ASME BOILER AND PRESSURE VESSEL CODE
AN AMERICAN NATIONAL STANDARD

SECTION II
Material Specifications

Part A — Ferrous

1989 EDITION

JULY 1, 1989

ASME BOILER AND PRESSURE VESSEL COMMITTEE
SUBCOMMITTEE ON MATERIALS

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

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This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment which provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

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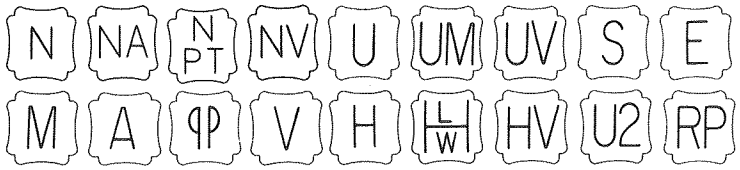

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1989 ASME
BOILER AND PRESSURE VESSEL CODE

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ADDENDA

Colored-sheet Addenda, which include additions and revisions to individual Sections of the Code, are published annually and will be sent automatically to purchasers of the applicable Sections up to the publication of the 1992 Code. The 1989 Code is available only in the loose-leaf format; accordingly, the Addenda will be issued in the loose-leaf, replacement-page format.

INTERPRETATIONS

ASME issues written replies to inquiries concerning interpretation of technical aspects of the Code. The Interpretations for each individual Section will be published separately and will be included as part of the update service to that Section. They will be issued semiannually (July and December) up to the publication of the 1992 Code. Interpretations of Section III, Divisions 1 and 2, will be included with the update service to Subsection NCA. Interpretations are not part of the Code or the Addenda.

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 will appear in the appropriate 1989 Code Cases book: (1) Boilers and Pressure Vessels and (2) Nuclear Components. Supplements will be sent automatically to the purchasers of the Code Cases books up to the publication of the 1992 Code.

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 revisions of the rules, new rules as dictated by technological development, Code Cases, and requests for interpretations. Requests for interpretation must be addressed to the Secretary in writing and must give full particulars in order to receive consideration and a written interpretation (see Mandatory Appendix covering preparation of technical inquiries). 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 ASME.

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, revisions are published 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 ASME.

After Code revisions are approved by ASME, 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 contracted for 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 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 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, methods 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 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.

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. States, provinces, municipalities, or other regulatory bodies 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. When reference is made in an ASME Material Specification to an ASTM Specification for which a companion ASME Specification exists, the reference shall be interpreted as applying to the ASME Material Specification. Specifications for welding materials given in Section II, Part C, are identical with or similar to those of the American Welding Society. Not all materials included in the ASME Material Specifications in Section II have been adopted for Code use. Usage is limited to those materials and grades adopted by at least one of the other Sections of the Code for application under rules of that Section. All materials allowed by these various Sections and used for construction within the scope of their rules shall be furnished in accordance with ASME Material 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 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 confirmed as 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 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.

When required by context in this Section, the singular shall be interpreted as the plural, and vice-versa; and the feminine, masculine, or neuter gender shall be treated as such other gender as appropriate.

Publication of the SI (Metric) Edition of the ASME Boiler and Pressure Vessel Code was discontinued with the 1986 Edition. Effective October 1, 1986, the SI Edition was withdrawn as an ASME Boiler and Pressure Vessel Code document.

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.

GUIDELINE ON THE ADOPTION OF NEW BASE MATERIALS FOR THE ASME BOILER AND PRESSURE VESSEL CODE

The ASME Boiler and Pressure Vessel Committee considers requests for adoption of new materials desired by the owner/user or fabricator, manufacturer, installer, assembler of boilers, pressure vessels, or components constructed to the Code. In order for the material to receive proper consideration by the appropriate subcommittees, information and data are required to properly categorize the material. In general, this information and data include, but are not necessarily limited to, the following information.

The proposed chemical composition should include those elements that establish the characteristics and behavior of the material.

The mechanical properties for the material should include tensile test data, ductility data, and other special mechanical test data which will assist the Committee in its review of the material and its application.

Tensile test data (per ASTM E 21), including both ultimate tensile strength and yield strength, should be at room temperature and at 100°F or 50°C intervals to a temperature at least 100°F higher than the intended use of the material. When creep properties may be expected to limit the allowable stress, creep and creep rupture data at temperature intervals of 100°F or 50°C are also required. Such data should be four or more time intervals, one of which should be longer than 2000 hr but less than 6000 hr, and one of which should be longer than 6000 hr.

Toughness data on base and weld metal (including heat affected zone) may also be required. It is preferred that these data include temperature-toughness curves of material subjected to heat treatment(s) representative of the finished fabricated product. The toughness testing data should be obtained using methods and procedures outlined in the applicable sections of the Code under which the material is to be used.

If the material is to be used in welded construction, data from actual welding tests made in accordance with Section IX of the Code are recommended. This should also include the welding processes and weld filler metal(s) intended for the fabrication of the material, all-weld-metal tensile test data for temperatures representative of intended service, any special restrictions on the welding of the material, and with the appropriate postweld heat treatment, if any, which will be given the material. If postweld heat treatment results in embrittlement of the material, the significance of such treatments with substantiating data should be forwarded. Toughness data on weld metal and heat affected zone in the as-welded and postweld heat treated conditions, when appropriate, should be submitted.

Where the material is intended for special applications, requires special handling or special welding procedures, or has known limitations or susceptibility to failure in certain services, precautionary requirements and information should be included in the submittal of the necessary data for Committee review.

The forms[1] of materials which are needed for construction in accordance with the Code and the Sections of the Code[2] for which application is to be considered will be required.

The general data recommended should be submitted on a minimum of three heats of material, preferably commercial heats of material. Where the chemical range will have an effect on the mechanical properties, the heats selected must cover both the high and low range of the effective chemical elements to show the effect on the mechanical properties. Any special heat treatment, whether applied by the material suppliers or the fabricator, should be applied to these test pieces in preparation of the data. If the material is presently covered by an ASTM specification, please enclose the specification number(s) and grade(s) involved in your

[1]Product forms, such as sheet, strip, plates, bars, shapes, seamless or welded pipe or tube, forging, casting, etc.

[2]Section I, III, IV, or VIII, Division 1 or 2.

application. If the material is not in ASTM specifications covering the product forms required, it will be necessary to apply to ASTM for specification coverage of this material.

Should there be a need for Code use prior to the inclusion of the material in ASTM specifications, the Committee will consider the issuance of a Code Case. In addition to the information and data noted above, the Committee should be provided with an indication of user need, the letter to ASTM requesting specification coverage, and sufficient information for the Committee to modify an appropriate existing ASME or ASTM specification to establish the material specification requirements for the material product form.

The foregoing is a general outline of the data which the Committee may need for appropriate review of new material. The applicable Sections for construction should be reviewed for any additional guidance, such as fatigue data for the requirements of Section III or Section VIII, Division 2. If the intended use of the new material is in elevated temperature nuclear construction, the proposer should request a copy of the special publication titled, "Guidelines for Required Data on New Materials for Elevated Temperature Nuclear Construction" (approved Jan. 8, 1976).

When the new material is a minor modification of a Code approved material, the data required may be reduced with the concurrence of the Committee. When the data supplied are insufficient for an adequate elevation, the Committee will request additional data. Such requests will be forwarded to inquirers, indicating those areas in which additional information is required.

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PREFACE

The American Society of Mechanical Engineers (ASME) and the American Society for Testing and Materials (ASTM) have cooperated for more than fifty years in the preparation of material specifications adequate for safety in the field of pressure equipment for ferrous and nonferrous materials, contained in Section II (Part A — Ferrous and Part B — Nonferrous) of the ASME Boiler and Pressure Vessel Code.

The evolution of this cooperative effort is contained in Professor A. M. Greene's "History of the ASME Boiler Code," which was published as a series of articles in *Mechanical Engineering* from July 1952 through August 1953 and is now available from ASME in a special bound edition. The following quotations from this history, which was based upon the minutes of the ASME Boiler and Pressure Vessel Committee, will help focus on the cooperative nature of the specifications found in Section II, Material Specifications.

"General discussion of material specifications comprising Paragraphs 1 to 112 of Part 2 and the advisability of having them agree with ASTM specifications," (1914).

"ASME Subcommittee appointed to confer with ASTM," (1916).

"Because of this cooperation the specifications of the 1918 Edition of the ASME Boiler Code were more nearly in agreement with ASTM specifications. In the 1924 Edition of the Code, 10 specifications were in complete agreement with ASTM specifications, 4 in substantial agreement and 2 covered materials for which ASTM had no corresponding specifications."

"In Section II, Material Specifications, the paragraphs were given new numbers beginning with S-1 and extending to S-213," (1925).

"Section II was brought into agreement with changes made in the latest ASTM specifications since 1921," (1932).

"The Subcommittee on Material Specifications arranged for the introduction of the revisions of many of the specifications so that they would agree with the latest form of the earlier ASTM specifications. . .," (1935).

From the preceding, it is evident that many of the material specifications were prepared by the Boiler and Pressure Vessel Code Committees, then subsequently, by cooperative action, modified and identified as ASTM specifications. Section II, Parts A and B, currently contain many material specifications which are identical with the corresponding ASTM specifications and some which have been modified for Code usage.

In 1969, the American Welding Society began publication of specifications for welding rods, electrodes, and filler metals, hitherto issued by ASTM. The Boiler and Pressure Vessel Committee has recognized this new arrangement, and is now working with AWS on these specifications. Section II, Part C, contains the welding material specifications approved for Code use.

All identical specifications are indicated by the ASME/ASTM symbols or the ASME/AWS symbols. The specifications prepared and copyrighted by ASTM and AWS are reproduced in the Code with the permission of the respective Society. The ASME Boiler and Pressure Vessel Committee has given careful consideration to each new and revised ASTM or AWS specification, and has made such changes as they deemed necessary to make the specification adaptable for Code usage. In addition, ASME has furnished ASTM with the basic requirements that should govern many proposed new specifications. Joint action will continue an effort to make the ASTM, AWS, and ASME specifications identical.

To assure that there will be a clear understanding on the part of the users of Section II, ASME publishes both the identical specifications and those amended for Code usage in three parts every three years, in the same page size to match the other sections of the Code, and Addenda are issued annually to provide the latest changes in Section II specifications.

The ASME Boiler and Pressure Vessel Code has been adopted into law by 45 states and many municipalities in the United States and by all of the Canadian Provinces.

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APPENDIX 1 — MANDATORY PREPARATION OF TECHNICAL INQUIRIES TO THE BOILER AND PRESSURE VESSEL COMMITTEE

1-100 INTRODUCTION

The ASME Boiler and Pressure Vessel Committee meets regularly to consider written requests for interpretations and revisions to the Code rules, and to develop new rules as dictated by technological development. The Committee's activities in this regard are limited strictly to interpretations of the rules or to the consideration of revisions to the present rules on the basis of new data or technology. As a matter of published policy, ASME does not approve, certify, rate, or endorse any item, construction, proprietary device, or activity, and, accordingly, inquiries requiring such consideration will be returned. Moreover, ASME does not act as a consultant on specific engineering problems or on the general application or understanding of the Code rules. If, based on the inquiry information submitted, it is the opinion of the Committee that the inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

All inquiries that do not provide the information needed for the Committee's full understanding will be returned.

1-200 INQUIRY FORMAT

Inquiries shall be limited strictly to interpretations of the rules or to the consideration of revisions to the present rules on the basis of new data or technology. Inquiries shall be submitted in the following format.

(a) Scope. Involve a single rule or closely related rules. An inquiry letter concerning unrelated subjects will be returned.

(b) Background. State the purpose of the inquiry, which would be either to obtain an interpretation of Code rules, or to propose consideration of a revision to the present rules. Provide concisely the information needed for the Committee's understanding of the inquiry, being sure to include reference to the applicable Code Section, Division, Edition, Addenda, paragraphs, figures, and tables. If sketches are provided, they shall be limited to the scope of the inquiry.

(c) Inquiry Structure. Prepare statements in a condensed and precise question format, omitting superfluous background information, and, where appropriate, composed in such a way that "yes" or "no" (perhaps with provisos) would be an acceptable reply. This inquiry statement should be technically and editorially correct.

(d) Proposed Reply. State what it is believed that the Code requires. If in the inquirer's opinion a revision to the Code is needed, recommended wording shall be provided.

1-300 SUBMITTAL

Inquiries shall preferably be submitted in typewritten form; however, legible handwritten inquiries will also be considered. They shall include the name and mailing address of the inquirer, and be mailed to the following address:

Secretary
ASME Boiler and Pressure Vessel Committee
345 East 47th Street
New York, NY 10017

SI UNITS

The 1989 Edition of the Boiler and Pressure Vessel Code is based on U.S. Customary (ft-lb) units of measurement which are to be regarded as the standard. This supplement is provided as a convenience to the Code user and contains SI conversion factors for units contained in the Code.

LIST OF SI UNITS FOR USE WITH ASME BOILER AND PRESSURE VESSEL CODE[1]

Quantity	Unit	Symbol	Other Units or Limitations
Space and Time			
plane angle	radian	rad	degree (decimalized)
length	meter	m	
area	square meter	m^2	
volume	cubic meter	m^3	liter (L) for liquid only (use without prefix other than in milliliter, mL)
time	second	s	minute (min), hour (h), day (d), week, and year
Periodic and Related Phenomena			
frequency	hertz	Hz	revolutions per second (r/s)
rotational frequency	revolutions per second	s^{-1}	revolutions per minute (r/m)
Mechanics			
mass	kilogram	kg	
density	kilogram per cubic meter	kg/m^3	
moment of inertia	kilogram · $meter^2$	$kg \cdot m^2$	
force	newton	N	
moment of force (torque)	newton-meter	$N \cdot m$	
pressure and stress	pascal	Pa	(pascal=newton per square meter)
energy, work	joule	J	kilowatt-hour (kW · h)
power	watt	W	
impact strength	joule	J	
section modulus	$meter^3$	m^3	
moment of section (second moment of area)	$meter^4$	m^4	
fracture toughness	$Pa \cdot \sqrt{m}$		
Heat			
temperature — thermodynamic [Note (2)]	kelvin	K	degree Celsius (°C)
temperature — other than thermodynamic	degree Celsius	°C	kelvin (K)
linear expansion coefficient	meter per meter-kelvin	K^{-1}	$°C^{-1}$
quantity of heat	joule	J	
heat flow rate	watt	W	
thermal conductivity	watt per meter-kelvin	$W/(m \cdot K)$	$W/(m \cdot °C)$
thermal diffusivity	square meter per second	m^2/s	
specific heat capacity	joule per kilogram-kelvin	$J/(kg \cdot K)$	$J/(kg \cdot °C)$
Electricity and Magnetism			
electric current	ampere	A	
electric potential	volt	V	
current density	ampere per $meter^2$	A/m^2	
magnetic field strength	ampere per meter	A/m	

NOTES:

(1) Conversion factors between SI units and U.S. customary are given in SI-1, "ASME Orientation and Guide for Use of SI (Metric) Units," and ASTM E 380.

(2) Preferred use for temperature and temperature interval is degrees Celsius (°C), except for thermodynamic and cryogenic work where kelvins may be more suitable. For temperature interval, 1 K = 1°C exactly.

COMMONLY USED CONVERSION FACTORS
(For Others See ASTM E 380) (See Note 1)

Quantity	To Convert From	To	Multiply by [Note (2)]	
plane angle	degree	rad	1.745 329	E–02
length	in	m	2.54*	E–02
	ft	m	3.048*	E–01
	yd	m	9.144*	E–01
area	in^2	m^2	6.451 6*	E–04
	ft^2	m^2	9.290 304*	E–02
	yd^2	m^2	8.361 274	E–01
volume	in^3	m^3	1.638 706	E–05
	ft^3	m^3	2.831 685	E–02
	US gallon	m^3	3.785 412	E–03
	Imperial gallon	m^3	4.546 09	E–03
	liter	m^3	1.0*	E–03
mass	lbm	kg	4.535 924	E–01
	ton (metric) (mass)	kg	1.000 00*	E+03
	ton (short 2000 lbm)	kg	9.071 847	E+02
force	kgf	N	9.806 65*	E+00
	lbf	N	4.448 222	E+00
bending, torque	kgf · m	N · m	9.806 65*	E+00
	lbf · in	N · m	1.129 848	E–01
	lbf · ft	N · m	1.355 818	E+00
pressure, stress	kgf/m^2	Pa	9.806 65*	E+00
	lbf/ft^2	Pa	4.788 026	E+01
	lbf/in^2 (psi)	Pa	6.894 757	E+03
	$kips/in^2$	Pa	6.894 757	E+06
	bar	Pa	1.0*	E+05
energy, work	Btu (IT) [Note (3)]	J	1.055 056	E+03
	ft · lbf	J	1.355 818	E+00
power	hp (550 ft · lbf/s)	W	7.456 999	E+02
fracture toughness	ksi $\sqrt{in}$	Pa · $\sqrt{m}$	1.098 843	E+06
temperature	°C	K	$t_K = t_C + 273.15$	
	°F	K	$t_K = (t_F + 459.67)/1.8$	
	°F	°C	$t_C = (t_F - 32)/1.8$	
temperature interval	°C	K	1.0*	E+00
	°F	K or °C	5.555 555	E–01

NOTES:
(1) Care should be taken when converting formulas or equations that contain constant terms or factors. The value of these terms must be understood and may also require conversion.
(2)(a) Relationships that are exact in terms of the base units are followed by a single asterisk.
(b) The factors are written as a number greater than 1 and less than 10 with 6 or less decimal places. The number is followed by the letter E (for exponent), a plus or minus symbol, and two digits which indicate the power of 10 by which the number must be multiplied to obtain the correct value. For example: 3.523 907 E–02 is $3.523\ 907 \times 10^{-2}$ or 0.035 239 07.
(3) International Table

SPECIFICATION FOR GENERAL REQUIREMENTS FOR ROLLED STEEL PLATES, SHAPES, SHEET PILING, AND BARS FOR STRUCTURAL USE

SA-6/SA-6M

(Identical with ASTM Specification A 6/A 6M-87d except for the deletion of Annex A2 and Appendix X2.)

1. Scope

1.1 This specification covers a group of common requirements that, unless otherwise specified in the material specification, apply to rolled steel plates, shapes, sheet piling, and bars under each of the following specifications issued by ASTM:

ASTM Designation	Title of Specification
A 36/A 36M	Structural Steel
A 131/A 131M	Structural Steel for Ships
A 242/A 242M	High-Strength Low-Alloy Structural Steel
A 283/A 283M	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
A 284/A 284M	Low and Intermediate Tensile Strength Carbon-Silicon Steel Plates for Machine Parts and General Construction
A 328/A 328M	Steel Sheet Piling
A 441/A 441M	High-Strength Low-Alloy Structural Manganese Vanadium Steel
A 514/A 514M	High-Yield Strength, Quenched and Tempered Alloy Steel Plate Suitable for Welding
A 529/A 529M	Structural Steel with 42 000 psi (290 MPa) Minimum Yield Point (½ in. (12.7 mm) Maximum Thickness)
A 572/A 572M	High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
A 573/A 573M	Structural Carbon Steel Plates of Improved Toughness
A 588/A 588M	High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. Thick
A 633/A 633M	Normalized High-Strength Low-Alloy Structural Steel
A 656/A 656M	Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
A 678/A 678M	Quenched and Tempered Carbon Steel Plates for Structural Applications
A 690/A 690M	High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments
A 699	Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel Plates, Shapes, and Bars
A 709	Structural Steel for Bridges
A 710/A 710M	Low-Carbon Age-Hardening Nickel-Copper - Chromium - Molybdenum - Columbium and Nickel-Cop per-Columbium Alloy Steels
A 769	Electric Resistance Welded Steel Shapes
A 786/A 786M	Rolled Steel Floor Plates
A 808/A 808M	High-Strength Low-Alloy Carbon, Manganese, Columbium, Vanadium Steel of Structural Quality with Improved Notch Toughness
A 827	Plates, Carbon Steel, for Forging and Similar Applications
A 829	Plates, Alloy Steel, Structural Quality
A 830	Plates, Carbon Steee, Structural Quality, Furnished to Chemical Composition Requirements
A 852/A 852M	Quenched and Tempered Low-Alloy Structural Steel Plate
A 875	Steel Sheet Piling, Cold Formed, Light Gage
A 871/A 871M	High-Strength Low Alloy Structural Steel, Plate with Atmospheric Corrosion Resistance

1.2 Annex A1 lists permissible variations in dimensions and mass (Note 1) in SI (metric) units. The values listed are not exact conversions of the values in Tables 1 through 31 but are, instead, rounded or rationalized values. Conformance to Annex A1 is mandatory when the "M" specification designation is used.

NOTE 1—The term "weight" is used when inch-pound units are the standard; however, under SI, the preferred term is "mass."

1.3 Annex A2 lists the dimensions of some shape profiles.

1.4 Appendix X1 describes the production and some of the characteristics of coiled product from which structural plate may be produced.

1.5 This specification also covers a group of supplementary requirements that are applicable to several of the above specifications as indicated therein. These are provided for use when additional testing or inspection is desired and apply only when specified individually by the purchaser in the order.

1.6 In case of any conflict in requirements, the requirements of the individual material specification shall prevail over those of this general specification.

1.7 The purchaser may specify additional requirements that do not negate any of the provisions of this general specification or of the individual material specifications. Such additional requirements, the acceptance of which are subject to negotiation with the supplier, must be included in the order information (see Section 4).

1.8 For purposes of determining conformance with this specification and the various material specifications referenced in 1.1, values shall be rounded to the nearest unit in the right-hand place of figures used in expressing the limiting values in accordance with the rounding method of Recommended Practice E 29.

1.9 The values stated in either inch-pound units or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two syytems may result in nonconformance with the specification.

1.10 This specification and the applicable material specifications are expressed in both inch-pound units and SI units. However, unless the order specifies the applicable "M"