

**ASME BOILER AND PRESSURE VESSEL CODE
AN AMERICAN NATIONAL STANDARD
ANSI/ASME BPV-IX**

SECTION IX

**Qualification Standard for Welding and
Brazing Procedures, Welders, Brazers,
and Welding and Brazing Operators**

1977 EDITION

JULY 1, 1977



**ASME BOILER AND PRESSURE VESSEL COMMITTEE
SUBCOMMITTEE ON WELDING**

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
United Engineering Center 345 East 47th Street New York, N.Y. 10017

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Date of Issue — July 1, 1977
(Includes all Addenda dated December 1976 and earlier)

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Library of Congress Catalog Card Number: 56-3934
Printed in the United States of America

Adopted by the Council of The American Society of Mechanical Engineers, 1914.
Revised 1940, 1941, 1943, 1946, 1949, 1952, 1953, 1956, 1959, 1962, 1965, 1968, 1971, 1974, 1977

1977 ASME BOILER AND PRESSURE VESSEL CODE

An American National Standard

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*Available in bound and loose-leaf versions. Either version may be used for ASME Certification.

Code Cases

The Boiler and Pressure Vessel Committee meets regularly to consider proposed additions and revisions to the Code, and to formulate Cases to clarify the intent of existing requirements or provide, when the need is urgent, rules for materials or constructions not covered by existing Code rules. Those Cases which have been adopted appear in one or both of the 1977 Code Cases books—(1) Boilers and Pressure Vessels and (2) Nuclear Components. Supplements will be sent automatically to the purchasers of one or both of the Code Cases books up to the publication of the 1980 Edition.

Addenda

Colored-sheet Addenda, which include additions and revisions to individual Sections of the Code, are published twice a year and will be sent automatically to purchasers of the applicable Sections up to the publication of the 1980 Code. Purchasers of the bound versions of the Sections will receive bound Addenda. Purchasers of the loose-leaf versions of the Sections will receive replacement pages.

Addenda Color Legend

Pink	Summer 1977	Blue	Winter 1978
Green	Winter 1977	Salmon	Summer 1979
Yellow	Summer 1978	Gray	Winter 1979

FOREWORD

The American Society of Mechanical Engineers set up a committee in 1911 for the purpose of formulating standard rules for the construction of steam boilers and other pressure vessels. This committee is now called the Boiler and Pressure Vessel Committee.

The Committee's function is to establish rules of safety governing the design, fabrication, and inspection during construction of boilers and pressure vessels, and to interpret these rules when questions arise regarding their intent. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property and to provide a margin for deterioration in service so as to give a reasonably long safe period of usefulness. Advancements in design and material and the evidence of experience have been recognized.

The Boiler and Pressure Vessel Committee deals with the care and inspection of boilers and pressure vessels in service only to the extent of providing suggested rules of good practice as an aid to owners and their inspectors.

The rules established by the Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design or as limiting in any way the manufacturer's freedom to choose any method of design or any form of construction that conforms to the Code rules.

The Boiler and Pressure Vessel Committee meets regularly to consider requests for interpretations and revisions of the rules, and to develop new rules as dictated by technological development. Inquiries must be addressed to the Secretary in writing and must give full particulars in order to receive consideration and a written interpretation. Proposed revisions to the Code resulting from inquiries will be presented to the Main Committee for appropriate action. The action of the Main Committee becomes effective only after confirmation by letter ballot of the Committee and approval by the Council of the Society.

Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute and published in *Mechanical Engineering* to invite comments from all interested persons. After the allotted time for public review and final approval by ASME Council, revisions are published semi-annually in Addenda to the Code.

Code Cases may be used in the construction of components to be stamped with the ASME Code symbol beginning with the date of their approval by the ASME Council.

After Code revisions are approved by Council they may be used beginning with the date of issuance shown on the Addenda. Revisions become mandatory as minimum requirements six months after such date of issuance, except for boilers or pressure vessels constructed prior to the end of the six-month period.

Manufacturers and users of components are cautioned against making use of revisions and Cases that are less restrictive than former requirements without having assurance that they have been accepted by the proper authorities in the jurisdiction where the component is to be installed.

Each state and municipality in the United States and each province in the Dominion of Canada that adopts or accepts one or more Sections of the Boiler and Pressure Vessel Code is invited to appoint a representative to act on the Conference Committee to the Boiler and Pressure Vessel Committee. Since the members of the Conference Committee are in active contact with the administration and enforcement of the rules, the requirements for inspection in this Code correspond with those in effect in their respective jurisdictions. The required qualifications for an Authorized Inspector or an Authorized Nuclear Inspector under these rules may be obtained from the administrative authority of any state, municipality, or province which has adopted these rules.

The Boiler and Pressure Vessel Committee in the formulation of its rules and in the establishment of maximum design and operating pressures considers materials, construction, method of fabrication, inspection, and safety devices. Permission may be granted to regulatory bodies and organizations publishing safety standards to use a complete Section of the Code by reference. If usage of a Section, such as Section IX, involves exceptions, omissions, or changes in provisions, the intent of the Code might not be attained.

Where a state or other regulatory body, in the printing of any Section of the Boiler and Pressure Vessel Code, makes additions or omissions, it is recommended that such changes be clearly indicated.

The National Board of Boiler and Pressure Vessel Inspectors is composed of chief inspectors of states and

municipalities in the United States and of provinces in the Dominion of Canada that have adopted the Boiler and Pressure Vessel Code. This Board, since its organization in 1919, has functioned to uniformly administer and enforce the rules of the Boiler and Pressure Vessel Code. The cooperation of that organization with the Boiler and Pressure Vessel Committee has been extremely helpful. Its function is clearly recognized and, as a result, inquiries received which bear on the administration or application of the rules are referred directly to the National Board. Such handling of this type of inquiry not only simplifies the work of the Boiler and Pressure Vessel Committee, but action on the problem for the inquirer is thereby expedited. Where an inquiry is neither clearly an interpretation of the rules nor a problem of application or administration, it may be considered both by the Boiler and Pressure Vessel Committee and the National Board.

It should be pointed out that the state or municipality where the Boiler and Pressure Vessel Code has been made effective has definite jurisdiction over any particular installation. Inquiries dealing with problems of local character should be directed to the proper authority of such state or municipality. Such authority may, if there is any question or doubt as to the proper interpretation, refer the question to the Boiler and Pressure Vessel Committee.

The Specifications for base materials given in Section II, Parts A and B, are identical with or similar to those of The American Society for Testing and Materials. The Specifications for welding materials given in Section II, Part C, are identical with or similar to those of the

American Welding Society. Use of the materials described in these Specifications is covered by the rules in one or more Sections of the Boiler and Pressure Vessel Code. All materials allowed by these various Sections and used for construction within the scope of their rules shall be furnished in accordance with ASME Materials Specifications contained in Section II except where otherwise provided in Code Cases or in the applicable Section of the Code. Materials covered by these Specifications are acceptable for use in items covered by the Code Sections only to the degree indicated in the applicable Section. Materials for Code use should preferably be ordered, produced, and documented on this basis; however, material produced under an ASTM Specification may be used in lieu of the corresponding ASME Specification, provided that the requirements of the ASTM Specification are identical (excluding editorial differences) or more stringent than the ASME Specification for the Grade, Class, or Type produced and provided that the material is concerned is complying with the ASTM Specification. Material produced to an ASTM specification with requirements different from the requirements of the corresponding ASME Specification may also be used in accordance with the above, provided the material manufacturer or vessel manufacturer certifies with evidence acceptable to the Authorized Inspector or Authorized Nuclear Inspector that the corresponding ASME Specification requirements have been met. Material produced to an ASME or ASTM Material Specification is not limited as to country of origin.

STATEMENT OF POLICY ON THE USE OF CODE SYMBOLS AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use Code Symbols for marking items or constructions which have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the Code Symbols for the benefit of the users, the enforcement jurisdictions, and the holders of the symbols who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the symbols, Certificates of Authorization, and reference to Code construction. The American Society of

Mechanical Engineers does not "approve," "certify," "rate," or "endorse" any item, construction, or activity and there shall be no statements or implications which might so indicate. An organization holding a Code Symbol and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities "are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code," or "meet the requirements of the ASME Boiler and Pressure Vessel Code."

The ASME Symbol shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of a Code Symbol who may also use the facsimile in advertising to show that clearly specified items will carry the symbol. General usage is permitted only when all of a manufacturer's items are constructed under the Rules.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the official Code Symbol Stamp described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the various

Code Symbols shall not be used on any item which is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME which tend to imply that all Code requirements have been met when in fact they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

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J. B. Mahoney	B. K. Thornley, Jr.
J. M. McLaughlin	H. W. Wahl
M. J. Morris	J. L. Walker
R. A. Muenow (w/o vote)	Z. Zudans
A. J. Neylan	

Subgroup on General Requirements (SC III & 3C)

H. F. Dobel, <i>Co-Chairman</i>	F. W. Catudal
J. M. McLaughlin, <i>Co-Chairman</i>	E. F. Gerwin
C. W. Allison	W. S. Gibbons, Jr.
J. N. Baysden	R. E. Keever
R. J. Bosnak	F. N. Moschini
F. W. Brady	J. C. Quinn
	W. Schultheis

Working Group on Quality Assurance (SG-GR) (SC III & 3C)

W. S. Gibbons, Jr., <i>Co-Chairman</i>	R. E. Jagger
R. E. Keever, <i>Co-Chairman</i>	F. W. Joyce
W. C. Buskey, <i>Secretary</i>	R. D. Kulchak
C. W. Allison	J. R. Lenardson
A. Breed	H. A. Manning
T. M. Brown	M. J. Meyer
J. Bosco	J. Milhoan
R. B. Bremmer	W. J. Miller
J. B. Conyers	W. M. Morrison
R. Davis	C. C. Simpson
R. H. Jacobs	G. M. Tolson

Working Group on Duties and Responsibilities (SG-GR) (SC III & 3C)

F. W. Brady, <i>Co-Chairman</i>	A. J. Moellenbeck
W. Schultheis, <i>Co-Chairman</i>	M. J. Morris
R. E. Conry	B. D. Rall
C. Glidewell	L. C. Shao
B. D. Hackney	D. W. Sher
N. I. Hyman	A. I. Snyder
L. F. Lapan	A. J. Stefanelli
A. S. Laurenson	L. R. Vancott
W. L. Lowry	D. E. Wainwright

Subgroup on Materials, Constructions, and Examinations (SC-3C)

M. F. Stuchfield, <i>Chairman</i>	R. F. Reedy
J. P. Allen	P. Reinhardt
J. F. Artuso	R. A. Rohrbacher
D. K. Croneberger	J. L. Walker
J. F. Hildebrand	

Working Group on Concrete (SG-M, C & E) (SC-3C)

J. P. Allen, <i>Chairman</i>	R. O. Lane
J. F. Artuso	G. R. Murphy
R. A. Bradshaw	H. G. Protze, Jr.
A. W. Isberner	R. A. Rohrbacher
F. W. Joyce	D. E. Wainwright
G. Karonis	C. H. Willetts

Working Group on Reinforcing and Prestressing Systems (SG-M, C, & E) (SC-3C)

J. L. Walker, <i>Chairman</i>	R. J. Stuart
D. S. Mehta	M. G. Suarez
P. Reinhardt	B. K. Thornley, Jr.
R. G. Smith	

Working Group on Liners (SG-M, C, & E) (SC-3C)

R. F. Reedy, <i>Chairman</i>	F. J. Hildebrand
G. L. Fisher	J. D. Madden
U. I. Gosts	M. F. Stuchfield

Subgroup on Design (SC-3C)

J. D. Stevenson, <i>Chairman</i>	R. E. Koppe
E. G. Burdette	J. B. Mahoney
D. A. Godfrey	A. J. Neylan
G. A. Harstead	M. Schupack
M. J. Holley, Jr.	Z. Zudans
D. C. Jeng	

Working Group on Concrete Reactor Vessels (SG-D) (SC-3C)

A. J. Neylan, <i>Chairman</i>	F. P. Schauer
R. A. Mattson	L. I. Skundric

Working Group on Concrete Containments (SG-D) (SC-3C)

R. E. Koppe, <i>Chairman</i>	R. A. Rettig
N. W. Edwards	B. B. Scott
C. H. Hofmayer	R. E. Shewmaker
P. K. Hsueh	M. A. Vivirito
T. E. Johnson	A. Walser
J. A. Raulinaitis	

Working Group on Component Supports (SG-D) (SC-3C)

J. M. Mahoney, <i>Chairman</i>	R. E. Lipinski
R. G. Benedict	D. S. Mehta
R. W. Brady	F. Moreadith
T. M. Brown	R. S. Orr
D. A. Godfrey	G. S. Shaw
H. Hu	

Working Group on Core Support Structures (SG-D) (SC-3C)

Z. Zudans, <i>Chairman</i>	A. E. Goldman
T. Y. P. Chang	P. A. Stancampiano
A. A. Cline	C. P. Tan
F. V. Fair	G. T. Yahr

Subgroup on Testing and Protection Against Overpressure (SC-3C)

J. R. Janney, <i>Chairman</i>	H. Hu
B. A. Erler	L. F. Wallace
H. T. Hill	

SUBCOMMITTEE ON HEATING BOILERS (SC IV)

S. F. Harrison, <i>Chairman</i>	G. L. Kasparian
E. D. Dow, <i>Vice Chairman</i>	T. H. Milton
G. F. Carlson	G. B. Sims
R. B. Duggan	M. J. Telesmanic
G. E. Fratcher	J. R. Thomson
J. F. Johnston	R. H. Weigel
D. R. Gallup	

Subgroup on Care and Operation of Heating Boilers (SC IV)

M. P. Bragg, <i>Chairman</i>	R. J. Sharp
D. R. Gallup	G. B. Sims
T. H. Milton	J. I. Woodworth

Subgroup on Water Heaters (SC IV)

G. E. Fratcher, <i>Chairman</i>	W. L. Garvin
A. N. Duncan, <i>Secretary</i>	G. R. Lewis
w/o vote	C. V. Moore
P. G. Daugirda	G. B. Sims
E. D. Dow	J. R. Thomson
D. R. Gallup	E. Wenczl

Subgroup on Cast Iron Boilers (SC IV)

E. D. Dow, <i>Chairman</i>	R. J. Sharp
W. L. Garvin	R. H. Weigel
J. F. Johnston	J. I. Woodworth

SUBCOMMITTEE ON NONDESTRUCTIVE EXAMINATION (SC V)

B. W. Bace, <i>Chairman</i>	W. C. Herman
R. C. Hudson, <i>Vice Chairman</i>	E. T. Hughes
A. S. Birks (Alternate for Sattler)	T. Kirk
H. G. Bogart	T. F. Luga
L. J. Chockie	W. C. McGaughey
D. C. Christofferson	J. R. MacKay
B. H. Clark	D. A. Olsson
L. T. Detlor	J. G. Rawlings
F. T. Duba	F. J. Sattler
R. M. Gibson	E. W. Shilling
P. J. Herbert	M. Trevino, G.
	B. L. Whitley

Subgroup on General Requirements (SC V)

R. M. Gibson, <i>Chairman</i>	D. M. Haddon
D. C. Christofferson	D. A. Olsson
B. H. Clark	B. L. Whitley
D. V. Ferree	

Subgroup on Radiography (SC V)

L. T. Detlor, <i>Chairman</i>	R. F. Koenig
D. C. Christofferson	T. F. Luga
W. C. Herman	R. E. Turner

Subgroup on Ultrasonics and Acoustic Emission (SC V)

J. G. Rawlings, <i>Chairman</i>	E. T. Hughes
F. C. Berry	W. C. McGaughey
L. J. Chockie	E. Potter
F. T. Duba	F. J. Sattler
P. J. Herbert	

Subgroup on Surface NDE (MP, LP, Visual, and Eddy Current) (SC V)

H. G. Bogart, <i>Chairman</i>	A. Plauchu
A. S. Birks	E. W. Shilling
T. Kirk	F. H. Watson

SUBCOMMITTEE ON PRESSURE VESSELS (SC VIII)

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J. LeCoff, <i>Vice Chairman</i>	W. L. Garvin
B. W. Bace	R. M. Gibson
R. D. Bonner	J. W. Kime
V. W. Butler	P. E. Loveday
H. F. Colter	C. V. Moore
J. T. Crosby	C. E. Rawlins
B. G. Earnheart	J. F. Sebal
R. A. Ecoff	J. E. Soehrens
J. R. Farr	J. J. Szigety
J. H. Faupel	C. M. Vogrin

Special Working Group on Heat Transfer Equipment (SC VIII)

J. F. Sebal, <i>Chairman</i>	J. H. Kissel
D. E. Bolt	A. Lohmeier
G. Borushko	D. A. Meyer
B. J. Field	I. Mortman
K. A. Gardner	H. C. Rauschenplat
R. L. Harris	V. Rolli
A. M. Impagliazzo	J. E. Soehrens
G. G. Karcher	A. I. Soler

Special Working Group on Layered Vessels (SC VIII)

G. E. Fratcher, <i>Chairman</i>	R. C. Griffin
A. M. Smolen, <i>Secretary</i>	J. LeCoff
F. Abernathy	F. O. Parnkopf
C. E. Allison	R. E. Pechacek
R. A. Ecoff	H. C. Rauschenplat
J. H. Faupel	J. J. Szigety
R. M. Gibson	C. M. Vogrin
N. Gilbert	

Subgroup on General Requirements (SC VIII)

R. D. Bonner, <i>Chairman</i>	D. A. Meyer
P. E. Loveday, <i>Secretary</i>	C. V. Moore
H. F. Colter	C. C. Neely
J. T. Crosby	H. C. Oakley
W. L. Garvin	A. J. Palmer
B. R. Jamieson	W. J. Stuber

Subgroup on Materials (SC VIII)

R. A. Ecoff, <i>Chairman</i>	E. D. Narduzzi
J. W. Kime, <i>Secretary</i>	C. J. Petchel
W. C. Banks	C. E. Rawlins
V. W. Butler	L. E. Spry
J. Gadbut	A. H. Weber

Subgroup on Design (SC VIII)

J. R. Farr, <i>Chairman</i>	G. G. Karcher
R. E. Knoblock, <i>Secretary</i>	J. R. Maison
J. H. Faupel	J. J. Murphy
R. M. Gibson	R. F. O'Neill
R. E. Gleason	J. E. Soehrens
J. A. Hayward	C. M. Vogrin
M. Jawad	

Subgroup on Fabrication and Inspection (SC VIII)

J. J. Szigety, <i>Chairman</i>	G. C. Mathews
R. F. O'Neill, <i>Secretary</i>	H. W. McColly
J. O. Brown	F. O. Parnkopf
B. G. Earnheart	D. H. Simpson
H. B. France	R. J. Sinisi
J. Lang	R. F. Wagner
J. R. Maison	

SUBCOMMITTEE ON WELDING (SC IX)

G. E. Fratcher, <i>Chairman</i>	A. H. Miller
L. J. Christensen, <i>Secretary</i>	J. P. Myers (Alternate for McDonald)
B. L. Alia	A. J. R. Rees
H. Broadbent	R. K. Sager
H. R. Conaway	H. S. Sayre
E. D. Dow	W. K. Scattergood
R. L. Harris	N. G. Schreiner
H. L. Helmbrecht	G. K. Sosnin
M. J. Houle	R. W. Straiton
R. E. Lorentz	R. G. Williams
D. J. McDonald	
J. Mikulak	

SUBCOMMITTEE ON REINFORCED PLASTIC PRESSURE VESSELS (SC X)

B. G. Earnheart, <i>Chairman</i>	A. B. Isham
M. P. Bragg	R. A. Johnson
J. W. Carter	E. M. Kloeblen (w/o vote)
G. E. Fratcher	E. D. Lowthian
S. F. Harrison	H. S. Mauk
J. Hassert	J. R. Vinson
W. D. Humphrey	

SUBCOMMITTEE ON NUCLEAR INSERVICE INSPECTION (SC XI)

L. J. Chockie, <i>Chairman</i>	P. J. Herbert
W. O. Parker, <i>Vice Chairman</i>	W. P. Johnson
O. Hedden, <i>Secretary</i>	L. R. Katz
C. W. Allison	T. D. Keenan (Alternate for Johnson)
D. R. Bartosch (Alternate for Allison)	M. S. Markowicz
A. J. Birkle	R. R. Maccary
S. H. Bush	J. M. Makepeace
F. J. Dodd (Alternate for Ham)	B. J. Milleville (Alternate for Osborne)
O. W. Dodd, Jr.	W. C. Osborne
F. T. Duba	F. A. Warner
L. B. Gross	S. A. Zych
G. J. Hallinan	
W. C. Ham	

Special Working Group on Retention of Records (SC XI)

O. W. Dodd, <i>Chairman</i>	P. J. Krumpas
F. T. Duba	F. A. Warner
W. C. Ham	S. A. Zych

Subgroup on Testing of Pumps and Valves (SC XI)

W. C. Osborne, <i>Chairman</i>	R. A. Krauss
J. C. Major, <i>Secretary</i>	E. R. Kurtz
G. A. Arlotto	L. J. Kuzenski
L. J. Booth	G. H. Martin
L. M. Hausler	B. J. Milleville
G. Kayser, Jr.	K. H. Schafer
W. G. Knecht	B. R. Shelton
R. Koester	

Subgroup on Water Cooled Systems (SC XI)

W. O. Parker, <i>Chairman</i>	O. F. Hedden
L. R. Katz, <i>Secretary</i>	R. C. Holt
A. E. Curtis	J. R. Knoke
D. D. Davis	R. R. Maccary
L. B. Gross	J. M. Makepeace
W. C. Ham	R. W. Smith

Special Working Group on Regulatory Guides (SG-WCS) (SC XI)

A. J. Birkle, <i>Chairman</i>	L. B. Gross
W. M. Clarke	E. J. Parent

Working Group on Evaluation (SG-WCS) (SC XI)

S. H. Bush, <i>Chairman</i>	J. M. Makepeace
W. H. Bamford	J. G. Merkle
C. Y. Cheng	H. S. Palme
W. C. Ham	P. C. Riccardella
J. T. Houstrup	S. Yukawa

Working Group on Nondestructive Examination (SG-WCS) (SC XI)

O. F. Hedden, <i>Chairman</i>	K. J. Hannah
J. F. Cook	P. J. Herbert
C. D. Cowfer	M. R. Hum
F. J. Dodd	W. C. McGaughey
F. T. Duba	W. O. Parker
J. R. Frederick	F. J. Sattler
D. F. Fox	

Working Group on Standards (SG-WCS) (SC XI)

L. B. Gross, <i>Chairman</i>	S. Raganath
A. J. Birkle	R. M. Stone
R. R. Maccary	S. A. Zych
F. N. Moschini	

Working Group on Repairs (SG-WCS) (SC XI)

W. C. Ham, <i>Chairman</i>	J. Jacobson
W. B. Bunn	P. J. Krumpas
J. S. Caplan	A. J. Matt
D. Christofferson	J. C. Quinn

Working Group on Steam Generator Inspection (SG-WCS) (SC XI)

A. J. Birkle, <i>Chairman</i>	R. H. Jacobs
C. J. Denton	E. J. Parent
L. Frank	R. W. Smith
L. B. Gross	J. D. Woodward

Working Group on Spare and Replacement Parts (SG-WCS) (SC XI)

L. J. Chockie, <i>Chairman</i>	G. W. Hallman
A. J. Birkle	J. B. Henderson
W. A. Ferreira	J. D. Lathrop
J. E. Gallivan	V. Laubenheimer
W. L. Garvin	S. A. Zych
J. Gischlon	

Working Group on Component Supports (SG-WCS) (SC XI)

J. R. Knoke, <i>Chairman</i>	A. S. Hafiz
J. T. Boyd	G. N. Krishnaswamy
T. E. Campbell	J. R. Hebert
D. D. Davis	K. A. Stanley
F. T. Duba	

Working Group on Containment (SG-WCS) (SC XI)

T. D. Keenan, <i>Chairman</i>	H. T. Hill
W. E. Cooper	R. F. Reedy
N. W. Edwards	

Subgroup on Gas Cooled Systems (SC XI)

F. A. Warner, <i>Chairman</i>	L. Frank
W. M. Clarke, <i>Secretary w/o</i>	C. R. Gates
vote	A. S. Greer
J. A. Breynaert	D. L. Leone
R. E. Bullock	J. T. Robb

Special Working Group on Inspection of High Temperature Materials (SG-GCS) (SC XI)

A. S. Greer, <i>Chairman</i>	J. T. Robb
L. Frank	

Special Working Group on Testing of Valves (SG-GCS) (SC XI)

L. M. Hausler, <i>Chairman</i>	R. W. Peters
W. G. Knecht	R. K. Pierson

Special Working Group on Reactor Internals (SG-GCS) (SC XI)

J. T. Robb, <i>Chairman</i>	A. S. Greer
W. M. Clarke	D. L. Leone
L. Frank	

Special Working Group on Testing of Pumps and Compressors (SG-GCS) (SC XI)

B. R. Shelton, <i>Chairman</i>	D. L. Leone
G. A. Arlotto	R. F. Robinson
L. F. Davis	G. C. Thurston

Working Group for Inspection and Tests (SG-GCS) (SC XI)

F. A. Warner, <i>Chairman</i>	A. S. Greer
W. M. Clarke	D. L. Leone
L. Frank	R. W. Peters

Working Group for Standards and Evaluations (SG-GCS) (SC XI)

C. R. Gates, <i>Chairman</i>	P. C. Riccardella
J. A. Breynaert	A. R. Whiting

Working Group for Repairs and Replacements (SG-GCS) (SC XI)

J. T. Robb, <i>Chairman</i>	R. E. Bullock
E. G. Arndt	H. L. Gotschall

Working Group on Concrete Pressure Components (SG-GCS) (SC XI)

M. L. Jones, <i>Chairman</i>	G. Volenteniy
H. Ashar	A. R. Whiting
R. P. Pizzuti	

Subgroup on Liquid Metal Cooled Systems (SC XI)

M. Markowicz, <i>Chairman</i>	H. C. Jung
J. B. Carr, <i>Secretary</i>	C. A. McLaughlin
W. L. Chase	K. J. Reimann
C. Y. Cheng	J. C. Tobin
J. Coonan	A. R. Whiting
G. J. Hallinan	

Special Working Group on Pumps (SG-LMCS) (SC XI)

L. J. Kuzenski, <i>Chairman</i>	W. F. Hickey
J. T. Cochran	W. J. Severson

Special Working Group on Valves (SG-LMCS) (SC XI)

J. F. Horning, <i>Chairman</i>	R. Louison
W. F. Hickey	G. H. Martin
R. Koester	

SUBCOMMITTEE ON PROPERTIES OF METALS (SC-P)

P. M. Brister, <i>Chairman</i>	J. J. Kanter
R. H. Moeller, <i>Secretary</i>	W. E. Leyda
C. C. Clark	C. E. Rawlins
J. F. Copeland	G. V. Smith
T. M. Cullen	W. R. Smith
W. D. Doty	W. E. Trumpler
R. F. Gill	F. A. Upson

Subgroup on Strength—Steel and High Temperature Alloys (SC-P)

W. E. Leyda, <i>Chairman</i>	R. J. Glodowski
M. Gold, <i>Secretary w/o vote</i>	J. J. Kanter
C. W. Alexander	R. A. Moen
M. N. Bressler	J. E. Rogozenski
D. Canonico	G. V. Smith
J. F. Copeland	W. R. Smith
T. M. Cullen	C. E. Spaeder
P. R. Davis	W. E. Trumpler
J. Flannery	F. A. Upson
R. F. Gill	

Subgroup on Strength—Nonferrous Alloys (SC-P)

R. H. Moeller, <i>Chairman</i>	D. G. Harman
J. W. Tackett, <i>Secretary</i>	E. Shapiro
K. O. Bogardus	W. V. Waterbury
C. L. Bulow	R. T. Webster
R. A. Ecoff	D. H. Wilson

Subgroup on Strength of Weldments (SC-P) & (SC IX) (Joint Subgroup)

W. D. Doty, <i>Chairman</i>	G. V. Smith
R. E. Lorentz	W. R. Smith

Subgroup on Fatigue Strength (SC-P)

W. J. O'Donnell, <i>Chairman</i>	M. Katcher
C. R. Brinkman	C. W. Lawton
J. A. Hayward	M. J. Manjoine
L. A. James	G. C. Millman
C. E. Jaske	R. R. Seeley
D. P. Jones	

Subgroup on Toughness (SC-P)

H. T. Corten, <i>Chairman</i>	F. J. Loss
B. L. Alia	C. E. Rawlins
D. J. Ayres	R. D. Stout
V. W. Butler	R. D. Webb
J. H. Gross	R. G. Williams
H. A. Grubb	D. E. Young
G. S. Hartman	S. Yukawa
W. S. Hazelton	R. Zawierucha
E. Landerman	

Working Group on Non-Nuclear Application (SG-T) (SC-P)

C. E. Rawlins, <i>Chairman</i>	R. D. Stout
B. L. Alia	R. D. Webb
V. W. Butler	

Working Group on Nuclear Application (SG-T) (SC-P)

E. Landerman, <i>Chairman</i>	W. S. Hazelton
H. A. Grubb	F. J. Loss
G. S. Hartman	D. E. Young

Working Group on Toughness Criteria (SG-T) (SC-P)

H. T. Corten, <i>Chairman</i>	R. G. Williams
D. J. Ayres	S. Yukawa
J. H. Gross	

SUBCOMMITTEE ON SAFETY VALVE REQUIREMENTS (SC-SV)

S. F. Harrison, <i>Chairman</i>	W. D. Greenlaw (Alternate for Corcoran)
W. L. Garvin, <i>Secretary</i>	W. L. Harding
W. F. Anderson	F. J. Howes
T. R. Bordelon (Alternate for Weber)	J. W. Kime
O. E. Buxton (Alternate for Garvin)	J. H. Parent (Alternate for Kime)
G. F. Carlson	A. J. Schmidt
F. W. Catudal	W. E. Somers
J. L. Corcoran	C. G. Weber
D. R. Gallup	

SUBCOMMITTEE ON CODE SYMBOL STAMPS (SC-CSS)

E. L. Kemmler, <i>Chairman</i>	<i>Alternates:</i>
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J. T. Crosby	H. McColly
J. F. Harvey	D. R. Gallup
J. W. Kime	P. M. Brister
P. E. Loveday	J. H. Parent
E. W. Shilling	W. J. Anderson
W. J. Stuber	E. A. Becker
	F. Forti

SUBCOMMITTEE ON NUCLEAR CERTIFICATION (SC-NC)

E. J. Hemzy, <i>Chairman</i>	<i>Alternates:</i>
M. N. Bressler, <i>Vice Chairman</i>	L. C. Bird
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D. J. Carreira	D. R. Gallup
W. E. Cooper	K. T. Kostal
D. K. Croneberger	F. N. Moschini
W. S. Gibbons	R. S. Orr
C. H. Harmsen	A. Breed
S. F. Harrison	J. D. Lenardson
J. F. Harvey	J. G. Gillissie
E. L. Kemmler	H. F. Dobel
J. E. Lattan	J. A. Jagger
G. W. Reinmuth (w/o vote)	T. F. Luga
	U. Potapovs

SUBCOMMITTEE ON DESIGN (SC-D)

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W. R. Mikesell, <i>Vice Chairman</i>	H. W. Marsh
I. Berman	E. C. Rodabaugh
J. R. Farr	R. D. Schueler

Subgroup on Openings (SC-D)

E. C. Rodabaugh, <i>Chairman</i>	P. P. Raju
M. P. Schwartz, <i>Secretary</i>	H. H. Schneider
M. N. Bressler	R. W. Schneider
R. T. Brown	H. K. Shaw
J. R. Farr	D. L. Shira
S. C. Lou	E. D. Ssinegurski
W. R. Mikesell	E. O. Waters

Subgroup on External Pressure (SC-D)

H. W. Marsh, <i>Chairman</i>	E. M. Livingston
L. Conway	E. E. Morgenegg
K. Hom	N. C. Small
M. H. Jawad	V. Svalbonas
C. J. Kelly	

Subgroup on Design Analysis (SC-D)

I. Berman, <i>Chairman</i>	E. R. Sliwinski
E. M. Lawrence, <i>Secretary</i>	S. W. Tagart
R. S. Barsoum	Z. Zudans
J. H. Faupel	

Subgroup on Elevated Temperature Design (SC-D)

R. I. Jetter, <i>Chairman</i>	C. W. Lawton
E. P. Esztergar, <i>Vice Chairman</i>	C. F. Nash
M. T. Jakub, <i>Secretary</i>	W. J. O'Donnell
E. J. Brown	F. A. Sebring
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J. B. Conway	G. V. Smith
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INTRODUCTION

The following is a brief introduction to the 1977 Edition of Section IX, general in nature, and cannot be considered as a substitute for actual review of appropriate sections of the document. However, this will give the reader a better understanding of the purpose and organization of Section IX.

Section IX of the ASME Boiler and Pressure Vessel Code relates to the qualification of welders, welding operators, and brazers, and brazing operators, and the procedures which they employ in welding or brazing according to the ASME Code. As such, this is an active document subject to constant review, interpretation, and improvement.

The format of Section IX was revised in 1974, and this format was substantially different from that of previous editions. The same format as the 1974 Edition is employed in the 1977 Edition. In the general review of Section IX, for the 1977 Edition, basic criteria for welding were established and observed in the preparation of welding requirements, affecting procedure and performance. It is important that the user of the 1977 Edition of Section IX understand these basic criteria in his review of the requirements which have been established.

The purpose of the welding procedure specification (WPS), and procedure qualification record (PQR), is to determine that the weldment proposed for construction is capable of having the required properties for its intended application. It is presupposed that the welder, or welding operator, performing the welding procedure qualification test is a skilled workman. That is, the welding procedure qualification test is to establish the properties of the weldment, not the skill of the welder or welding operator. In addition to this general requirement, special consideration was given when notch toughness is required by other sections of the Code.

In performance qualification, the basic criteria established for the welder are to determine ability to deposit sound weld metal. The purpose of the performance qualification test for the welding operator is to determine mechanical ability to operate the welding machine.

In developing the revision of Section IX, each welding process to be included was reviewed with regard to those

items (called variables) which have effect upon the welding operations as applied to procedure or performance criteria. It became apparent, early in this review, that the previous distinction between ferrous and nonferrous metals, with very few exceptions, would not be required; as all metals in the welding processes have essentially similar variables in the production of weldments. For this reason, the document is established in two major parts: welding, to cover all metals involved in welding, and the present brazing document. The brazing part of the new document contains no essential technical changes from past requirements. It reflects only a realignment of existing paragraphs in the new format.

Preamble

The Preamble of Section IX, both past and present, is often overlooked. It is the Preamble which recognizes that welding and brazing requirements, for both procedure and performance, considered acceptable in past years, are not entirely negated by the issuance or addenda of a new edition. The Preamble recognizes successful welding applications and, in most cases, it is this past welding experience which results in new and revised requirements of Section IX. The Preamble permits the use of welding procedure and performance qualifications, which meet the requirements of the 1962, or later editions of the Code, for the performance of production welding. The Preamble states, as it has in the past, that all new procedures and performance shall be in accordance with the latest edition of this section of the Code. It is not the purpose of the Code to cause extensive retesting of previously employed welding or brazing procedures, welders, brazers, or welding and brazing operators.

Welding

The welding part of the document consists of the following four Articles:

- I. General Requirements
- II. Procedure Qualifications
- III. Performance Qualifications
- IV. Welding Data

Article I General Requirements

The General Article of the 1977 Edition of Section IX is quite similar to that contained in the 1974 Edition and the 1971 Edition, for both the ferrous and nonferrous metals. This Article contains general references and guides which apply to procedure and performance requirements such as: weld orientations, more generally known as positions; the type of mechanical test employed with their acceptance criteria; and macro-examination with its acceptance criteria. It will be noted that this Article, as well as the following two Articles, contain written information only in paragraph form with reference data, tables, and figures in Article IV Welding Data. This will aid the user of the document in continuity of reading paragraphs, without interruption by tabulations or tables.

Article II Procedure Qualifications

The major technical revisions of the 1977 and 1974 Editions over the 1971 Edition are contained in the Procedure Qualification Article. Each process is listed separately with the essential and nonessential variables as applied to that particular process. In general, the new procedure requirements are that the manufacturer or contractor prepare written welding procedure specifications (WPS's), which are greater in detail, to give guidance to the welder, or welding operator, performing production weldments. Both the essential and nonessential variables for each welding process shall be included in the written welding procedure specification. If a change is made in one or more of the essential variables, as has been in the past, preparation of a new or revised welding procedure specification and requalification is required. If a change is made to one or more of the nonessential variables, listed in the qualified welding procedure specification, a new or revised welding procedure specification is required; but the previous procedure qualification test will still be applicable. The types of tests for qualification of a welding procedure specification are the same as those employed in the past: tension tests, bend tests, and when required, notch toughness tests.

Each welding process is identified by a separate paragraph number. This paragraph is further divided into: essential variables, supplementary essential variables for notch toughness, and nonessential variables. The same variable may appear in both the supplemental essential variable paragraphs, and nonessential variable paragraphs; and are considered as essential only when notch toughness requirements are established by other sections of the Code. In general, notch toughness requirements are mandatory for all P Number 11 quenched and tempered metals, for low temperature applications of other metals as applied to Section VIII, and for various classes of construction required by Section III. Acceptance criteria

for the notch toughness tests are as established in the other sections of the Code. This article refers to variables as QW-400 paragraph numbers in Article IV Welding Data. As a handy reference, the welding procedure specification variables are contained in tabular form in QW-415.

Some major technical changes are contained in the 1974 and 1977 Editions:

1. Elimination of position as an essential variable, except where notch toughness requirements are a factor. Elimination of the diameter requirements for pipe, up to 24 in. diameter, for procedure qualification previously indicated in Table Q-13.3 and Table QN-13.3.
2. Qualification in plate also qualifies for pipe welding and vice versa.
3. Permission to join metals from different P Numbers, up to and including P Number 5, with a maximum 3% nominal chrome content.

In addition to covering various welding processes, rules are also included to cover special processes. Corrosion resistant weld metal overlay and hard-facing weld metal overlay are the only special processes now included.

Article III Performance Qualifications

The performance article, in general, reflects requirements of the 1971 and 1974 Section IX Code and Addenda, as applied to welding performance qualifications.

This article lists the welding processes separately, with the essential variables which apply to welder performance qualifications. The welder qualification is limited by the essential variables given for each process. These essential variables are listed in Article IV Welding Data, and are summarized in tabular form in QW-416.

A welding operator may be qualified by radiography of a test plate, radiography of his initial production welding, or by bend tests taken from a test plate. The welding operator qualifies by process only, with no specific limits. The lists of essential variables do not apply to welding operator qualifications. A significant change in welding operator qualification requirements is the deletion of sectioning.

Article IV Welding Data

The Welding Data Article includes the welding variables grouped as joints, base metals, filler metals, positions, preheat, post weld heat treatment, gas, electrical characteristics, and technique.

The P Number tables have been retained as general groupings. The P Numbers have been further divided into group numbers in the 1974 and 1977 Editions to classify

metals, generally along strength levels, for the purpose of procedure qualification, where notch toughness requirements are a factor. The P Number tables have both the ferrous and nonferrous metals.

The F Number and A Number tables were revised in the 1974 Edition to consolidate the ferrous and nonferrous metals in each table.

The tables concerned with tests and qualification limits (Q-13, QN-13, Q-24, and QN-24) have been combined and

are in QW-451 and QW-452 of the 1974 and 1977 Editions. A new table, QW-461.7, lists Performance Qualification Position limitations.

The Graphics are similar to the Figures in the previous Section IX, with the inclusion of some new figures as an aid for test positions, test specimens, and the corrosion resistant overlay cladding chemical analysis test. Order of removal figures are shown for both procedure and performance qualifications.

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PREAMBLE

This Edition of Section IX is divided into two parts. Part QW gives requirements for Welding and Part QB contains requirements for Brazing.

Welding and brazing procedures, welders, brazers, and operators of machine welding and brazing equipment, qualified in accordance with the rules in this Section, may be used in any construction built to the ASME Boiler and Pressure Vessel Code, and stamped with the appropriate Code symbol.

Procedure and performance qualifications, made in accordance with the requirements of the 1962 or any later Edition of Section IX, may be used in any construction

built to the ASME Boiler and Pressure Vessel Code and stamped with the appropriate Code Symbol.

Procedure and performance qualifications, made in accordance with the requirements of Editions prior to 1962, in which all of the requirements of 1962 or later Editions were met, also may be used.

Procedure and performance qualification test records, dated prior to 1962, shall be acceptable, if the results meet the requirements of the 1962 or later Editions.

Any requalifications or new qualifications shall be made in accordance with the test requirements of the current Edition.

QW-101 Scope

The rules in this Section apply to the production of welding procedures, specifications, and the qualification of welders, brazers, and operators of machine welding and brazing equipment for all types of pressure and non-pressure vessels, piping, and structural components. These rules shall also be applied, insofar as they are applicable, to other manual or machine welding processes.

QW-102 Terms and Definitions

Some of the more common terms relating to welding are defined in QW-102. These definitions shall be consistent with the definitions of the American Welding Society given in its dictionary, "ASME Welding Terms and Definitions."

Whenever the word pipe is designated, welds shall also be applied.

QW-103 Responsibility

QW-103.1 Welding. Each manufacturer or contractor is responsible for the welding done by his organization and shall conduct the tests required in this Section to qualify the welding procedures used in the construction of the equipment built under this

Whenever these words are used in Sec. IX, they shall include similar or equivalent.

QW-104 WELD ORIENTATION

The orientation of welds are classified in QW-104.

QW-105 TEST POSITIONS FOR GROOVE WELDS

Groove welds may be made in the vertical position in any of the positions QW-401.2 or QW-401.3 and is described in the following paragraph. Except that an angular deviation of $\pm 5^\circ$ or more is permitted in the horizontal position and angular deviation of regular deviation of $\pm 5^\circ$ or more is permitted in the vertical position. The specified in other rules is permitted during welding.

QW-111 Test Figures

QW-111.1 Test Figure 1. This test figure shall show the weld metal deposited from above. Refer to QW-401.2.1.1.

QW-111.2 Horizontal Position. This is a vertical plate with the axis of the weld horizontal. Refer to QW-401.2.1.1.

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Part IX gives requirements for Welding and Part IXB gives requirements for Brazing. A list of welding and brazing procedures, welders, brazers, and operators of machines welding and brazing equipment, qualified in accordance with the rules in this Section may be used in any construction built to the ASME Boiler and Pressure Vessel Code, and stamped with the appropriate Code symbol.

Procedures and performance qualifications, made in accordance with the requirements of the 1965 or any later Edition of Section IX, may be used in any construction.

Procedures and performance qualifications, made in accordance with the requirements of the 1965 or any later Edition of Section IX, may be used in any construction.

Any construction stamped with the ASME Boiler and Pressure Vessel Code, and stamped with the appropriate Code symbol.

Procedures and performance qualifications, made in accordance with the requirements of the 1965 or any later Edition of Section IX, may be used in any construction.

Procedures and performance qualifications, made in accordance with the requirements of the 1965 or any later Edition of Section IX, may be used in any construction.

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PART QW WELDING

ARTICLE I

WELDING GENERAL REQUIREMENTS

QW-100 GENERAL

All pages in this article are identified by the number 1, followed by the specific page identifying number, which is indicated at the bottom of each page.

QW-101 Scope

The rules in this Section apply to the preparation of welding procedure specifications, and the qualification of welding procedures, welders, and welding operators for all types of manual and machine welding processes permitted in other Sections. These rules may also be applied, insofar as they are applicable, to other manual or machine welding processes.

QW-102 Terms and Definitions

Some of the more common terms relating to welding are defined in QW-492. These are in substantial agreement with the definitions of the American Welding Society given in its document, "A3.0-69 Terms and Definitions."

Wherever the word pipe is designated, tubes shall also be applicable.

QW-103 Responsibility

QW-103.1 Welding. Each manufacturer¹ or contractor¹ is responsible for the welding done by his organization and shall conduct the tests required in this Section to qualify the welding procedures he uses in the construction of the weldments built under this

Code, and the performance of welders and welding operators who apply these procedures.

QW-103.2 Records. Each manufacturer, or contractor, shall maintain a record of the results obtained in welding procedure and welder and welding operator performance qualifications. These records shall be certified by the manufacturer, or contractor, and shall be accessible to the Authorized Inspector. Refer to recommended Forms in QW-480.

QW-110 WELD ORIENTATION

The orientations of welds are illustrated in QW-461.1.

QW-120 TEST POSITIONS FOR GROOVE WELDS

Groove welds may be made in test material oriented in any of the positions in QW-461.2 or QW-461.3 and as described in the following paragraphs, except that an angular deviation of plus or minus 15 degrees ($\pi/12$ rad) from the specified horizontal and vertical planes, and an angular deviation of plus or minus 5 degrees ($\pi/36$ rad) from the specified inclined plane is permitted during welding.

QW-121 Plate Positions

QW-121.1 Flat Position 1G. Plate in a horizontal plane with the weld metal deposited from above. Refer to QW-461.2(a).

QW-121.2 Horizontal Position 2G. Plate in a vertical plane with the axis of the weld horizontal. Refer to QW-461.2(b).

¹Wherever these words are used in Section IX, they shall include installer or assembler.