with NB-360, National Board Acceptance of Authorized Inspection Agencies (AIA) Accredited by the American Society of Mechanical Engineers (ASME) ~~or accredited in accordance with NB-369, Accreditation of Authorized Inspection Agencies (AIA) Performing Inservice Inspection Activities and Qualification of Inspectors of Boilers and Pressure Vessels~~.
b) Have a written Quality Assurance Program that complies with the requirements of this section and address all controls for the intended category and scope of activities.
c) Have a current edition of the NBIC.

Item 19-12 – Withers – 01-22-2019

NBIC NR Revisions.

Paragraph 1.6.3 – revise text to clarify Quality Assurance Program requirements:

Existing Text;

b) Have a written Quality Assurance Program that complies with the requirements of this section and address all controls for the intended category and scope of activities.

Revised text;

b) Have a written Quality Assurance Program ~~that complies with the requirements of~~ which includes the quality assurance manual and any supporting procedures, instructions and specifications required to comply with ~~-~~this section. The Quality Assurance Program shall ~~and~~ address all controls for the intended category and scope of activities requested.

Item 19-13 – Hellman – 7-15-2019

NBIC NR Revisions.

Explanation of Need: Revise text to clarify responsibilities for performing audits between the Certificate Holder and the AIA.

Location: Paragraph's 1.6.6.2 s); 1.6.7.2 s); and 1.6.8.2 s) AUDITS

The provisions identified in ASME NQA-1, Part 1, and Requirement 18 shall apply and shall include the following:

A comprehensive system of planned and periodic audits of the NR Certificate Holder's Quality Assurance Program shall be performed. ~~Audits shall include internal audits by the Certificate Holder and audits by the Authorized Inspection Agency.~~ Audit frequency shall be specified in the organization's Quality Assurance Manual. Audits shall be conducted at least annually (within 12 months) for any ongoing code activity to verify compliance with the Quality Assurance Program requirements, performed criteria, and to determine the effectiveness of the Quality Assurance Program. When no code work has been performed, the required annual audit need only include those areas of responsibility required to be continually maintained such as training, audits, organizational structure, and Quality Assurance Program revisions. The Quality Assurance Manual shall as a minimum describe the following:

a. Audits shall be performed in accordance with written procedures or checklists by qualified audit personnel not having direct responsibility in areas being audited;
b. Audit personnel shall be qualified in accordance with the current requirements of ASME NQA-1;
c. Audit results shall be documented and reviewed by responsible management for adequacy and effectiveness of the quality assurance program;
d. Requirements for follow-up actions shall be specified for any deficiencies noted during the audit;
e. Audit records and applicable documentation shall be made available to the Authorized Nuclear Inspect~~or~~ion Agency for review;
f. Audit records shall include as a minimum;
    i. Written procedures
    ii. Checklists;
    iii. Reports;
    iv. Written replies; and
    v. Completion of corrective actions.

Performance of Authorized Inspection Agency audits required by ASME QAI-1 and NB-263, RCI-1 shall be addressed in the Quality Assurance Manual.

Proposed change to repair and alteration plan certificate with respect to ASME Section VIII DIv.2 class 1 vessels

3.3.5.2 REPAIR PLAN

The user shall prepare, or cause to have prepared, a detailed plan covering the scope of the repair.

a) Engineer Review and Certification

The repair plan shall be reviewed and certified by an engineer meeting the criteria of ASME Section VIII, Division 2 or 3, as applicable, for an engineer signing and certifying a Manufacturer's Design Report. The review and certification shall be such as to ensure the work involved in the repair is compatible with the User's Design Specification and the Manufacturer's Design Report. The certifying requirement may be waived for vessels that did not require the Manufacture's Design Report to be signed during initial construction

Note: The engineer qualification criteria of the Jurisdiction where the pressure vessel is installed should be verified before selecting the certifying engineer.

3.4.5.1 ALTERATION PLAN

a) Engineer Review and Certification

The alteration plan shall be reviewed and certified by an engineer meeting the criteria of ASME Section VIII, Division 2 or 3, as applicable, for an engineer signing and certifying a Manufacturer's Design Report. The review and certification shall be such as to ensure the work involved in the alteration is compatible with the user's design specification and the Manufacturer's Design Report. Provided that the alteration does not introduce a condition that would require an Engineer to sign the Manufacture Design Report the certifying requirement may be waived for vessels that did not require the Manufacture's Design Report to be signed during initial construction

Note: The engineer qualification criteria of the jurisdiction where the pressure vessel is installed should be verified before selecting the certifying engineer.

Justification,

This change is in-line with interpretation 17-08 and is on the basis that some vessel during new construction do not the Manufacture design report to be certified by and Engineer and accordingly repair or alteration plans to the same equipment do not need this step.

I changed the wording of the enquirer as it appeared to waive engineering sign off for all Div.1 class 1 vessels whereas interpretation 17-08 was specifically limited to those which were not required to be signed.

Item 19-16: NBIC Part 3, 3.2.2 e)
Submitted by: Eben Creaser eben.creaser@gnb.ca

Explanation of Need: This wording of this clause is causing confusion. I have had multiple instances where owners have requested to purchase welded replacement parts directly and read this clause with the belief that they can purchase a replacement part for in some cases a welded pressure part for an ASME Section I boiler and safe money by having the fabricator not Hydro test as per Section I even when it was not impractical to have the testing performed.

Background Information: The second sentence of 3.2.2 seems to provide optional provisions that contradict the mandatory requirement stated in the first sentence that requires 3.2.2 c) or d) parts to be pressure tested by the original code of construction. If this is the intent of the committee then the clause should be reworded to add an "or" between the sentences. The wording could also be understood to mean that all parts addressed in 3.2.2 c) or d) have to be pressure tested. But then the second sentence alludes to an optional requirement, it's just not clear.

Proposed Text:
If the intent of this clause is to provide optional pressure test requirements for parts then;

e) Replacement parts addressed by 3.2.2 c) or d) above shall receive a pressure test as required by the original code of construction prior to installation, or, when accepted by the owner, the Inspector and, where required, the Jurisdiction, parts ~~. If replacement parts have not been pressure tested as required by the original code of construction prior to installation they~~ may be installed without performing the original code of construction pressure test provided the owner, the Inspector and, when required, the Jurisdiction accept the use of one or a combination of the examination and test methods shown in Part 3, Section 4, paragraph 4.4.1 (for repairs) or 4.4.2 (for alterations). The R Certificate Holder responsible for completing the R Form shall note in the Remarks section of the R Form the examination(s) and test(s) performed, and the reason the replacement part was not tested in accordance with the original code of construction.

S6.16.4 REGISTRATION OF FORM R-1 AND FORM R-2

a) Organizations performing repairs, alterations, or modifications required by this supplement shall register such repairs, alterations, or modifications with the National Board.

b) The repair organization shall maintain a sequential Form “R” Log that shall identify the following:

1) Form number assigned ~~for Form R~~ 1to the “R” Form;
2) Identify if the activity was a repair, alteration, or modification;
3) When the repair, alteration, or modification was completed, and
4) Date sent to the National Board.

2) Amended SWPSs: When an amendment occurs the suffix “AMD1” is added to the SWPS designation Amendments are issued when essential for the prompt correction of an error that could be misleading. Amendments are incorporated into the existing text of the SWPS, which is reprinted and clearly marked as incorporating an amendment(s), and which is identified in the revised Foreword of the amended SWPS.

3) Revised SWPSs: When a revision to a published SWPS occurs, the publication date is added to the SWPS designation. The date of the superseded SWPS is also noted on the cover page. Previous versions of the superseded SWPS may be used at the option of the R Certificate holder.

TABLE 2.3

(19)

CARBON STEEL — (M-1/P-1 MATERIALS)

SMAW — Shielded Metal Arc Welding	
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel, (M-1/P-1, Group 1 or 2), 3/16 in. ~~(5 mm)~~ through 3/4 in. ~~(19 mm)~~, in the As-Welded Condition, With Backing.	B2.1.001-90 and B2.1-1-001: 90(R2006)
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. (~~3.2 mm~~) through 1 ½ in. ~~(38 mm)~~ Thick, E7018, As-Welded or PWHT Condition.	B2.1-1-016-94 and B2.1-1-016-94R
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E6010, As-Welded or PWHT Condition.	B2.1-1-017-94 and B2.1-1-017-94R
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E6010 (Vertical Uphill) followed by E7018, As-Welded or PWHT Condition.	B2.1-1-022-94 and B2.1-1-022-94R
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E6010 (Vertical Downhill) followed by E7018, As-Welded or PWHT Condition.	B2.1-1-026-94 and B2.1-1-026-94R
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ Thick, E6010 (Vertical Uphill) followed by E7018, (Vertical Uphill) As-Welded Condition, Primarily Pipe Applications.	B2.1-1-201-96, and B2.1-1-201-96(R2007)
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ thick, E6010 (Vertical Downhill) followed by E7018 (Vertical Uphill), As-Welded Condition, Primarily Pipe Applications.	B2.1-1-202-96(R2007)
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ Thick, E6010 (Vertical Uphill), As-Welded Condition, Primarily Pipe Applications.	B2.1-1-203-96 and B2.1-1-203-96(R2007)
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ Thick, E6010 (Vertical downhill root with balance vertical uphill), As-Welded Condition, Primarily Pipe Applications.	B2.1-1-204-96 and B2.1-1-204-96(R2007)
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E6010 (Vertical Uphill) followed by E7018 (Vertical Uphill), As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-205-96 and B2.1-1-205-96(R2007)

Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ ~~3/4~~ in. ~~(19 mm)~~ Thick, E6010 (Vertical Downhill) followed by E7018 (Vertical Uphill), As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-206-96 and B2.1-1-206-96(R2007)
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ ~~3/4~~ in. ~~(19 mm)~~ Thick, E7018, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-208-96
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through1 ½ in. ~~(38 mm)~~ Thick, E7018, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-208-96(R2007)
GTAW — Gas Tungsten Arc Welding	
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Carbon Steel, (M-1/P-1, Group 1 or 2), 3/16 in. ~~(5 mm)~~ through 7/8 in. ~~(22 mm)~~ Thick, in the As-Welded Condition, With or Without Backing.	B2.1-002-90, B2.1-002-90(R2006) and B2.1-1-002-90R
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ ~~3/4~~ in. ~~(19 mm)~~ Thick, ER70S-2,	B2.1-1-207-96
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER70S-2, As-Welded or PWHT Condition, Primarily Pipe Application.	B2.1-1-207-96 (R2007)
Standard Welding Procedure Specification for Gas Tungsten Arc Welding (Consumable Insert) of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ ~~3/4~~ in. ~~(19 mm)~~ Thick, INMs1 and ER70S-2, As-Welded or PWHT Condition, Primarily Pipe Application.	B2.1-1-210-96
Standard Welding Procedure Specification for Gas Tungsten Arc Welding with Consumable Insert Root of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1-1/2 in. ~~(38 mm)~~ Thick, INMs-1, ER70S-2, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-210:2001 (R2012)
FCAW — Flux Core Arc Welding	
Standard Welding Procedure Specification for Self-Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E71T-8, As-Welded Condition.	B2.1-1-018-94 and B2.1-1.018-94R
Standard Welding Procedure Specification for CO2 Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E70T-1 and E71T-1, As-Welded Condition.	B2.1-1-019-94 and B2.1-1-019-94R and B2.1-1-94-AMD1
Standard Welding Procedure Specification for 75% Ar/25% CO2 Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ ~~1-1/2~~ in. ~~(38 mm)~~ Thick, E70T-1M and E71T-1M, As-Welded or PWHT Condition.	B2.1-1-020-94 and B2.1-1-020-94R and B2.1-1-020-94-AMD1
Standard Welding Procedure for Self-Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1/2 in. ~~(13 mm)~~ Thick, E71T-11, As-Welded Condition.	B2.1-1-027:~~1995~~ 1998 and B2.1-1-027-~~1998~~2011
Standard Welding Procedure Specification (SWPS) for Argon Plus 25% Carbon Dioxide Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 and 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E7XT-XM, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-234: 2006

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GMAW – Gas Metal Arc Welding	
Standard Welding Procedure Specification for Argon Plus 25% Carbon Dioxide Shielded Gas Metal Arc Welding (Short Circuiting Transfer Mode) followed by Argon Plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1/S-1, Groups 1 and 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER70S-3, Flat Position Only, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-233: 2006
Standard Welding Procedure Specification for Argon Plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1/S-1, Groups 1 and 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER70S-3, Flat Position Only, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-235: 2006
GTAW/SMAW Combination of Welding Processes	
Standard Welding Procedure Specification for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. (3.2 mm) through 1 ½ in. (38 mm) Thick, ER70S-2 and E7018, As-Welded or PWHT Condition.	B2.1-1-021-94 and B2.1-1-021-94R
Standard Welding Procedure Specification for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ ~~3/4~~ in. ~~(19 mm)~~ Thick, ER70S-2 and E7018, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-209-96
Standard Welding Procedure Specification for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER70S-2 and E7018, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-209-96 (R2007)
Standard Welding Procedure Specification for Gas Tungsten Arc Welding (Consumable Insert) Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½~~3/4~~ in. ~~(19 mm)~~ Thick, INMs1 and E7018, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-211-96
Standard Welding Procedure Specification for Gas Tungsten Arc Welding with Consumable Insert Root Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, INMs-1, ER70S-2, and E7018 As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-211:2001 (R2012)
GMAW/FCAW – Combination of Welding Processes	
Standard Welding Procedure Specification for Argon Plus 25% Carbon Dioxide Shielded Gas Metal Arc Welding (Short Circuiting Transfer Mode) Followed by Argon Plus 25% Carbon Dioxide Shielded Flux Cored Arc Welding of Carbon Steel (m-1/P-1/S-1, Groups 1 and 2), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER70S-3 and EXT-X, As-Welded or PWHT Condition, Primarily Pipe Applications.	B2.1-1-232:2006

Austenitic Stainless Steel — (M-8/P-8/~~S8~~ Materials)

SMAW — Shielded Metal Arc Welding	
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1½ in. ~~(38 mm)~~ Thick, As-Welded Condition.	B2.1-8-023-94
Standard Welding Procedure Specification for Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1½ in. ~~(38 mm)~~ Thick, E3XX-XX, As-Welded Condition, Primarily Pipe Application.	B2.1-8-213-97 and B2.1-8-213-~~96~~97(R2007)

GTAW — Gas Tungsten Arc Welding	
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, As-Welded Condition.	B2.1-8-024-94
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/16 in. ~~(1.6 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER3XX, As-Welded Condition, Primarily Plate and Structural Applications.	B2.1-8-024:2001
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8~~1/16~~ in. ~~(1.6 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER3XX, As-Welded Condition, Primarily Pipe Applications.	B2.1-8-212-97
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/16 in. ~~(1.6 mm)~~ through 1 ½ in. ~~(38 mm)~~ thick, ER3XX, As-Welded Condition, Primarily Pipe Applications.	B2.1-8-212:2001 (R2012)
Standard Welding Procedure Specification for Gas Tungsten Arc Welding With Consumable Insert Root of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, IN3XX and ER3XX As-Welded Condition, Primarily Pipe Applications.	B2.1-8-215:1998 B2.1-8-215:2001 (R2012)
Combination Processes GTAW/SMAW	
Standard Welding Procedure Specification for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, As-Welded Condition.	B2.1-8-025-94
Standard Welding Procedure Specification for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER3XX and E3XX-XX, As-Welded Condition, Primarily Plate and Structural Applications.	B2.1-8-025:2001
Standard Welding Procedure Specification for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER3XX and E3XX-XX, As-Welded Condition, Primarily Pipe Applications.	B2.1-8-214-97
Standard Welding Procedure Specification for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER3XX and E3XX-XX, As-Welded Condition, Primarily Pipe Applications.	B2.1-8-214:2001 (R2012)
Standard Welding Procedure Specification for Gas Tungsten Arc Welding With Consumable Insert Followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ thick, IN3XX, ER3XX, and E3XX-XX As-Welded Condition, Primarily Pipe Application.	B2.1-8-216-1998
Standard Welding Procedure Specification for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, IN3XX, ER3XX, and E3XX-XX As-Welded Condition, Primarily Pipe Applications.	B2.1-8-216:2001 (R2012)

Combination of Carbon Steel (M-1/P-1 Material) To Austenitic Stainless Steel (M-8/P-8 Material)

SMAW — Shielded Metal Arc Welding	
Standard Welding Procedure Specifications for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, E309(L)-15, -16, or -17, As-Welded Condition, Primarily Pipe Applications.	B2.1-1/8-228:2002 (R2013)

GTAW — Gas Tungsten Arc Welding	
Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/16 in. ~~(1.6 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, ER309(L), As-Welded Condition, Primarily Pipe Applications.	B2.1-1/8-227:2002, 2002 AMD1 and (R2013)
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding with Consumable Insert Root of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/16 in. ~~(1.6 mm)~~ through 1½ in. ~~(38 mm)~~ Thick, IN309 and ER309(L), As-Welded Condition, Primarily Pipe Applications.	B2.1-1/8-230:2002, 2002 AMD1 and (R2013)
GTAW/SMAW Combination of Welding Processes	
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1,Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1½ in. ~~(38 mm)~~ Thick, ER309(L) and E309(L)-15, -16, or -17, As-Welded Condition, Primarily Pipe Applications.	B2.1-1/8-229:2002, 2002 AMD1 and (R2013)
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 or 2) to Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 in. ~~(3.2 mm)~~ through 1½ in. ~~(38 mm)~~ Thick, IN3009, ER309, and E309-15, -16, or -17 or IN309, ER309(L) and ER309(L)-15, -16, or -17, As-Welded Condition, Primarily Pipe Applications.	B2.1-1/8-231:2002 (R2015)

Chromium Molybdenum Steel (M-4/P-4 and M-~~5a~~5A/P-5A Materials)

SMAW — Shielded Metal Arc Welding	
Standard Welding Procedure Specifications for Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), E8018-B2, 1/8 in. ~~(3.2 mm)~~ through ~~1 ½~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 1½ in. ~~(38 mm)~~ Thick, PWHT Condition, Primarily Pipe Applications.	B2.1-4-218:1999 (R2009)
Standard Welding Procedure Specifications for Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), E9018-B3, 1/8 in. ~~(3.2 mm)~~ through ~~1 ½~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 1½ in. ~~(38 mm)~~ Thick, PWHT Condition, Primarily Pipe Applications.	B2.1-5A-223:1999 (R2009)
GTAW — Gas Tungsten Arc Welding	
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), ER80S-B2, 1/8 in. ~~(3.2 mm)~~ through ~~1 ½~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ Thick, PWHT Condition, Primarily Pipe Applications.	B2.1-4-217:1999 (R2009)
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding (Consumable Insert Root) of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), E8018-B2, 1/8 in. ~~(3.2 mm)~~ through ~~1 ½~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ Thick, PWHT Condition, IN515 and ER80S-B2, Primarily Pipe Applications.	B2.1-4-220:1999 (R2009)
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), ER90S-B3, 1/8 in. ~~(3.2 mm)~~ through ~~1½~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ Thick, PWHT Condition, Primarily Pipe Applications.	B2.1-5A-222:1999 (R2009)

SECTION 2

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Standard Welding Procedure Specifications for Gas Tungsten Arc Welding (Consumable Insert Root) of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 in. ~~(3.2 mm)~~ through ~~1 1/2~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 3/4 in. ~~(19 mm)~~ Thick, PWHT Condition, IN521 and ER90S-B3, Primarily Pipe Applications.	B2.1-5A-225:1999 (R2009)
Chromium-Molybdenum Steel Processes GTAW/SMAW	
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding (Consumable Insert Root) followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through ~~1 1/2~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, PWHT Condition, IN515, ER80S-B2, and E8018-B2, Primarily Pipe	B2.1-4-221:1999 (R2009)
Standard Welding Procedure Specifications for Gas Tungsten Arc Welded followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 in. ~~(3.2 mm)~~ through ~~1 ½~~1/2 in. ~~(38 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, PWHT Condition, ER90S-B3 and E9018-B3, Primarily Pipe Applications.	B2.1-5A-224:1999 (R2009)
Standard Welding Procedure Specifications for Gas Tungsten Arc Welding (Consumable Insert Root) followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 in. ~~(3.2 mm)~~ through ~~1 ½~~1/2 in. ~~(38 mm)~~ Thick, As- Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, PWHT Condition, IN521, ER90S-B3, and E9018-B3, Primarily Pipe Applications.	B2.1-5A-226:1999 (R2009)
Standard Welding Procedure Specifications (SWPS) for Gas Tungsten Arc Welded followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4A/P-4, Group 1 or 2), 1/8 in. ~~(3.2 mm)~~ through 1/2 in. ~~(13 mm)~~ Thick, As-Welded Condition, 1/8 in. ~~(3.2 mm)~~ through 1 ½ in. ~~(38 mm)~~ Thick, PWHT Condition, ER80S-B2 and E9018-B2, Primarily Pipe Applications.	B2.1-4-219:1999 (R2009)

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2.4 AWS REFERENCE STANDARDS

The following AWS Standards have been adopted by the NBIC for use as referenced below:

a) AWS B2.1 - Specification for Welding Procedure and Performance Qualification

b) AWS B2.1 BMG - Base Metal Grouping for Welding Procedure and Performance Qualification

2.5 HEAT TREATMENT

(19) ### 2.5.1 PREHEATING

a) Preheating may be employed during use of a process to assist in completion of the joint. The need for and the temperature of preheat are dependent on a number of factors such as chemical analysis, degree of restraint of the items being joined, material thickness, and mechanical properties. The procedure specification for the material being joined shall specify the preheat temperature requirements.

b) See minimum temperatures for preheating given in NBIC Part 3, Table 2.5.1 as a general guide. It is cautioned that the preheating temperatures listed may not be the same as those of the original code of construction and do not necessarily ensure satisfactory completion of the joint. Requirements for individual materials within the P-Number listing may have preheating requirements more or less restrictive than this general guide. When reference is made in this section to materials by the ASME designation, P-Number and Group Number, the suggestions of this section apply to the applicable materials of the original code of construction, either ASME or other, which conform by chemical composition

ANSI/AWS B2.1-1-027-95
An American National Standard

Standard
Welding Procedure
Specification (WPS) for

Self-Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 3/4 inch Thick, E71T-11, As-Welded Condition

American Welding Society

ANSI/AWS B2.1-1-027:1998
An American National Standard

Standard Welding Procedure Specification (WPS) for

Self Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1,Group 1 or 2),1/8 through 1/2 inch Thick, E71T-11, As-Welded Condition

American Welding Society

Key Words—Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, manual welding, shielded metal arc welding

ANSI/AWS B2.1-1-206-96 (R2007)
An American National Standard

Approved by the
American National Standards Institute
May 28, 1996

Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, E6010 (Vertical Downhill) Followed by E7018 (Vertical Uphill), As-Welded or PWHT Condition, Primarily Pipe Applications

Prepared by the
American Welding Society (AWS) B2 Committee on Welding Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual shielded metal arc welding with E6010 (vertical downhill) followed by E7018 (vertical uphill). It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words — Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, manual welding, shielded metal arc welding

ANSI/AWS B2.1-1-206-96
An American National Standard

Approved by
American National Standards Institute
May 28, 1996

Standard Welding Procedure Specification (WPS) Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2) 1/8 through 1-1/2 inch Thick, E6010 (Vertical Downhill) Followed by E7018 (Vertical Uphill) As-Welded or PWHT Condition

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by
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Key Words—Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, manual welding, gas tungsten arc welding

ANSI/AWS B2.1-1-207-96 (R2007)
An American National Standard

Approved by the
American National Standards Institute
May 28, 1996

Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, ER70S-2, As-Welded or PWHT Condition, Primarily Pipe Applications

Prepared by the
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Under the Direction of the
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Approved by the
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Key Words — Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, manual welding, gas tungsten arc welding

ANSI/AWS B2.1-1-207-96
An American National Standard

Approved by
American National Standards Institute
June 7, 1996

Standard Welding Procedure Specification (WPS) Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, ER70S-2, As-Welded or PWHT Condition (Primarily Pipe Applications)

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
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Approved by
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Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

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Key Words—Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, manual welding, shielded metal arc welding

ANSI/AWS B2.1-1-208-96 (R2007)
An American National Standard

Approved by the
American National Standards Institute
May 28, 1996

Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, E7018, As-Welded or PWHT Condition, Primarily Pipe Applications

Prepared by the
American Welding Society (AWS) B2 Committee on Welding Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.


American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words — Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, manual welding, shielded metal arc welding

ANSI/AWS B2.1-1-208-96
An American National Standard

Approved by
American National Standards Institute
May 28, 1996

Standard Welding Procedure Specification (WPS) Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2) 1/8 through 1-1/2 inch Thick, E7018 As-Welded or PWHT Condition

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Key Words—Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, gas tungsten arc welding, shielded metal arc welding, manual welding

ANSI/AWS B2.1-1-209-96 (R2007)
An American National Standard

Approved by the
American National Standards Institute
June 7, 1996

Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, ER70S-2 and E7018, As-Welded or PWHT Condition, Primarily Pipe Applications

Prepared by the
American Welding Society (AWS) B2 Committee on Welding Procedure and Performance Qualification

Under the Direction of the
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Approved by the
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Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

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550 N.W. LeJeune Road, Miami, FL 33126

Key Words — Welding Procedure Specification, base metal, allowable joint designs, filler metal, carbon steel, gas tungsten arc welding, shielded metal arc welding, manual welding

ANSI/AWS B2.1-1-209-96
An American National Standard

Approved by
American National Standards Institute
June 7, 1996

Standard Welding Procedure Specification (WPS) Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2) 1/8 through 1-1/2 inch Thick, ER70S-2 and E7018 As-Welded or PWHT Condition

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
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Approved by
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Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

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Key Words — Welding Procedure Specification, base metal, allowable joint designs, consumable insert, filler metal, carbon steel, manual welding, gas tungsten arc welding

ANSI/AWS B2.1-1-210-96
An American National Standard

Approved by
American National Standards Institute
June 7, 1996

Standard Welding Procedure Specification (WPS) Gas Tungsten Arc (Consumable Insert) Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2) 1/8 through 1-1/2 inch Thick, INMs-1 and ER70S-2 As-Welded or PWHT Condition

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding with consumable inserts. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Key Words— Welding Procedure Specification, base metal, allowable joint designs, consumable insert, filler metal, carbon steel, manual welding, gas tungsten arc welding

AWS B2.1-1-210:2001
An American National Standard

Approved by
American National Standards Institute
October 31, 2001

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding with Consumable Insert Root of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, INMs-1 and ER70S-2, As-Welded or PWHT Condition, Primarily Pipe Applications

Supersedes AWS B2.1-1-210:2000

Prepared by
AWS B2 Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding with consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Key Words — Welding Procedure Specification, base metal, allowable joint designs, consumable insert, filler metal, carbon steel, manual welding, gas tungsten arc welding, shielded metal arc welding

ANSI/AWS B2.1-21-96
An American National Standard

Approved by
American National Standards Institute
June 7, 1996

Standard Welding Procedure Specification (WPS) Gas Tungsten Arc (Consumable Insert) Welding Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2) 1/8 through 1-1/2 inch Thick, INMs-1, ER70S-2, and E7018 As-Welded or PWHT Condition

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding with consumable inserts, followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Key Words— Welding Procedure Specification, base metal, allowable joint designs, consumable insert, filler metal, carbon steel, manual welding, gas tungsten arc welding, shielded metal arc welding

AWS B2.1-1-211:2001
An American National Standard

Approved by
American National Standards Institute
October 31, 2001

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, INMs-1, ER70S-2, and E7018, As-Welded or PWHT Condition, Primarily Pipe Applications

Supersedes AWS B2.1-1-211:2000

Prepared by
AWS B2 Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding with consumable insert root, followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

AWS B2.1-4-217:1999 (R2009)
An American National Standard

Approved by the
American National Standards Institute
December 8, 1999
Reaffirmed: May 29, 2009

Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), ER80S-B2, 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 3/4 in. Thick, PWHT Condition, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding

AWS B2.1-4-217:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), ER80S-B2, 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 3/4 in. Thick, PWHT Condition, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

AWS B2.1-4-218:1999 (R2009)
An American National Standard

Approved by the
American National Standards Institute
December 8, 1999
Reaffirmed: May 29, 2009

Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), E8018-B2, 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 1-1/2 in. Thick, PWHT Condition, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 in. through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, filler metal, pipe, chromium-molybdenum steel, manual welding, shielded metal arc welding

AWS B2.1-4-218:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), E8018-B2, 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 1-1/2 in. Thick, PWHT Condition, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 in. through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

AWS B2.1-4-219:1999 (R2009)
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Approved by the
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December 8, 1999
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Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 1-1/2 in. Thick, PWHT Condition, ER80S-B2 and E8018-B2, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 in. through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding followed by manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding, shielded metal arc welding

AWS B2.1-4-219:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 1-1/2 in. Thick, PWHT Condition, ER80S-B2 and E8018-B2, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 in. through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding followed by manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

AWS B2.1-4-220:1999 (R2009)
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Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding (Consumable Insert Root) of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 3/4 in. Thick, PWHT Condition, IN515 and ER80S-B2, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 in. through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, consumable insert, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding

AWS B2.1-4-220:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding (Consumable Insert Root) of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 3/4 in. Thick, PWHT Condition, IN515 and ER80S-B2, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 in. through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

AWS B2.1-4-221:1999 (R2009)
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Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding (Consumable Insert Root) followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 1-1/2 in. Thick, PWHT Condition, IN515, ER80S-B2, and E8018-B2, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root, followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, consumable insert, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding, shielded metal arc welding

AWS B2.1-4-221:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding (Consumable Insert Root) followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-4/P-4, Group 1 or 2), 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 1-1/2 in. Thick, PWHT Condition, IN515, ER80S-B2, and E8018-B2, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root, followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

AWS B2.1-5A-222:1999 (R2009)
An American National Standard

Approved by the
American National Standards Institute
December 8, 1999
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Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), ER90S-B3, 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 3/4 in. Thick, PWHT Condition, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding

AWS B2.1-5A-222:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), ER90S-B3, 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 3/4 in. Thick, PWHT Condition, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

AWS B2.1-5A-223:1999 (R2009)
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Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), E9018-B3, 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 1-1/2 in. Thick, PWHT Condition, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, filler metal, pipe, chromium-molybdenum steel, manual welding, shielded metal arc welding

AWS B2.1-5A-223:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), E9018-B3, 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 1-1/2 in. Thick, PWHT Condition, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

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Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 1-1/2 in. Thick, PWHT Condition, ER90S-B3 and E9018-B3, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding followed by manual shielded arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding, shielded metal arc welding

AWS B2.1-5A-224:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 1-1/2 in. Thick, PWHT Condition, ER90S-B3 and E9018-B3, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding followed by manual shielded arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

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Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding (Consumable Insert Root) of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 3/4 in. Thick, PWHT Condition, IN521 and ER90S-B3, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, consumable insert, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding

AWS B2.1-5A-225:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding (Consumable Insert Root) of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 3/4 in. Thick, PWHT Condition, IN521 and ER90S-B3, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 through 3/4 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

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Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding (Consumable Insert Root) followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 through 1/2 in. Thick, As-Welded Condition; 1/8 through 1-1/2 in. Thick, PWHT Condition, IN521, ER90S-B3, and E9018-B3, Primarily Pipe Applications

1st Edition

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition; or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root, followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This standard welding procedure specification (SWPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words—Welding Procedure Specification, WPS, base metal, allowable joint designs, consumable insert, filler metal, pipe, chromium-molybdenum steel, manual welding, gas tungsten arc welding, shielded metal arc welding

AWS B2.1-5A-226:1999
An American National Standard

Approved by
American National Standards Institute
December 8, 1999

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding (Consumable Insert Root) followed by Shielded Metal Arc Welding of Chromium-Molybdenum Steel (M-5A/P-5A), 1/8 through 1/2 in. Thick, As-Welded Condition, 1/8 through 1-1/2 in. Thick, PWHT Condition, IN521, ER90S-B3, and E9018-B3, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for chromium-molybdenum steel in the thickness range of 1/8 through 1/2 in. in the as-welded condition, or 1/8 through 1-1/2 in. in the postweld heat treated (PWHT) condition, using manual gas tungsten arc welding with a consumable insert root, followed by shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove welds. This welding procedure specification (WPS) was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Key Words — Welding Procedure Specification, base metal, allowable joint designs, filler metal, austenitic stainless steel, manual welding, gas tungsten arc welding

ANSI/AWS B2.1-8-212-97
An American National Standard

Approved by
American National Standards Institute
March 20, 1997

Standard Welding Procedure Specification (WPS) Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1) 1/8 through 1-1/2 inch Thick, ER3XX As-Welded Condition, Primarily Pipe Applications

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for austenitic stainless steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Key Words— Welding Procedure Specification, base metal, allowable joint designs, filler metal, austenitic stainless steel, manual welding, gas tungsten arc welding

AWS B2.1-8-212:2001
An American National Standard

Approved by
American National Standards Institute
October 31, 2001

Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/16 through 1-1/2 inch Thick, ER3XX, As-Welded Condition, Primarily Pipe Applications

Supersedes AWS B2.1-8-212:2000

Prepared by
AWS B2 Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for austenitic stainless steel in the thickness range of 1/16 through 1-1/2 inch, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Key Words—Welding Procedure Specification, base metal, allowable joint designs, filler metal, austenitic stainless steel, manual welding, shielded metal arc welding

ANSI/AWS B2.1-8-213-97 (R2007)
An American National Standard

Approved by the
American National Standards Institute
March 20, 1997

Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 through 1-1/2 inch Thick, E3XX-XX, As-Welded Condition, Primarily Pipe Applications

Prepared by the
American Welding Society (AWS) B2 Committee on Welding Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard contains the essential welding variables for austenitic stainless steel in the thickness range of 1/8 through 1-1/2 inch, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Key Words — Welding Procedure Specification, base metal, allowable joint designs, filler metal, austenitic stainless steel, manual welding, shielded metal arc welding

ANSI/AWS B2.1-8-213-97
An American National Standard

Approved by
American National Standards Institute
March 20, 1997

Standard Welding Procedure Specification (WPS) Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 through 1-1/2 inch Thick, E3XX-XX, As-Welded Condition (Primary Pipe Applications)

Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for austenitic stainless steel in the thickness range of 1/8 through 1-1/2 inch, using manual shielded metal arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for pipe applications.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Item 19-32: NBIC Part 3, 3.3.2 and 3.4.4
Submitted by: Paul Shanks paul.shanks@onecis.com

Explanation of Need: When heater treaters and some other similar equipment is constructed in accordance with section VIII div.1 an item called a fire tube is often removable (bolted) and should be part of the code boundary. In use these items are consumables and are replaced often with items not bearing the code markings or manufactured to code practices. This practice places the users and public in jeopardy and should be curtailed.

Background Information: ASME VIII Div.1 allows for the code boundary to terminate at a flange face only when connecting to external piping or other code items, if a code fire tube is replace with a none code item the ASME construction code has been violated and the potential for harm is increased. Please be aware that ASME has a task group focused on clarifying the requirements for fire tubes. https://www.glossary.oilfield.slb.com/en/Terms/h/heater_treater.aspx

Proposed Text Changes: see following pages

3.3.2 ROUTINE REPAIRS

a) Routine repairs are repairs for which the requirements for in-process involvement by the Inspector and stamping by the "R" Certificate Holder may be waived as determined appropriate by the Jurisdiction and the Inspector. All other applicable requirements of this code shall be met. Prior to performing routine repairs, the "R" Certificate Holder should determine that routine repairs are acceptable to the Jurisdiction where the pressure-retaining item is installed;

b) The Inspector, with the knowledge and understanding of jurisdictional requirements, shall be responsible for meeting jurisdictional requirements and the requirements of this code;

c) The "R" Certificate Holder's Quality System Program shall describe the process for identifying, controlling, and implementing routine repairs. Routine repairs shall be documented on Form R-1 with this statement in the Remarks section: "Routine Repair";

d) Alternative welding methods without posteweld heat treatment as described in NBIC Part 3, 2.5.3 shall not be used for routine repairs.

e) The following repairs may be considered as routine repairs and shall be limited to these categories:

1) Welded repairs or replacements of valves, fittings, tubes, or pipes NPS 5 (DN 125) in diameter and smaller, or sections thereof, where neither postweld heat treatment nor NDE other than visual is required by the original code of construction. This includes their attachments such as clips, lugs, skirts, etc., but does not include nozzles to pressure-retaining items;

2) The addition or repair of nonload bearing attachments to pressure-retaining items where postweld heat treatment is not required;

3) Weld buildup of wasted areas in heads, shells, flanges and fittings not exceeding an area of 100 in.2 (64,520 mm2) or a thickness of 25% of nominal wall thickness or 1/2 in. (13 mm), whichever is less;

4) Corrosion resistance weld overlay not exceeding 100 in.2 (64,520 mm2);

5) Seal welding a mechanical connection for leak tightness where by-design, the pressure retaining capability is not dependent on the weld for strength and requires no postweld heat treatment; and

6)The replacement (without welding) of a fire-tube with another physically identical item which bears the required code part stamp.

3.4.4 EXAMPLES OF ALTERATIONS

a) An increase in the maximum allowable working pressure (internal or external) or temperature of a pressure-retaining item regardless of whether or not a physical change was made to the pressure-retaining item;

b) A decrease in the minimum temperature;

c) The addition of new nozzles or openings in a boiler or pressure vessel except those classified as repairs;

d) A change in the dimensions or contour of a pressure-retaining item;

e) In a boiler, an increase in the heating surface or steaming capacity as described on the original Manufacturer's Data Report;

f) The addition of a pressurized jacket to a pressure vessel;

g) Except as permitted in NBIC Part 3, 3.3.3 s); replacement of a pressure retaining part in a pressure retaining item with a material of different allowable stress or nominal composition from that used in the original design;

h) The addition of a bracket or an increase in loading on an existing bracket that affects the design of the pressure-retaining item to which it is attached;

i) The replacement of a pressure relieving device (PRD) as a result of work completed on a pressure-retaining item (PRI) that changes the resultant capacity to exceed the minimum required relieving capacity (MRRC) required by the original code of construction as described on the original Manufacturer's Data Report.

j) For plate heat exchangers, in addition to the applicable examples of alterations above, the following changes from what is listed on the MDR or described on the Original Equipment Manufacturer's (OEM)-drawing:

1) For heat transfer plates:
    a. A change in material grade or nominal thickness;
    b. A reduction in number beyond any minimum, or when no minimum is specified;
    c. An increase in number beyond any maximum, or when no maximum is specified;
    d. A change in model type;
2) Any change in material whether described at 3.3.3 s) or as described at 3.4.4 g):
    a. A change in connection bolt or frame compression bolt diameter or material grade;

k) Performing postweld heat treatment where none was originally performed on the pressure retaining item;

l) The installation of a welded leak box; and

m)The replacement of a fire-tube with another which is either not identical or not supplied with code part stamping or requires welding activities.

Item 19-43

6/11/2019

Request for NBIC Part 3, Section 1.6 Revisions

Purpose	Update the edition of ISO/IEC-17025 to include 2017
Scope:	References to "ISO/IEC-17025:2005" need to be changed to include "ISO/IEC-17025:2017" to align with ASME Section III requirements in the following paragraphs: 1.6.6.2 m) 1), 1.6.6.2 m) 4) a), 1.6.6.2 m) 5) a), 1.6.7.2 m) 1), 1.6.7.2 m) 4) a), 1.6.7.2 m) 5) a), 1.6.8.2 m) 1), 1.6.8.2 m) 4) a), 1.6.8.2 m) 5) a)
Background	Based on Interp. 19-44: Many, if not all calibration labs are already accredited to ISO/IEC 17025:2017 and will be required to by 2020. No lab will bother accreditation to 2005 after that, so finding a calibration house will be difficult. Interpretation Item 19-44 intends to allow the 2017 edition of ISO/IEC-17025 to be used currently, however this Action Item (19-43 intends to correct the verbiage in the 2021 Edition of the NBIC.
Proposed Revision	See page 2 for proposed revisions. See pages 3-5 for 2019 ASME Sect III, NCA references.

1.6.6.2, 1.6.7.2, and 1.6.8.2 QUALITY PROGRAM ELEMENTS

m) Control of Measuring and Test Equipment

The "NR" Certificate Holder may utilize calibration and test activities performed by subcontractors when surveys and audits are performed. As an alternative to performing a survey and audit for procuring Laboratory Calibration and Test Services, the "NR" Certificate Holder as documented in their Quality Program may accept accreditation of an International Calibration and Test Laboratory Services by the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) provided this alternative method is described in the "NR" Certificate Holder's Quality Program and the following requirements are met:

1) The "NR" Certificate Holder shall review and document verification that the supplier of calibration or test services was accredited by an accredited body recognized by the ILAC MRA encompassing ISO/IEC-17025:2005 or 2017, "General Requirements for the Competence of Testing and Calibration Laboratories";

2) For procurement of calibration services, the published scope of accreditation for the calibration lab-oratory covers the needed measurement parameters, ranges and uncertainties.

3) For procurement of testing services, the published scope of accreditation for the test laboratory covers the needed testing services including test methodology and tolerances/uncertainty.

4) The "NR" Certificate Holder's purchase documents shall include:

   a. Service provided shall be in accordance with their accredited ISO/IEC-17025:2005 or 2017 program and scope of accreditation;

   b. As-found calibration data shall be reported in the certificate of calibration when items are found to be out-of-calibration;

   c. Standards used to perform calibration shall be identified in the certificate of calibration;

   d. Notification of any condition that adversely impacts the laboratories ability to maintain the scope of accreditation;

   e. Any additional technical and/or quality requirements, as necessary, which may include tolerances, accuracies, ranges, and standards;

   f. Service suppliers shall not subcontract services to any other supplier.

5) The "NR" Certificate Holder shall upon receipt inspection, validate that the laboratory documentation certifies that:

   a. Services provided by the laboratory has been performed in accordance with their ISO/IEC-17025:2005 or 2017 program and performed within their scope; and

   b. Purchase order requirements have been met.

n) Handling, Storage and Shipping

From 2019 ASME Section 3, NCA:

LIST OF CHANGES IN RECORD NUMBER ORDER

Record Number	Change
11-1037	Revised Table NCA-3200-1, Document Distribution for Division 2 Construction.
11-2161	Added new definition "Certified Design Report Summary."
14-315	Revised Table NCA-7100-2 for TR-3 and TR-4 to the following: *(a)* TR-3 "2008 through 2017." *(b)* TR-4 "2008a through 2017."
15-2538	Revised editorially NCA-4134.17(d) to add lifetime record no. 20.
15-2539	Added reference to NC- and ND-6114.2(d) to NCA-8322.1(d).
16-363	Revised Table NCA-8100-1 to address appurtenances. Revised Form N-2 to address the certification of Nuclear parts and established a new Form N-2A for the certification of Nuclear appurtenances.
16-1827	Revised NCA-3820(c).
16-2116	Updated wording of NCA-3360(b) to show that the Certifying Engineer certifies the Construction Specification and Design Drawings on behalf of the Designer.
16-2145	Revised NCA-1274 to clarify that the inlet and outlet parts of rupture disk holders are to be considered as material, part, or appurtenance.
16-2204	Revised Table NCA-7100-2.
16-2964	Added the 2006 Edition of SNT-TC-1A as an acceptable Edition within Table NCA-7100-2, Table NCA-7100-3, and Table WA-7100-2.
17-650	Restructured and renumbered NCA-3551. Clarified that date of certification is the date(s) the Design Reports are certified with an alternative of the date the Summary is Certified.
17-1111	Revised NCA-3761(a).
17-2058	Revised Table NCA-7100-1 to update the referenced standards.
17-2149	Added reference to NCA-3127 in NCA-4134.7(g).
17-2210	Errata correction. See Summary of Changes for details.
17-2214	Errata correction. See Summary of Changes for details.
17-2295	Clarified the recent revision to the Forewords for Section III and Section XI to properly address all items that have nuclear rules addressing their structural integrity.
17-3081	Changed "Registered Professional Engineer" to "Certifying Engineer" in NCA-3784.2 and NCA-3784.5.
18-340	Revised Table NCA-7100-2 to reference NQA-1-2015. Revised NCA-4100 to clarify the use of NQA-1 Part II and the use of commercial grade dedication for software.
18-355	Added ISO/IEC 17025 reference editions 2005 and 2017 to Tables NCA-7100-2 and NCA-7100-3. Deleted 2005 reference edition from ISO/IEC 17025 in NCA-3126, NCA-3127, NCA-4354.3, NCA-4255.3(c), and NCA-4255.3(d).
18-402	Revised Table NCA-7100-3 to delete two references (PTI M50.1 and AASHTO LRFD Bridge Design Specifications) that are no longer needed based on changes approved in Record 17-718.
18-955	Errata correction. See Summary of Changes for details.
18-1446	Revised NCA-5125(i).
18-1669	Revised Table NCA-7100-3 to update the applicable reference editions.
18-2668	Revised Table NCA-7100-3.

Table NCA-7100-2
Standards and Specifications Referenced in Division 1

(19)

Standard ID	Published Title	Section III Referenced Edition
The American Society of Mechanical Engineers (ASME)		
ASME NQA-1	Quality Assurance Requirements for Nuclear Facility Applications	2015
ASME PTC 25	Pressure Relief Devices	2014
ASME QAI-1	Qualifications for Authorized Inspection	Latest
American Society for Nondestructive Testing (ASNT)		
SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing	2006, 2011
American Society for Testing and Materials (ASTM)		
ASTM A275	Standard Test Method for Magnetic Particle Examination of Steel Forgings	2009a
ASTM A673	Standard Specification for Sampling Procedure for Impact Testing of Structural Steel	1977
ASTM E8	Standard Test Methods for Tension Testing of Metallic Materials	1969 through 2015
ASTM E23	Standard Test Methods for Notched Bar Impact Testing of Metallic Materials	2002a
ASTM E94	Standard Guide for Radiographic Examination	1977
ASTM E142	Standard Method for Controlling Quality of Radiographic Testing (Discontinued 2000, Replaced by ASTM E94)	1977
ASTM E185	Standard Practice for Design of Surveillance Programs for Light-Water Moderated Nuclear Power Reactor Vessels	1982
ASTM E186	Standard Reference Radiographs for Heavy-Walled [2 in. to 4½ in. (51 mm to 114 mm)] Steel Castings	1967, 1973, 1975, 1979, 2010
ASTM E208	Standard Test Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels	1991
ASTM E213	Standards Practice for Ultrasonic Examination of Metal Pipe and Tubing	1979
ASTM E280	Standard Reference Radiographs for Heavy-Walled [4½ in. to 12 in. (114 mm to 305 mm)] Steel Castings	1968, 1972, 1975, 2010
ASTM E426	Standard Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Titanium, Austenitic Stainless Steel and Similar Alloys	1988
ASTM E446	Standard Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness	1972, 1975, 1978, 2010
ASTM E571	Standard Practice for Electromagnetic (Eddy-Current) Examination of Nickel and Nickel Alloy Tubular Products	1982 (R1988)
ASTM E606	Standard Practice for Strain-Controlled Fatigue Testing	Latest
ASTM E883	Standard Guide for Reflected-Light Photomicrography	2002
ASTM E1921	Standard Test Method for the Determination of Reference Temperature, T_o, for Ferritic Steels in the Transition Range	2016
ASTM F788	Standard Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series	2013
ASTM F812	Standard Specification for Surface Discontinuities of Nuts, Inch and Metric Series	2012
American Welding Society (AWS)		
AWS A4.2	Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel	1991
ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories	2005, 2017
Plastics Pipe Institute (PPI)		
PPI TR-3	Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Hydrostatic Design Stresses (HDS), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe	2008 through 2017
PPI TR-4	PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe	2008a through 2017

Table NCA-7100-3
Standards and Specifications Referenced in Division 2 (Cont'd)

Standard ID	Published Title	Section III Referenced Edition
International Organization for Standardization		
ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories	2005, 2017
Post-Tensioning Institute (PTI)		
PTI M10.2	Specification for Unbonded Single Strand Tendons	2017
U.S. Army Corps of Engineers		
CRD-C 36	Method of Test for Thermal Diffusivity of Concrete	1973
CRD-C 39	Test Method for Coefficient of Linear Thermal Expansion of Concrete	1981
CRD-C 44	Method for Calculation of Thermal Conductivity of Concrete	1963

Item Number: 19-50	NBIC Location: Part 3, 3.3.4.3 e) 3) l)	Attachment Page 89
General Description: Revising Part 3, 3.3.4.3 e) 3) l) to match rules of ASME PCC-2 **Subgroup:** Repairs and Alterations **Task Group:** None assigned **Explanation of Need:** There are a couple of typos in the paragraph as it does not match up with the rules of ASME PCC-2 for External Weld Metal Buildup.		

David Martinez (PM)

NBIC Part 3

3.3.4.3 WASTED AREAS

e) External Weld Metal Buildup

3) External weld buildup shall be applied in accordance with the following requirements:

l. For each repair, the maximum dimension (L, length along axis) compensated by a circular or oval weld buildup shall not exceed the lesser of 1/4 the nominal outside diameter ~~or~~ of the component ~~of~~ or 8 in. (200 mm). The length of a rectangular patch is not limited;

ASME PCC-2–2018

Article 202 External Weld Buildup to Repair Internal Thinning

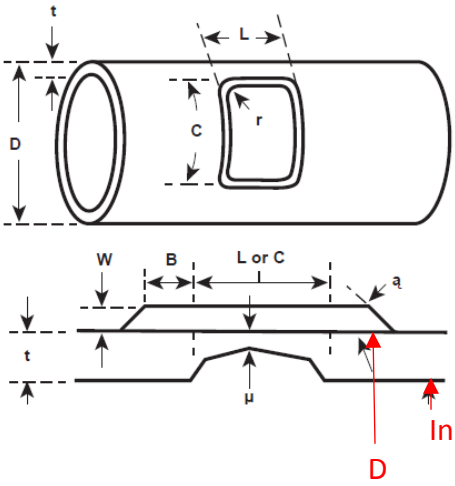
202-3.1.3.1 Prequalified Design. Application of weld buildups on straight piping sections and associated welds to correct limited degradation may be considered a *prequalified design* and shall be exempt from an engineered design qualification or a proof test qualification if all of the following conditions are met:

(f) For each repair, the maximum dimension (*L*, length along axis) compensated by a circular, oval, or rectangular buildup does not exceed the lesser of one-half the nominal outside diameter of the pressure component or 200 mm (8 in.).

Issue: Is the maximum dimension (*L,* length along axis) not to exceed the lessor of ¼ or ½ the nomimal outside diameter of the pressure component, or 8”?

NBIC Part 3

FIGURE 3.3.4.3-c
EXTERNAL OVERLAY TERMS AND DEFINITIONS



L = length of area to be repaired along the axis of the component

C = length of area to be repaired along outside circumference of the component

W = the completed thickness of the overlay

ą = the angle between the component and the overlay (maximum 45°)

B = 3/4 $(Rt)^{0.5}$ minimum

R = nominal outside radius of the component

D = the nominal outside diameter of the component

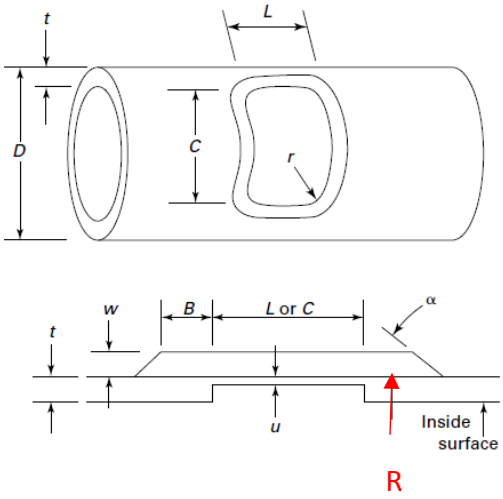
t = nominal wall thickness of the component

μ = remaining wall thickness of the component shall be 1/16 in. (1.6 mm) or greater

r = minimum radius, not less than the overlay thickness

ASME PCC-2

Figure 202-3-1 Weld Buildup Profile



202-3.1.2.2 Extension Beyond Base Metal. The weld shall extend, at full thickness, a minimum distance, B, in each direction beyond the affected base metal (unless otherwise justified by a fitness for service assessment).

$$B = {}^{3}\!/_{4}\sqrt{Rt_{nom}}$$

where

R = outer radius of the component, or $\frac{1}{2}D$

t_{nom} = nominal wall thickness of the component

Item 19-52 - Hellman – 6/25/19

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~~.~~, provided that all other requirements of this section are met.

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* (2006 edition), or ANSI/ASNT CP-189, *Standard for Qualification and Certification of Nondestructive Testing Personnel* (2006 edition), shall be used as a guideline for employers to establish their written practice. Provisions for training, experience, qualification, and certification of NDE personnel shall be described in the "R" Certificate Holder's written quality system.

Item 19-55

7/9/2019

Request for NBIC Part 3, Section 4 Revision

Purpose	To change the maximum test pressure requirement when performing liquid pressure tests of repair and alteration activities. This proposal was initially part of item NB16-2603, which proposed changes to 4.4.1 a) 1) and 4.4.2 a) 1). However, only the changes to 4.4.1 a) 1) made it into the 2019 NBIC.
Scope:	To revise paragraph 4.4.2 a) 1) of the NBIC Part 3 to require maximum liquid test pressure be in accordance with the original construction Code.
Background	For liquid pressure testing of repairs and alterations, paragraph 4.4.2(a)(1) of the NBIC Part 3 require a maximum test pressure of 150% of the maximum allowable working pressure (MAWP) stamped on the pressure retaining item, as adjusted for temperature. However, repairs and alterations of DOT vessels are required to be tested at a minimum of 150% of design pressure which makes it virtually impossible to comply with the NBIC maximum requirement. Further, repairs and alterations to DOT ammonia transport vessels made from UHT materials require a test pressure of 200% of design pressure (49CFR 180.413(b)(6) and 177.337-16). Obviously, this is in violation of the NBIC Part 3. Paragraph UG-99 of ASME Section VIII, Div. 1 does not not specify a maximum test pressure for hydrostatic tests. Therefore, it is p[proposed that paragraph 4.4.2(a)(1) be revised to remove the maximum test pressure of 150% of MAWP. The paragraph will have new wording (similar to existing paragraph 4.4.1(b) for pneumatic testing) which states test pressure shall not to exceed the maximum test pressure of the original code of construction.
Proposed Revision	See page 2 for proposed revisions.

EXISTING PARAGRAPH 4.4.2(a)(1) of NBIC Part 3

4.4.2 TEST OR EXAMINATION METHODS APPLICABLE TO ALTERATIONS

Based on the nature and scope of the alterations activity, one or a combination of the following examination and test methods shall be applied to alterations and replacement parts used in alterations.

a) Liquid Pressure Test

Pressure testing of alterations shall meet the following requirements:

1) A pressure test as required by the original code of construction shall be conducted. ~~The test pressure shall not exceed 150% of the maximum allowable working pressure (MAWP) stamped on the pressure retaining item, as adjusted for temperature.~~ When the original test pressure included consideration of corrosion allowance, the test pressure may be further adjusted based on the remaining corrosion allowance. The pressure test for replacement parts may be performed at the point of manufacture or point of installation;

PROPOSAL OF REVISION TO 4.4.2(a)(1)

1) A pressure test as required by the original code of construction shall be conducted. The test pressure shall not exceed the maximum liquid test pressure of the original code of construction. When the original test [pressure included consideration of corrosion allowance, the test pressure may be further adjusted based on the remaining corrosion allowance. The pressure test for replacement parts may be performed at the point of manufacture or point of installation.