CASTI PUBLICATIONS

CASTI GUIDEBOOK SERIES™

Volume 1 - CASTI Guidebook to ASME Section II - Materials Index
Volume 2 - CASTI Guidebook to ASME Section IX - Welding Qualifications
Volume 3 - CASTI Guidebook to ASME B31.3 - Process Piping
Volume 4 - CASTI Guidebook to ASME Section VIII Div. 1 - Pressure Vessels

CASTI HANDBOOK SERIES™

Volume 1 - CASTI Handbook of Cladding Technology
Volume 2 - CASTI Handbook of Stainless Steels and Nickel Alloys
Volume 3 - CASTI Handbook of Corrosion Control in Soils

CASTI DATA BOOK SERIES™

CASTI Metals Black Book™ - North American Ferrous Data
CASTI Metals Black Book™ - European Ferrous Data
CASTI Metals Red Book™ - Nonferrous Metals
CASTI Metals Blue Book™ - Welding Filler Metals

CASTI SELF-STUDY SERIES™

Volume 1 - CASTI Self-Study Guide to Corrosion Control

CASTI ENGINEERING CD-ROM SERIES™

CASTI’s 100 Best Engineering Shareware CD-ROM

First printing, May 2000

All rights reserved. No part of this book covered by the copyright hereon may be reproduced or used in any form or by any means - graphic, electronic, or mechanical, including photocopying, recording, taping, or information storage and retrieval systems without the written permission of the publisher.
FROM THE PUBLISHER

IMPORTANT NOTICE

The material presented herein has been prepared for the general information of the reader and should not be used or relied upon for specific applications without first securing competent technical advice. Nor should it be used as a replacement for current complete engineering codes and standards. In fact, it is highly recommended that the appropriate current engineering codes and standards be reviewed in detail prior to any decision-making.

While the material in this book was compiled with great effort and is believed to be technically correct, CASTI Publishing Inc. and its staff do not represent or warrant its suitability for any general or specific use and assume no liability or responsibility of any kind in connection with the information herein.

Nothing in this book shall be construed as a defense against any alleged infringement of letters of patents, copyright, or trademark, or as defense against liability for such infringement.

OUR MISSION

Our mission at CASTI Publishing Inc. is to provide industry and educational institutions with practical technical books at low cost. To do so, CASTI publications focus only on timely topics needed to solve current industry problems and are written by respected experts in their fields.

We would like to hear from you. Your comments and suggestions help us keep our commitment to the continuing quality of the CASTI Guidebook Series™.

All correspondence should be sent to the author in care of:

CASTI Publishing Inc.
10566 - 114 Street
Edmonton, Alberta, T5H 3J 7, Canada
tel: (780) 424-2552, fax: (780) 421-1308
E-mail: casti@casti.ca
Internet Web Site: http://www.casti.ca
PREFACE

The ASME Boiler and Pressure Vessel Code is a large compilation of rules and guidance covering numerous types of construction. Those rules pertain to various issues within each construction type encompassing design, materials selection and procurement, fabrication, inspection and testing, overpressure protection, and stamping. There are numerous other subsets of these issues, each having its own degree of complexity. Then there are simply those precautions noted throughout that should be considered. To the novice first-time user of the Code, this is an awesome task, trying to find all the rules and guidelines that apply to a given application. Even to the veteran user of the Code, it is surprising what one finds in other parts of the Code that can be of general use elsewhere.

I was a "novice" first-time user of the Code in the late 1960s and, like all others, was overwhelmed by the complexity, strange terminology, and sheer dimension of the Code. As a metallurgical engineer, my primary interest was in materials but in a broad sense ranging from selection and specification to properties and environmental effects. And like the typical well organized engineer, I started making my own checklists, indexes, and cross references to ensure that my work would be done in the most efficient and proficient ways possible.

In 1969, I started what became a long association with the committees that write the Code. Affiliations have included: Task Groups on Materials Behavior, Physical Properties, Inspection of Reactor Internal Structures, and Environmental Effects; Subgroups on Strength of Ferrous Alloys and Materials, Fabrication, and Examination (SC III); Subcommittees on Specifications, Materials, and Nuclear Power; and the Main Committee of the ASME Boiler and Pressure Vessel Code. In the mid 1970s, my first materials index found its way into Code committee work. Its primary use was in achieving consistency in the use of nominal composition designations throughout the Code. The format of that index led to numerous improvements over the years. During this time, peers started to recognize the usefulness of the index, and it was during this time that they encouraged me to publish it so others might also benefit from its many useful features.

The first editions of ASME Section II Practical Guide concentrated primarily on the features of the original "Moen Index". Recognizing that materials support people for Code construction would benefit from additional guidance on materials issues, the 1998 Edition provides additional help in understanding broader aspects of the Code as well as focusing on the location of materials requirements and guidance within the various Code sections. It is my desire to make this the ultimate "primer" for anyone dealing with Code materials issues, benefiting everyone from the "novice" to the "veteran."

Richard A. Moen
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter 1</th>
<th>Introduction</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 2</td>
<td>Organization of the ASME Boiler and Pressure Vessel Code From a Materials Standpoint</td>
<td>5</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Organization and the Use of Section II, Part D</td>
<td>31</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Evolution, Organization and Use of ASME Materials Specifications</td>
<td>57</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Code Alloys By UNS Numbers</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Aluminum-Base Alloys</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>Copper-Base Alloys</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>Cast Irons</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>AISI and SAE Carbon and Alloy Steels</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Cast Steels</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Miscellaneous Steels and Ferrous Alloys</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Nickel Base Alloys</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Special Metals (Co, Ti, Zr)</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>Heat and Corrosion Resistant Steels</td>
<td>77</td>
</tr>
<tr>
<td>Chapter 6</td>
<td>Code Specifications by Nominal Composition &amp; by Common Name</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>ASME General Requirement Specifications</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Code Specifications By Nominal Compositions for Grouped Alloys</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Carbon Steels</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Clad Steels</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Cast Irons</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>Low Alloy Steels (C-Mo)</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>Low Alloy Steels (½ Cr - 1 ⅛ Cr)</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Low Alloy Steels (1 ⅜ Cr - 3 Cr)</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>Low Alloy Steels (5 Cr - 9 Cr)</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Low Alloy Steels (Mn, Mn-Mo, and Si Steels)</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Low Alloy Steels (Nickel Steels)</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>High Alloy Steels (Including Stainless Steels)</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>Aluminum Base Alloys</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>Copper Base Alloys</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>Nickel Base Alloys</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>Special Alloys (Cobalt-Base)</td>
<td>138</td>
</tr>
<tr>
<td></td>
<td>Titanium Base Alloys</td>
<td>138</td>
</tr>
<tr>
<td></td>
<td>Zirconium Base Alloys</td>
<td>141</td>
</tr>
<tr>
<td>Chapter 7</td>
<td>Ferrous Alloys Specifications By Common Name or Trade Name</td>
<td>143</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>Nonferrous Alloys Specifications By Common Name or Trade Name</td>
<td>167</td>
</tr>
</tbody>
</table>
Chapter 1

INTRODUCTION

The Materials Index (Moen Index)

Historical Perspective

The “Moen Index” has evolved over a period of nearly twenty years, appearing in various forms. This latest format is keyed to Part D of Section II of the ASME Boiler and Pressure Vessel Code (B&PVC). As with earlier versions, the primary reason for developing such an index is to assist the infrequent user of the ASME Code with a better understanding of the identification of materials used in ASME Code construction.

In the mid 1970s, when the author was involved in ASME Code committee work associated with thermophysical properties, it was noted that the four principal sections of the ASME Code (I, III, VIII, and IX) on occasion referred to materials in their individual stress tables by different nominal composition designations. Since there was a necessity at that time to tie thermo-physical properties to nominal compositions, there was first a need to identify and resolve nominal composition designation differences within the Code. That exercise resulted in the first version of the Moen Index.

Once the merits of such a materials index were recognized as a tool for maintaining consistency in nominal composition designations, there were logical “next steps” that included the addition of corresponding common trade names, ASME Code section usage, minimum specified tensile properties, and Unified Numbering System (UNS) numbers.

These first few editions of the Moen Index were updated yearly, with significant changes every three to four years. Throughout these past few years, colleagues continuously encouraged the author to publish the Moen Index. Therefore this book was written. The latest version (this one) now covers material used in Section IV and Section VIII, Division 3 construction. This additional coverage was driven by a need for a more complete depiction of materials used in all boiler and pressure vessel construction.

A newer yet Materials Index, is now being developed for B31.1 and B31.3 materials. This new publication was inspired by the fact that the ASME B&PVC Subcommittee on Materials is now responsible for setting the stresses used by B31.1 and B31.3 and questions continued to surface concerning materials applications within those two Codes.

Materials Index Development

The first step in developing the Materials Index is to list all specifications contained in Section II, Part A - Ferrous Specifications and Part B - Nonferrous Specifications, showing material grades, types, and/or classes within each specification. Heat treatment, product form, and size limits are also included. In some cases for a given material, separate entries are made as a function of size or heat
treatment condition. Tensile strength requirements are also shown as ultimate tensile strength (UTS) or yield strength (YS). Values in ksi (1000 psi) are minimum values unless noted otherwise. This listing results in the inclusion of materials that are not yet approved for use in Code construction, but are materials simply included in ASTM specifications adopted by ASME.

The second step is to go through each of the stress tables found in Section II, Part D and place a check (✓) under each column heading whenever a particular material is found within the stress tables.

Within the Materials Index, the Section II, Part D table headings are as follows:

**Table 1A**
Section I; Section III, Classes 2 and 3; and Section VIII, Division 1 - Maximum Allowable Stress Values for Ferrous Materials.

**Table 1B**
Section I; Section III, Classes 2 and 3; and Section VIII, Division 1 - Maximum Allowable Stress Values for Nonferrous Materials.

**Table 2A**
Section III, Class 1 and Section VIII, Division 2 - Design Stress Intensity Values for Ferrous Materials.

**Table 2B**
Section III, Class 1 and Section VIII, Division 2 - Design Stress Intensity Values for Nonferrous Materials.

**Table 3**
Section III, Classes 2 and 3 and Section VIII, Divisions 1 and 2 - Maximum Allowable Stress Values for Bolting Materials.

**Table 4**
Section III, Class 1 and Section VIII, Division 2 - Design Stress Intensity Values for Bolting Materials.

The materials permitted for Section IV construction—Tables HF300 and HLW 300, and Section VIII, Division 3—Tables KCS-1, and KHA-1 and KNF-1 are also covered.

Section II, Part D contains tables of tensile strength, yield strength, thermal expansion, thermal conductivity, thermal diffusivity, and modulus of elasticity, but none of these are specific to particular ASME Code book sections, with the exception of Tables U-2 and Y-3 which are specific to Section VIII, Division 3. Thus, the Materials Index does not indicate ASME Code usage for these tables—only what is reflected within the stress tables of Section II, Part D, the stress tables of Section IV, and the three tables of permitted materials from Section VIII, Division 3.

The third step is to go through Table QW/QB-422 of Section IX, checking whether the materials are assigned welding P-Numbers. If so, the welding P-Numbers are listed under the column heading Weld No./P-Gr.

The fourth step is to review every current Code Case, for both non-nuclear and nuclear construction, to define which materials are covered by these cases. When a case references a new material, that Code case is identified in the appropriate “Code Case Coverage” column. The goal of the Code is to incorporate the provisions of these cases into the body of the Code as soon as the materials are adequately covered by ASME specifications and adequate use experience is achieved.

The last step is to ensure that nominal compositions are properly identified and uniformly applied throughout the specification listing. For those materials not yet described by Unified Numbering System numbers within the specifications, ASTM DS56G (Eighth Edition with 1999 update) is used.
to supplement and correct, if necessary, the ASME Code. Trade names are included whenever they are known and when the grade or type designation gives little clue as to the real identity. This is all collectively portrayed in Chapters 9 and 10 of this guide for ferrous and nonferrous materials, respectively. Issues surrounding assignment of nominal composition and UNS numbers will be discussed in more detail in the next subsection of this chapter and in Chapter 3 under Alloy Designation/UNS No.

The second part of the Materials Index serves those who have a nominal composition and simply need to know all of the specifications associated with that composition. The first portion of Chapter 6 is limited to ferrous materials, primarily because these materials are better known by nominal composition than by UNS number. The second portion lists nonferrous alloys by their UNS number and then lists the corresponding specifications for those unique materials. For the nonferrous materials, most users are more familiar with UNS designations than with nominal compositions. Also included in Chapter 6 are general requirements specifications applicable to products covered by specifications listed in Chapters 9 and 10.

Chapter 5 of the Materials Index contains an abbreviated cross index, primarily associating UNS numbers for 10 classes of alloys with their common designation (if it exists). Where specific names for steels do not exist, the Materials Index simply provides the applicable specifications.

Chapter 11 of the Materials Index lists the ASME Code material specification titles and designations found in ASME Section II Parts A and B. This information is first divided into ferrous and nonferrous materials, then is listed by product form, alloy group, and finally by specification number sequence. Sometimes, knowing the title of a specified material designation can provide the user with valuable information to deal with the issue at hand.

Nominal Composition Designation

Since the original motivation for the Materials Index was to achieve some consistency in the nominal composition of ASME Code materials, it is appropriate at this point to explain how those compositions are derived. For ferrous alloys, usually the principal alloying ingredients other than iron are listed. Note that “usually” is underlined; that means there are cases where alloys have had a particular nominal composition for twenty-five years or more, which is not totally indicative of the actual composition. With the long term recognition of a material by that nominal composition, there is now no compelling reason to change. Cast versions of a given wrought product may be assigned the same nominal composition as the wrought product, even though particular elements may differ by one to two percent from the nominal composition of the wrought product. This has caused some concern, but it was done with a good purpose in mind, namely there was a desire to tie thermophysical data to both the wrought and cast materials, thus a single composition was usually selected and it was typically that of the wrought product materials.

In the nickel base system of alloys, nominal compositions can be long and detailed due to the complexity of these alloys. Thus, liberty is taken in showing percentages of only the principle alloying elements, generally not for more than four elements. Throughout the Materials Index, it should be obvious that there is no absolute system for developing nominal compositions. It is mostly a case of following in the footsteps of those who initially came upon the idea and not deviating very far from that “system.”

Development of nominal compositions has never been “standardized” and several committees and/or individuals within ASTM or ASME committee structures may develop such an identifier. This may explain why there may appear to be different approaches for this task. Until there are rules for developing nominal composition designations, there will inevitably be differences. The Materials
Chapter 2

ORGANIZATION OF THE
ASME BOILER & PRESSURE VESSEL CODE
FROM A MATERIALS STANDPOINT

The “heart” of the CASTI Guidebook to ASME Section II - Materials Index is the tabulation of ferrous and nonferrous materials specifications by Code section use. However, this Index is only part of the story with respect to Section II and Code materials in general. The focus of this guide is also on how Section II relates to the rest of the ASME Boiler and Pressure Vessel Code, how Section II - Part D is organized, and on some of the common metallurgical issues and terms encountered in the specifications conveyed in Section II, Parts A and B.

The word Code in this guide refers to the ASME Boiler and Pressure Vessel Code (see General Overview of the Code for a list of the Code Sections.) Construction book committees refers to SC I, SC III, SC IV, SC VIII, and SC X (where SC is the abbreviation for Subcommittee). Service book committees refers to SC II, SC V, and SC IX who provide service to all construction book committees. All of these Subcommittees are responsible for Code books (or Code Sections) covering the specific subject areas.

Scope

Section II is an integral part of the 11 section ASME Boiler and Pressure Vessel Code, hereafter referred to simply as the Code. This chapter focuses on how Section II interacts with the rest of the Code, and other related Codes. Important features common to all or most Code sections are discussed. Presentations focus on the “materials person” who should be an integral part of any engineering task. This materials person may be an experienced metallurgical or materials engineer whose role is to provide expert guidance on materials issues, or it may simply be an engineer of another discipline who assumes the broader role of a materials specialist, along with his/her other areas of expertise. The current trends within industry, and practice of engineering in particular, have underscored the need to broaden the skill base and become even more versatile. This Materials Index is evolving with this trend in mind.

A Brief History of the Code

A series of tragedies in the late 1800s and early 1900s precipitated what would become the first set of steam boiler construction rules. During a 14 year period between 1889 and 1903, approximately 1,200 people were killed in 1,600 boiler explosions in the United States. First recognizing a way to halt this tragic loss of life was the Commonwealth of Massachusetts. In 1907, it enacted the first set of steam boiler construction rules, all of which were conveyed in just three pages. Four years later in 1911, New York and Ohio published similar boiler construction laws. By 1920, nine other states had followed suit.
Each state had developed slightly different rules, however. For a manufacturer who desired to market a standard boiler in all states, this presented a severe hardship. Recognizing this unfavorable situation in 1911, the American Society for Mechanical Engineers Council appointed a committee to formulate standard specifications for the construction of steam boilers and other pressure vessels. The Council was also concerned about the care of boilers in service. The first published version of the ASME Code appeared in 1914, covering power and heating boilers. By 1937, nine sections had been issued covering procedures for all phases of fabrication, materials selection, maintenance, and inspection of pressure vessels.

The late 1940s brought about newer design methods and advances in materials technology. In the early 1950s, the Code committee completed a comprehensive review of stress tables. Later in that decade, demands for higher temperatures and pressures pushed the envelope into the regime where creep considerations became significant. Within a few years, particularly in the case of Grade 321 stainless steel, failures began to appear, indicating a need to reevaluate the bases for setting stresses. These events led to a renewed emphasis on materials testing. An important step was taken in 1966 with formation of the Metals Properties Council. This organization worked closely with the Code committee to improve the databases and the analytical processes used to set Code allowable stresses. As the Code takes on a more international “flavor”, a major step was taken in 1998 to reduce the factor on tensile strength used in deriving allowable stresses for Sections I, III (Classes 2 and 3) and VIII – Div. 1 vessels. This step aligns the ASME B & PV Code with comparable European codes.

The problem of state-specific boiler codes was gradually rectified as states began to adopt the ASME Boiler and Pressure Vessel Code. Today, the Code has been adopted by nearly every state in America and all 10 provinces in Canada, and is now well on the way to become a truly international Code.

A more complete history of the development of rules for construction of boilers appears in a three part article in Power Engineering, Vol. 100, No. 2, February 1996 (pp 15 - 30). These articles provide further insight into the involvement of the American Boiler Manufacturers Association (ABMA), ASME, and the National Board of Boiler and Pressure Vessel Inspectors (NBBI).

### Content of the 1998 Code Edition

Today's Code (the 1998 Edition) is made up of the following sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>No. Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Rules for Construction of Power Boilers</td>
<td>283</td>
</tr>
<tr>
<td>II</td>
<td>Part A - Ferrous Materials Specifications</td>
<td>1447</td>
</tr>
<tr>
<td></td>
<td>Part B - Nonferrous Materials Specifications</td>
<td>1015</td>
</tr>
<tr>
<td></td>
<td>Part C - Specifications for Welding Rods, Electrodes and Filler Metals</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Part D - Properties</td>
<td>717</td>
</tr>
<tr>
<td>III</td>
<td>Division 1 - Rules for Construction of Nuclear Power Plant Components</td>
<td>2187</td>
</tr>
<tr>
<td></td>
<td>Division 2 - Code for Concrete Reactor Vessels and Containments</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>Division 3 - Containment Systems and Transport Packagings for Spent Nuclear Fuel and High Level Radioactive Waste</td>
<td>207</td>
</tr>
<tr>
<td>IV</td>
<td>Rules for Construction of Heating Boilers</td>
<td>298</td>
</tr>
<tr>
<td>V</td>
<td>Nondestructive Examination</td>
<td>736</td>
</tr>
<tr>
<td>VI</td>
<td>Recommended Rules for the Care and Operation of Heating Boilers</td>
<td>102</td>
</tr>
<tr>
<td>VII</td>
<td>Recommended Guidelines for the Care of Power Boilers</td>
<td>161</td>
</tr>
</tbody>
</table>
No attempt will be made to update this page tally for each new addenda—it is shown here to simply illustrate the general magnitude of the Code. This is quite a change from the three page Code that first appeared in 1914! This phenomenal growth has been driven mostly by technological advances in materials, testing, inspection, design and analysis methodology, fabrication, and overpressure protection as well as demands for rules covering new service conditions.

Sections II, V, and IX are “service sections” providing rules and guidance for both nonnuclear and nuclear construction. These sections constitute 4,834 pages or 38% of the 12,591 total pages in the Code. Rules for nonnuclear components (Sections I, IV, VI, VII, VIII, X, and their Code cases) involve 3,269 pages or 26%. The remainder of the Code covers nuclear construction (Sections III, XI, and Code cases) with a total of 4,488 pages or about 36% of the Code. Section II alone, with 3,831 pages, represents 30% of the entire Code.

Constructing a component in accordance with Code rules requires, first, a basic decision on which category of rules apply.

General categories are: - power boilers (fired),
- heating boilers,
- unfired pressure vessels,
- nuclear systems, or
- fiber-reinforced plastic pressure vessels.

One important issue to understand is that each category has unique materials requirements for that type of construction. Within each of the governing Code books are additional factors that must be addressed as the design, fabrication, testing, inspection, and installation processes progress. The following outlines show the organization of the various Code sections with particular emphasis on materials requirements. These outlines may serve as checklists or quick references for the materials specialist in Code construction.

Section I - Power Boilers

Part PG - General Requirements for Power Boilers and High Pressure, High Temperature Water Boilers
General Materials
PG-5 General
PG-6 Plate
PG-7 Forgings
PG-8 Castings
PG-9 Pipes, Tubes and Pressure Containing Parts
PG-10 Material Identified with or Produced to a Specification Not Permitted by This Section, and Material Not Fully Identified
Chapter 3

ORGANIZATION AND THE USE OF SECTION II, PART D

There is a near-symbiotic association between the “heart” of this CASTI Guidebook to ASME Section II and Section II, Part D. Each has influenced the other as they progressed to their current forms. The evolution of both spanned a time period of nearly 20 years, which lends support to the adage that “good things take time.” Unfortunately, the publication of Section II, Part D represented a somewhat controversial departure from an older, well established way of conveying allowable stresses and properties of Code materials. Some of the confusion surrounding use of this “new” approach is addressed by this chapter, and many of the questions will be answered and misunderstandings dispelled.

Scope

Section II, Part D is now the focal point for allowable stresses and properties for those materials permitted in Section I, III and VIII (Divisions 1 and 2) construction. This chapter delves into the development of Section II, Part D, its organization, use of the many stress and property tables, external pressure charts, associated appendices, and current efforts to adopt non-ASTM (foreign) specifications. It also provides additional useful information on materials behavior. As frequently suggested in Chapter 1, much of this information in Section II, Part D may be valuable in other engineering assignments. So, becoming comfortable with its organization and use is a MUST.

A Brief History of the Development of Section II, Part D

This author wrote a letter on October 5, 1979 to the Chairman of Subcommittee on Properties (as it was called at that time, before it was combined with the Subcommittee on Specifications to become the current Subcommittee on Materials), proposing that there be an “attempt to combine stress tables within a separate Code book.” It was further suggested at that time that other minimum and nominal properties and other materials characteristics, that are independent of Code application, be included as well. The arguments cited were that it would be a “quality control system to ensure consistency” and that it would eliminate a lot of duplicate pages, common to numerous Code sections. This letter also recognized “how this approach could uncover minor (and perhaps major) discrepancies in stress listings.” The gestation period for this idea was about five years, culminating in early 1985 with a move to resurrect a Task Group on Tabulation of Allowable Stresses and Materials Properties. The ambitious goal of publishing a new document in the 1986 Edition of the Code was obviously not met, but the wheels of motion were moving forward.

Michael Gold, current chairman of the Subcommittee on Materials, presented a paper at the 1995 ASME Pressure Vessel and Piping meeting, in Honolulu, Hawaii in June 1995, entitled “Section II, Part D and Adoption of Foreign Materials.” The balance of this historical recap uses portions of
Mr. Gold’s paper and is updated to cover the time since that paper was authored. Section II, Part D first appeared in the 1992 Edition of the Code, combining into one book, as suggested earlier, design stress values and materials property values previously published in Sections I, III, and VIII (Divisions 1 and 2). The stated purpose for publishing the information in a single volume for use with the respective sections was to ensure consistency of design values. This was essential since criteria used to develop the values and the data bases upon which values were based were identical.

The first version of Section II, Part D was nothing more than an editorial reformatting of information that existed in the four targeted Code sections. No attempts were made at that time to correct discrepancies that would now be painfully obvious. Over the next three years, concerted efforts were expended to eliminate the many inconsistencies that became evident not only in stress values, but in notes, nomenclature, and use temperatures. Corrections then allowed the merging of many stress lines, and that reduced the size of Section II, Part D.

The 1995 Edition of Section II, Part D was a “slimmed down” version with a new note system, further simplifying the stress tables. Also making the stress tables more user friendly was the numbering of lines to follow stress lines and associated information from one page to the next one, two, or three pages. Efforts will continue to further improve the quality of stresses and material properties as better data become available.

Structure of Section II, Part D

The Michael Gold paper cited earlier also provided an excellent description of the organizational structure of Section II, Part D. This write-up was based on “A Users Guide to BPV Section II Materials, Part D Properties: 1992 Addenda”, written by G. M. Eisenberg, at that time Secretary for the B&PVC Main Committee. The following was taken verbatim from Mr. Gold’s paper, with permission from ASME.

BASIC ORGANIZATION

The organization and structure of Section II, Part D, has been described thoroughly by G. M. Eisenberg (1992), in the User Guide to BPV Section II, Materials, Part D Properties: 1992 Edition, which was published as part of the 1992 Addenda update to Section II, Part D. Because that User Guide did not have page numbers, even current users of the Code may have lost track of it by now, so much of the information developed by Eisenberg has also been included here.

Section II, Part D, is divided into Subparts, followed by Appendices. These are described below.

Subpart 1: Stress Tables

Grouping by Criteria

The individual tables in Subpart 1 include values for materials, based on common stress criteria. For materials other than bolting, Tables 1A (Ferrous) and Table 1B (Non-Ferrous) contain maximum allowable stress values, based on the criteria that have been adopted for use in: Section I; Section III, Class 2 and 3; and Section VIII, Division 1. Tables 2A (Ferrous) and 2B (Non-Ferrous) contain design stress intensity values based on the criteria used for Section III, Class 1, and Section VIII, Division 2.
For bolting materials, Table 3 contains allowable stress values based on the criteria used in: Section VIII, Division 1; Section VIII, Division 2, according to the rules of Appendix 3 of Division 2; and Section III, Class 2 and 3. Table 4 contains design stress intensity values for bolting based on the criteria used for: Section VIII, Division 2; according to the rules of Appendices 4, 5, and 6, of Division 2; and those constructed according to the rules of Section III, Class 1. Table U contains tensile strength values for ferrous and nonferrous materials, previously contained only in Section III. Table Y-1 contains the yield strength values for ferrous and nonferrous materials previously contained in Sections I, III, and VIII, Division 2. Table Y-2 contains factors for limiting permanent strain for nickel, high nickel alloys, and high alloy steels from data previously contained in Sections III, and VIII, Division 2. Tables U-2 and Y-3 contain ultimate tensile strength and yield strength values respectively for additional materials used in Section VIII, Division 3 construction.

Ordering of Listing

The sorting order for materials, as they are listed in the tables, differs between Tables 1A and 1B. This difference persists in the other tables, as well, for ferrous and nonferrous materials, respectively. In Tables 1A and 2A, and the portions of Tables 3, 4, U, and Y-1 containing ferrous materials, the underlying sorting sequence in order of priority, is: nominal composition, tensile strength ST, yield strength SY, specification number, and grade or type. Two variables to this ordering are worth mentioning: There is no distinction made among the carbon steels on the basis of nominal compositions shown as C, C-Si, C-Mn, and C-Mn-Si. These were all treated as being identical carbon steels, with regard to nominal compositions, and were placed at the beginning of the table. In fact, those distinctions in Nominal Composition for carbon steels will soon be eliminated from Code stress tables and those materials will all be described simply as “C Steels.” This is already reflected in this version of the Materials Index. Micro-alloyed carbon steels will still retain their original distinction even though the reported thermophysical properties for carbon steels also are appropriate for these micro-alloyed carbon steels. The ordering of the carbon steels in stress tables begins with the tensile strength as the primary discriminator. Further, the austenitic stainless steels, those with chromium contents between 16 and 25, were separated from the ferritic steels and placed after them.

In Tables 1B, 2B, and the portions of Tables 3, 4, U, and Y-1 containing the nonferrous materials, the sorting priority is somewhat different: alloy/UNS number (alpha-numeric), tensile strength ST, yield strength SY, class/condition/temper, and specification number. Nominal compositions are not included as a sorting priority for the nonferrous materials. In fact, nominal compositions are not listed for the aluminum and copper alloys, because of all of the many different variations of nominal compositions available in different systems for these materials. For all nonferrous materials, the primary ordering sequence is based on the more unique UNS numbers that have been assigned to each grade.

Other Information in Tables

In addition to providing columns for the materials and the criteria by which they are sorted, and, of course, the design values, other information is provided in the stress tables: This includes nominal composition (for the other nonferrous materials), product form (e.g. tube, pipe, plate, etc.), specification number, type or grade, alloy designation or UNS number, class/condition/ temper, size/thickness, welding
P-number and group number, minimum tensile strength in ksi, minimum yield strength in ksi, and most importantly, the maximum temperature and applicability for each material in the Construction Codes appropriate for each table.

**Applicability-Temperature Limit Columns**

An example of the applicability/temperature limit column heading, is as follows.

<table>
<thead>
<tr>
<th>NP = (Not Permitted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>800</td>
</tr>
</tbody>
</table>

This entry indicates that, for this particular stress line, the values shown are appropriate for use in Section I construction, up to a maximum temperature of 800°F, and are appropriate for use in Section VIII, Division 1 construction, up to a maximum temperature of 1,500°F. The NP entry indicates that this stress line is not permitted for Section III construction. The difference in temperatures of applicability between Section I and Section VIII, may have no technical basis. It is possible that no inquirer ever requested use of this material in Section I construction, above 800°F. Many of these types of inconsistencies have been, and will continue to be eliminated in future Addenda. Further, the NP doesn’t necessarily mean that this particular material would never be permitted in Section III construction; it might mean that either no one has ever requested this material for use in Section III construction, or that there is another stress line, with some differences, that has previously been approved for Section III construction, and it would normally be found immediately above or below this particular line. Subcommittee II is working to eliminate such inconsistencies, and the 1995 Edition went a long way in that direction.

**External Pressure Charts and Notes**

Other information included in the stress tables are the external pressure chart numbers, and their references. Many inconsistencies in the referenced external pressure charts existed in the initial publication of Section II, Part D, but these have since been addressed and resolved.

The 1992 Edition and its three Addenda contained separate tables for notes, essentially as they originally appeared in the construction Codes. The 1995 Edition merged all of those notes into a single set of notes applicable to each stress table. Unfortunately, those who became familiar with a particular identification number for certain notes will have to learn new numbers. The new system is much more understandable and combines many similarly worded notes that had exactly the same meaning into single notes.

**Subpart 2: Physical Properties Tables**

There are four sets of physical properties tables. Those in the first set are the nominal coefficients of thermal expansion, numbered TE-1 through TE-5. These combined existing values from the 1989 Editions of Section III and Section VIII, Division 2. The five tables cover ferrous materials, aluminum alloys, copper and copper alloys, high nickel alloys, and titanium and titanium alloys, respectively. The next table is Table TCD, which includes nominal coefficients of thermal conductivity and thermal diffusivity. The values in this table were also extracted from tables that existed in the
Chapter 4

EVOLUTION, ORGANIZATION AND USE OF ASME MATERIALS SPECIFICATIONS

This chapter is intended for users who are new to materials specifications or to comprehensive collections such Section II, Parts A, B, and C of the ASME Boiler and Pressure Vessel Code. It includes basic information on how the Code specifications were developed and how they should be used.

Scope

ASME Code specifications cover ferrous, nonferrous, and weld filler materials. This chapter concentrates on the ferrous and nonferrous materials covered by specifications in Parts A and B, respectively, of Section II. Welding filler metals are already covered in a companion book, CASTI Metals Blue Book - Welding Filler Metals, and to a lesser extent in the recently published CASTI Guidebook to ASME Section IX - Welding Qualifications, both published by CASTI Publishing Inc.

Evolution of ASME Specifications

ASME materials specifications are currently based on ASTM materials specifications that have been reviewed and approved by the various Code committees as being suitable for Code construction. Suitability is generally determined by a set of chemical composition requirements and well defined mechanical property requirements. When such specifications are not suitable, there is obvious pressure for ASTM to make the necessary changes to make their standards more acceptable. This close association between ASTM and the ASME Code has been going on since the 1920s or about 75 years. An article by Michael Gold in the January 1996 issue of ASTM Standardization News, entitled "ASTM and ASME: Partners in Materials Specifications" expounds on the role of ASTM standards for metals in the ASME Boiler and Pressure Vessel Code. The article covers very clearly the exhaustive review and approval process required by both organizations.

The Foreword to the various Code sections also contains information relative to the evolution of ASME materials specifications. Excerpts follow:

"Revisions to material specifications are originated by the American Society for Testing and Materials (ASTM) and other recognized national or international organizations, and are usually adopted by ASME. However, those revisions may or may not have any effect on the suitability of material, produced to earlier editions of specifications, for use in ASME construction. ASME material specifications approved for use in each construction Code are listed in the Appendices of Section II, Parts A and B. These Appendices list, for each specification, the latest edition adopted by ASME, and earlier and later editions considered by ASME to be identical for ASME construction."
The words “other recognized national or international organizations” (in the context of standards that might be adopted as ASME specifications) in the above excerpt are recent additions to the Foreword. They reflect a recent policy decision by the ASME Code Committee to remove impediments to greater use of the ASME Code overseas. Appearing at the end of the Chapter 9 table are the first non-ASTM Standards adopted for Code construction.

**Organization of Parts A and B of Section II**

The organization of Parts A and B of Section II has already been defined in Chapter 2. Listings of specifications found within these two books are found in Chapter 11 of this Guidebook. Each of these specifications covers one or more product forms and anything from one to 90 or more different material grades. This will become obvious in Chapters 9 and 10 for ferrous and nonferrous materials. Parts A and B also contain numerous general requirement specifications listed at the beginning of Chapter 6.

**Organization of Typical Specifications**

In dealing with a well established set of national standards, the first expectation would be that a common, consistent format would be used in all material specifications. Unfortunately, that is not the case. Nearly every ASME specification (which is based on an ASTM specification) has a slightly different format. So, rather than attempt to describe some hypothetical ideal common specification format, discussions will center around the more common features. Since almost all start with a scope statement, reference documents, and ordering information, the ensuing discussion covers those subjects first and then touches on other subjects, not necessarily in the order they appear in any particular specification. A review of both Parts A and B of Section II suggest that this approach will apply equally to both ferrous and nonferrous material specifications.

**Scope**

The scope statement contains very important information, generally dealing with application intentions or limits not fully conveyed in the title of the specification. ASME SA-620 provides a good example.

**Title:** Specification for Steel, Sheet, Carbon, Drawing Quality, Special Killed, Cold-Rolled

**Scope:** This specification covers cold-rolled carbon steel sheet of drawing quality, special killed, in coils or cut lengths.

This material is intended for fabricating identified parts where particularly severe drawing or forming may be involved or essential freedom from aging is required.

The second sentence of this scope statement defines quite clearly where material of this type should be used.
One more example is SA-540, a bolting specification:

**Title:** Specification for Alloy - Steel Bolting Materials for Special Applications

**Scope:** Para 1.1 - This specification covers regular and special quality alloy steel bolting materials which may be used for nuclear and other special applications. Bolting materials as used in this specification cover rolled or forged bars, rotary pierced or extruded seamless tubes, forged bars, or forged hollows from forged or rolled bar segments to be manufactured into bolts, studs, washers, and nuts.

Para. 1.2 - Several grades of steel are covered. The grade and class shall be specified by the purchaser.

Para. 1.3 - Supplementary requirements of an optional nature are provided for use when special quality is desired. These supplementary requirements call for additional tests to be made and when desired shall be so stated in the order, together with the acceptance limits required.

There are two more paragraphs (1.4 and 1.5) with units (SI); in other specifications, such information might be found as footnotes. Paragraphs 1.2 and 1.3, in other specifications, might be found under Ordering Information (which will be discussed later). Paragraph 1.1 is the real “meat” of the scope statement, defining further where such material is typically used and how it can be manufactured. In this particular specification, there is paragraph 4, Manufacture, but that only defines the steel-making process.

In summary, there is a tremendous amount of application information in these scope statements and they should be read carefully and often until the serious materials person has the more frequently used ones almost memorized.

**Reference Documents**

“Reference Documents”, almost without exception, is the second paragraph heading of any ferrous or nonferrous material specification. The first documents generally listed are the ASTM standards, including ones for the material from which this product form might be made, the general requirements specifications that apply (in addition to the requirements within the subject specification), and any applicable testing method specifications.

There may be other standards listed from ASME, ANSI, SAE, ASNT, MSS, AWS, API, AIAG, etc. When there are general requirements specifications listed in the Reference Documents paragraph, there is generally specific reference to the specification one or more times in other paragraphs.

**General Requirements and Ordering Information**

Some specifications cover this information in a single paragraph while others separate the information into two paragraphs, with some variation in which is presented first.

The General Requirements mostly emphasize that material furnished shall conform to applicable requirements of the appropriate general requirements specification. In many specifications for nonferrous materials, this paragraph will be missing and may be replaced by a paragraph on Terminology (which will be discussed later).
Chapter 5

CODE ALLOYS BY UNS NUMBERS

Alloys used in ASME Code construction are divided into 10 groupings of alloy types, as depicted below:

- AXXXXX Aluminum-base alloys
- CXXXXX Copper-base alloys
- FXXXXX Cast iron alloys
- GXXXXX AISI and SAE carbon and alloys steels
- HXXXXX AISI and SAE H-steels
- JXXXXX Cast steels
- KXXXXX Misc. steel and ferrous alloys
- NXXXXX Nickel-base alloys
- RXXXXX Special metals and alloys
- SXXXXX Heat and corrosion resistant steels

The following pages are arranged by UNS sections and by increasing number. This portion matches UNS numbers with nominal composition and alloy grade or specification. Materials shown in this chapter appear in ASME “SA” or “SB” specifications, but they may not have been assigned stresses that allow their use in Code construction. Indications of assigned stresses will be found in Chapters 9 and 10 for ferrous and nonferrous materials, respectively.

Groupings of UNS numbers beginning with F, G, H, J, and K contain a more complete listing of actual specifications/grades/classes that are associated with each UNS number. The balance of the UNS number groupings, beginning with A, C, N, R, and S show only the grade designation and generally the common name or trade name. As was discussed back in Chapter 3, assignment of UNS numbers is an ongoing process and there will most likely be some changes in the future to these UNS numbers.
### ALUMINUM-BASE ALLOYS BY UNS No.

<table>
<thead>
<tr>
<th>UNS No.</th>
<th>Nominal Composition</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>A02040</td>
<td>Al – Cu – Mg</td>
<td>Alloy 204</td>
</tr>
<tr>
<td>A03560</td>
<td>Al – Si – Mg</td>
<td>Alloy 356; old SG70A</td>
</tr>
<tr>
<td>A03570</td>
<td>Al – Si – Mg</td>
<td>---</td>
</tr>
<tr>
<td>A13560</td>
<td>Al – Si – Mg – Cu</td>
<td></td>
</tr>
<tr>
<td>A24430</td>
<td>Al – Si</td>
<td>Alloy 443; old S5A</td>
</tr>
<tr>
<td>A83003</td>
<td>---</td>
<td>Alclad 3003</td>
</tr>
<tr>
<td>A83004</td>
<td>---</td>
<td>Alclad 3004</td>
</tr>
<tr>
<td>A86061</td>
<td>---</td>
<td>Alclad 6061</td>
</tr>
<tr>
<td>A91060</td>
<td>99.60 Al</td>
<td>1060</td>
</tr>
<tr>
<td>A91100</td>
<td>99.0 Al – Cu</td>
<td>1100</td>
</tr>
<tr>
<td>A92014</td>
<td>Al – 4 Cu – Si – Mn</td>
<td>2014</td>
</tr>
<tr>
<td>A92024</td>
<td>Al – 4 Cu – Mg</td>
<td>2024</td>
</tr>
<tr>
<td>A93003</td>
<td>Al – Mn – Cu</td>
<td>3003</td>
</tr>
<tr>
<td>A93004</td>
<td>Al – Mn – Mg</td>
<td>3004</td>
</tr>
<tr>
<td>A95052</td>
<td>Al – 2.5 Mg</td>
<td>5052</td>
</tr>
<tr>
<td>A95083</td>
<td>Al – 4.4 Mg – Mn</td>
<td>5083</td>
</tr>
<tr>
<td>A95086</td>
<td>Al – 4.0 Mg – Mn</td>
<td>5086</td>
</tr>
<tr>
<td>A95154</td>
<td>Al – 3.5 Mg</td>
<td>5154</td>
</tr>
<tr>
<td>A95254</td>
<td>Al – 3.5 Mg</td>
<td>5254</td>
</tr>
<tr>
<td>A95454</td>
<td>Al – 2.7 Mg – Mn</td>
<td>5454</td>
</tr>
<tr>
<td>A95456</td>
<td>Al – 5.1 Mg – Mn</td>
<td>5456</td>
</tr>
<tr>
<td>A95652</td>
<td>Al – 2.5 Mg</td>
<td>5652</td>
</tr>
<tr>
<td>A96061</td>
<td>Al – Mg – Si – Cu</td>
<td>6061</td>
</tr>
<tr>
<td>A96063</td>
<td>Al – Mg – Si</td>
<td>6063</td>
</tr>
</tbody>
</table>

### COPPER-BASE ALLOYS BY UNS No.

<table>
<thead>
<tr>
<th>UNS No.</th>
<th>Nominal Composition</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10200</td>
<td>99.95 Cu</td>
<td>OF Cu</td>
</tr>
<tr>
<td>C10400</td>
<td>99.95 Cu + Ag</td>
<td>OFS Cu</td>
</tr>
<tr>
<td>C10500</td>
<td>99.95 Cu + Ag</td>
<td>OFS Cu</td>
</tr>
<tr>
<td>C10700</td>
<td>99.95 Cu + Ag</td>
<td>OFS Cu</td>
</tr>
<tr>
<td>C11000</td>
<td>99.90 Cu</td>
<td>ETP Cu</td>
</tr>
<tr>
<td>C12000</td>
<td>99.90 Cu + P</td>
<td>DLP Cu</td>
</tr>
<tr>
<td>C12200</td>
<td>99.9 Cu + P</td>
<td>DHP Cu</td>
</tr>
<tr>
<td>C12300</td>
<td>99.90 Cu + Ag &amp; P</td>
<td>DPS Cu</td>
</tr>
<tr>
<td>C12500</td>
<td>99.88 Cu</td>
<td>FRTP Cu</td>
</tr>
<tr>
<td>C14200</td>
<td>99.40 Cu + As &amp; P</td>
<td>DPA Cu</td>
</tr>
<tr>
<td>C19200</td>
<td>98.7 Cu + Fe + P</td>
<td>Phosphorized 1% Fe</td>
</tr>
<tr>
<td>C19400</td>
<td>97.4 Cu + Fe</td>
<td>Cu-Fe alloy</td>
</tr>
<tr>
<td>C23000</td>
<td>85 Cu – 15 Zn</td>
<td>Red brass</td>
</tr>
<tr>
<td>C28000</td>
<td>60 Cu – 40 Zn</td>
<td>Muntz metal</td>
</tr>
<tr>
<td>C36500</td>
<td>60 Cu – 39 Zn – Pb</td>
<td>Lead Muntz metal, uninhibited</td>
</tr>
<tr>
<td>C37700</td>
<td>60 Cu – 37 Zn – 2 Pb</td>
<td>Forging brass</td>
</tr>
<tr>
<td>C44300</td>
<td>71 Cu – 28 Zn – Sn – As</td>
<td>Admiralalty metal B (arsenical)</td>
</tr>
<tr>
<td>C44400</td>
<td>71 Cu – 28 Zn – Sn – Sb</td>
<td>Admiralalty metal C (antimonial)</td>
</tr>
<tr>
<td>C44500</td>
<td>71 Cu – 28 Zn – Sn – P</td>
<td>Admiralalty metal D (phosphorized)</td>
</tr>
<tr>
<td>C46400</td>
<td>60 Cu – 39 Zn – Sn</td>
<td>Naval brass, uninhibited</td>
</tr>
<tr>
<td>C46500</td>
<td>60 Cu – 39 Zn – Sn – As</td>
<td>Naval brass, arsenical</td>
</tr>
</tbody>
</table>
### COPPER-BASE ALLOYS BY UNS No. (Continued)

<table>
<thead>
<tr>
<th>UNS No.</th>
<th>Nominal Composition</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>C60800</td>
<td>95 Cu – 5 Al</td>
<td>Aluminum bronze</td>
</tr>
<tr>
<td>C61300</td>
<td>90 Cu – 7 Al – 3 Fe – Sn</td>
<td>Aluminum bronze</td>
</tr>
<tr>
<td>C61400</td>
<td>90 Cu – 7 Al – 3 Fe</td>
<td>Aluminum bronze D or 3</td>
</tr>
<tr>
<td>C62300</td>
<td>88 Cu – 9 Al – 3 Fe</td>
<td>Aluminum bronze 2</td>
</tr>
<tr>
<td>C63000</td>
<td>81 Cu – 10 Al – 3 Fe – Ni</td>
<td>Aluminum-nickel bronze 2</td>
</tr>
<tr>
<td>C64200</td>
<td>91 Cu – 7 Al – 2 Si</td>
<td>Aluminum bronze 1</td>
</tr>
<tr>
<td>C65100</td>
<td>98.5 Cu – 1.5 Si</td>
<td>Copper silicon alloy B</td>
</tr>
<tr>
<td>C65500</td>
<td>97 Cu – 3 Si</td>
<td>High silicon bronze alloy A</td>
</tr>
<tr>
<td>C66100</td>
<td>94 Cu – 8 Si – P</td>
<td>Copper-silicon alloy D</td>
</tr>
<tr>
<td>C68700</td>
<td>78 Cu – 20 Zn – 2 Al</td>
<td>Aluminum brass B</td>
</tr>
<tr>
<td>C70400</td>
<td>95 Cu – 5 Ni</td>
<td>95 – 5 copper nickel</td>
</tr>
<tr>
<td>C70600</td>
<td>90 Cu – 10 Ni</td>
<td>90 – 10 copper nickel</td>
</tr>
<tr>
<td>C71000</td>
<td>80 Cu – 20 Ni</td>
<td>80 – 20 copper nickel</td>
</tr>
<tr>
<td>C71500</td>
<td>70 Cu – 30 Ni</td>
<td>70 – 30 copper nickel</td>
</tr>
<tr>
<td>C71640</td>
<td>66 Cu – 30 Ni – 2 Fe – 2 Mn</td>
<td>Copper-nickel</td>
</tr>
<tr>
<td>C72200</td>
<td>80 Cu – 16 Ni – Mn – Zn – Cr</td>
<td>Copper-nickel</td>
</tr>
<tr>
<td>C74500</td>
<td>65 Cu – 10 Ni – Zn</td>
<td>Nickel silver 65 – 10</td>
</tr>
<tr>
<td>C75200</td>
<td>65 Cu – 18 Ni – Zn</td>
<td>Nickel silver 65 – 18</td>
</tr>
<tr>
<td>C75700</td>
<td>65 Cu – 12 Ni – Zn</td>
<td>Nickel silver 65 – 12</td>
</tr>
<tr>
<td>C76400</td>
<td>60 Cu – 18 Ni – Zn</td>
<td>Nickel silver 60 – 18</td>
</tr>
<tr>
<td>C77000</td>
<td>55 Cu – 18 Ni – Zn</td>
<td>Nickel silver 55 – 18</td>
</tr>
<tr>
<td>C79200</td>
<td>63 Cu – 12 Ni – Zn - Pb</td>
<td>Leaded nickel silver</td>
</tr>
<tr>
<td>C83600</td>
<td>85 Cu – 5 Sn – 5 Zn – 5 Pb</td>
<td>Alloy 85 or 85-5-5-5</td>
</tr>
<tr>
<td>C84400</td>
<td>81 Cu – 9 Zn – 7 Pb – 3 Sn</td>
<td>Leaded, semi-red brass</td>
</tr>
<tr>
<td>C90300</td>
<td>87 Cu – 8 Sn – 4 Zn</td>
<td>Tin bronze</td>
</tr>
<tr>
<td>C92200</td>
<td>88 Cu – 6 Sn – 4.5 Zn – Pb</td>
<td>Alloy 2A or valve bronze</td>
</tr>
<tr>
<td>C93700</td>
<td>80 Cu – 10 Sn – 9 Pb</td>
<td>Cast high leaded tin bronze</td>
</tr>
<tr>
<td>C95200</td>
<td>88 Cu – 9 Al – 3 Fe</td>
<td>Aluminum bronze 9A</td>
</tr>
<tr>
<td>C95400</td>
<td>85 Cu – 11 Al – 4 Fe</td>
<td>Aluminum bronze 9C</td>
</tr>
<tr>
<td>C95820</td>
<td>77.5 Cu – 9 Al – 5 Ni – Fe</td>
<td>Nickel-aluminum bronze</td>
</tr>
<tr>
<td>C96200</td>
<td>87.5 Cu – 10 Ni – Fe – Mn</td>
<td>Alloy A</td>
</tr>
<tr>
<td>C96400</td>
<td>66 Cu – 30 Ni – Fe – Mn</td>
<td>Alloy B</td>
</tr>
<tr>
<td>C97600</td>
<td>65 Cu – 20 Ni – 8 Zn – Pb</td>
<td>Leaded nickel-silver</td>
</tr>
</tbody>
</table>

### CAST IRONS BY UNS No.

<table>
<thead>
<tr>
<th>UNS No.</th>
<th>Nominal Composition</th>
<th>Specification - Grade/Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>F11401</td>
<td>Cast iron</td>
<td>SA-278 Class 20</td>
</tr>
<tr>
<td>F11701</td>
<td>Cast iron</td>
<td>SA-278 Class 25</td>
</tr>
<tr>
<td>F12101</td>
<td>Cast iron</td>
<td>SA-278 Class 30</td>
</tr>
<tr>
<td>F12401</td>
<td>Cast iron</td>
<td>SA-278 Class 35</td>
</tr>
<tr>
<td>F12803</td>
<td>Cast iron</td>
<td>SA-278 Class 40</td>
</tr>
<tr>
<td>F13102</td>
<td>Cast iron</td>
<td>SA-278 Class 45</td>
</tr>
<tr>
<td>F13502</td>
<td>Cast iron</td>
<td>SA-278 Class 50</td>
</tr>
<tr>
<td>F13802</td>
<td>Cast iron</td>
<td>SA-278 Class 55</td>
</tr>
<tr>
<td>F14102</td>
<td>Cast iron</td>
<td>SA-278 Class 60</td>
</tr>
<tr>
<td>F22200</td>
<td>Malleable iron</td>
<td>SA-47 Grade 32510</td>
</tr>
<tr>
<td>F32800</td>
<td>Nodular iron</td>
<td>SA-395</td>
</tr>
<tr>
<td>F34100</td>
<td>Nodular iron</td>
<td>SA-476</td>
</tr>
</tbody>
</table>
### AISI AND SAE CARBON AND ALLOY STEELS BY UNS No.

<table>
<thead>
<tr>
<th>UNS No.</th>
<th>Nominal Composition</th>
<th>Specification - Grade/Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>G10180</td>
<td>C steel SA-311, Grade 1018</td>
<td></td>
</tr>
<tr>
<td>G10350</td>
<td>C steel SA-311, Grade 1035</td>
<td></td>
</tr>
<tr>
<td>G10450</td>
<td>C steel SA-311, Grade 1045</td>
<td></td>
</tr>
<tr>
<td>G10500</td>
<td>C steel SA-311, Grade 1050</td>
<td></td>
</tr>
<tr>
<td>G11170</td>
<td>C steel SA-311, Grade 1117</td>
<td></td>
</tr>
<tr>
<td>G11370</td>
<td>C steel SA-311, Grade 1137</td>
<td></td>
</tr>
<tr>
<td>G11410</td>
<td>C steel SA-311, Grade 1141</td>
<td></td>
</tr>
<tr>
<td>G11440</td>
<td>C steel SA-311, Grade 1144</td>
<td></td>
</tr>
<tr>
<td>G15410</td>
<td>C steel SA-311, Grade 1541</td>
<td></td>
</tr>
<tr>
<td>G40370</td>
<td>C-¼ Mo SA-320 Grades L7A, L71, SA-574 Grade 4037</td>
<td></td>
</tr>
<tr>
<td>G40420</td>
<td>C-¼ Mo SA-194 Grade 7, SA-574 Grade 4042</td>
<td></td>
</tr>
<tr>
<td>G41350</td>
<td>1 Cr-¼ Mo SA-372 Grade F</td>
<td></td>
</tr>
<tr>
<td>G41370</td>
<td>1 Cr-½ Mo SA-320 Grades L7B, L72 SA-574 Grade 4137, SA-372 Grade J</td>
<td></td>
</tr>
<tr>
<td>G41400</td>
<td>1 Cr-½ Mo SA-193 Grades B7, B7M, SA-194 Grades 7, 7M, SA-320 Grades L7, L7M, SA-574 Grade 4140</td>
<td></td>
</tr>
<tr>
<td>G41420</td>
<td>1 Cr-½ Mo SA-574 Grade 4142</td>
<td></td>
</tr>
<tr>
<td>G41450</td>
<td>1 Cr-½ Mo SA-574 Grade 4145</td>
<td></td>
</tr>
<tr>
<td>G43400</td>
<td>1½ Ni-¼ Cr-½ Mo SA-574 Grade 4340, SA-320 Grade L43</td>
<td></td>
</tr>
<tr>
<td>G61500</td>
<td>1 Cr-0.15 V SA-232</td>
<td></td>
</tr>
<tr>
<td>G87400</td>
<td>½ Ni-½ Cr-¼ Mo SA-320 Grades L7C and L73, SA-574 Grade 8740</td>
<td></td>
</tr>
</tbody>
</table>

### AISI AND SAE H-STEELS BY UNS No.

<table>
<thead>
<tr>
<th>UNS No.</th>
<th>Nominal Composition</th>
<th>Specification - Grade/Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>H15211</td>
<td>Low C - Boron steel SA-320 Grade L1</td>
<td></td>
</tr>
<tr>
<td>H41420</td>
<td>1 Cr - 1Mn - ¼ Mo SA-540 Grade B22</td>
<td></td>
</tr>
<tr>
<td>H43400</td>
<td>2 Ni - ¼ Cr - ¼ Mo SA-540 Grade B23</td>
<td></td>
</tr>
</tbody>
</table>

### CAST STEELS BY UNS No.

<table>
<thead>
<tr>
<th>UNS No.</th>
<th>Nominal Composition</th>
<th>Specification - Grade/Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>J02502</td>
<td>C steel SA-216 Grade WCA</td>
<td></td>
</tr>
<tr>
<td>J02503</td>
<td>C steel SA-216 Grade WCC</td>
<td></td>
</tr>
<tr>
<td>J02504</td>
<td>C steel SA-352 Grade LCA, SA-660 Grade WCA</td>
<td></td>
</tr>
<tr>
<td>J02505</td>
<td>C steel SA-352 Grade LCC, SA-660 Grade WCC</td>
<td></td>
</tr>
<tr>
<td>J03002</td>
<td>C steel SA-216 Grade WCB</td>
<td></td>
</tr>
<tr>
<td>J03003</td>
<td>C steel SA-352 Grade LCB, SA-660 Grade WCB</td>
<td></td>
</tr>
<tr>
<td>J11522</td>
<td>C - ½ Mo - Si SA-426 Grade CP15</td>
<td></td>
</tr>
<tr>
<td>J11547</td>
<td>½ Cr - ½ Mo SA-426 Grade CP2</td>
<td></td>
</tr>
<tr>
<td>J11562</td>
<td>1 Cr - ½ Mo SA-426 Grade CP12</td>
<td></td>
</tr>
<tr>
<td>J11872</td>
<td>1¼ Cr - ½ Mo SA-217 Grade WC11</td>
<td></td>
</tr>
<tr>
<td>J12072</td>
<td>1¼ Cr - ½ Mo SA-217 Grade WC6, SA-426 Grade CP11</td>
<td></td>
</tr>
<tr>
<td>J12082</td>
<td>1 Ni - ½ Cr - ½ Mo SA-217 Grade WC4, SA-487 Grades 11A and 11B</td>
<td></td>
</tr>
<tr>
<td>J12084</td>
<td>Ni - Cr - Mo - V SA-487 Grade 7A</td>
<td></td>
</tr>
<tr>
<td>J12521</td>
<td>C - ½ Mo SA-426 Grade CP-1</td>
<td></td>
</tr>
<tr>
<td>J12522</td>
<td>C - ½ Mo SA-352 Grade LC1</td>
<td></td>
</tr>
<tr>
<td>J12524</td>
<td>C - ½ Mo SA-217 Grade WC1</td>
<td></td>
</tr>
<tr>
<td>J13002</td>
<td>Mn - V SA-487 Grades 1A, 1B and 1C</td>
<td></td>
</tr>
<tr>
<td>J13005</td>
<td>Mn - ¼ Mo - V SA-487 Grades 2A, 2B and 2C</td>
<td></td>
</tr>
<tr>
<td>UNS No.</td>
<td>Nominal Composition</td>
<td>Specification - Grade/Class</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>J13047</td>
<td>½ Ni - ½ Cr - ¼ Mo - V</td>
<td>SA-487 Grades 4A, 4B, 4C, 4D and 4E</td>
</tr>
<tr>
<td>J13080</td>
<td>Ni - Mo</td>
<td>SA-487 Grades 13A and 13B</td>
</tr>
<tr>
<td>J13345</td>
<td>1 Cr - ½ Mo</td>
<td>SA-487 Grades 9A, 9B, 9C, 9D and 9E</td>
</tr>
<tr>
<td>J13855</td>
<td>Mn - Ni - Cr - Mo</td>
<td>SA-487 Grades 6A and 6B</td>
</tr>
<tr>
<td>J15580</td>
<td>Ni - Mo</td>
<td>SA-487 Grade 14A</td>
</tr>
<tr>
<td>J21890</td>
<td>2 ¼ Cr - 1Mo</td>
<td>SA-217 Grade WC9, SA-426 Grade CP22</td>
</tr>
<tr>
<td>J22000</td>
<td>¾ Ni - 1 Mo - ¼ Cr</td>
<td>SA-217 Grade WC5, SA-487 Grades 12A and 12B</td>
</tr>
<tr>
<td>J22091</td>
<td>2 ¼ Cr - 1 Mo</td>
<td>SA-487 Grades 8A, 8B and 8C</td>
</tr>
<tr>
<td>J22500</td>
<td>2 ½ Ni</td>
<td>SA-352 Grade LC2</td>
</tr>
<tr>
<td>J23015</td>
<td>1 ½ Ni - ¾ Cr - ¼ Mo</td>
<td>SA-487 Grades 10A and 10B</td>
</tr>
<tr>
<td>J31200</td>
<td>Low C Mn-Ni</td>
<td>SA-487 Grade 16A</td>
</tr>
<tr>
<td>J31300</td>
<td>9 Ni</td>
<td>SA-352 Grade LC9</td>
</tr>
<tr>
<td>J31545</td>
<td>3 Cr - 1 Mo</td>
<td>SA-426 Grade CP21</td>
</tr>
<tr>
<td>J31550</td>
<td>3 ½ Ni</td>
<td>SA-352 Grade LC3</td>
</tr>
<tr>
<td>J41500</td>
<td>4 ½ Ni</td>
<td>SA-352 Grade LC4</td>
</tr>
<tr>
<td>J42045</td>
<td>5 Cr - ½ Mo</td>
<td>SA-217 Grade C5, SA-426 Grade CP5</td>
</tr>
<tr>
<td>J42215</td>
<td>Ni - Cr - Mo</td>
<td>SA-352 Grade LC2-1</td>
</tr>
<tr>
<td>J51545</td>
<td>5 Cr - ½ Mo - Si</td>
<td>SA-426 Grade CP5b</td>
</tr>
<tr>
<td>J82090</td>
<td>9 Cr - 1 Mo</td>
<td>SA-217 Grade C12, SA-426 Grade CP9</td>
</tr>
<tr>
<td>J91150</td>
<td>13 Cr</td>
<td>SA-217 Grade CA15, SA-426 Grade CPC15, SA-487 Grades CA15A and CA15B</td>
</tr>
<tr>
<td>J91151</td>
<td>13 Cr - Mo</td>
<td>SA-487 Grade CA15M-A</td>
</tr>
<tr>
<td>J91171</td>
<td>13 Cr</td>
<td>SA-487 Grades CA15C and CA15D</td>
</tr>
<tr>
<td>J91540</td>
<td>13 Cr - 4 Ni - .7 Mo</td>
<td>SA-352 Grade CA6NM, SA-487 Grade CA6NM-A/-B</td>
</tr>
<tr>
<td>J92110</td>
<td>15 Cr - 5 Ni - 3 Cu</td>
<td>SA-747 Grade CB7Cu-2</td>
</tr>
<tr>
<td>J92180</td>
<td>16 Cr - 4 Ni - 3 Cu</td>
<td>SA-747 Grade CB7Cu-1</td>
</tr>
<tr>
<td>J92500</td>
<td>18 Cr - 8 Ni</td>
<td>SA-351 Grades CF3 and CF3A, SA-451 Grades CPF3 and CPF3A</td>
</tr>
<tr>
<td>J92590</td>
<td>19 Cr - 9 Ni - ½ Mo</td>
<td>SA-351 Grade CF10</td>
</tr>
<tr>
<td>J92600</td>
<td>18 Cr - 8 Ni</td>
<td>SA-351 Grades CF8 and CF8A, SA-451 Grades CPF8 and CPF8A</td>
</tr>
<tr>
<td>J92700</td>
<td>16 Cr - 12 Ni - 2 Mo - N</td>
<td>SA-351 Grade CF3MN</td>
</tr>
<tr>
<td>J92710</td>
<td>18 Cr - 10 Ni - Cb</td>
<td>SA-351 Grade CF8C, SA-451 Grade CPF8C</td>
</tr>
<tr>
<td>J92800</td>
<td>16 Cr - 12 Ni - 2 Mo</td>
<td>SA-351 Grades CF3M and CF3MA, SA-451 Grade CPF3M</td>
</tr>
<tr>
<td>J92802</td>
<td>24 Cr - 9 Ni - Mo - N</td>
<td>SA-351 Grade CE20N, SA-451 Grade CPE20N</td>
</tr>
<tr>
<td>J92900</td>
<td>16 Cr - 12 Ni - 2 Mo</td>
<td>SA-351 Grade CF8M, SA-451 Grade CPF8M</td>
</tr>
<tr>
<td>J92901</td>
<td>19 Cr - 9 Ni - 2 Mo</td>
<td>SA-351 Grade CF10M</td>
</tr>
<tr>
<td>J92971</td>
<td>16 Cr - 14 Ni - 2 Mo</td>
<td>SA-351 Grade CF10MC, SA-451 Grade CPF 10 MC</td>
</tr>
<tr>
<td>J92972</td>
<td>18 Cr - 8 Ni - 4 Si - N</td>
<td>SA-351 Grade CF10SMnN</td>
</tr>
<tr>
<td>J92999</td>
<td>19 Cr - 11 Ni - 3 Mo</td>
<td>SA-351 Grade CG3M</td>
</tr>
<tr>
<td>J93000</td>
<td>19 Cr - 10 Ni - 3 Mo</td>
<td>SA-351 Grade CG8M</td>
</tr>
<tr>
<td>J93254</td>
<td>20 Cr - 18 Ni - 6 Mo-Cu-N</td>
<td>SA-351 Grade CK3MCuN</td>
</tr>
<tr>
<td>J93345</td>
<td>24 Cr - 10 Ni - 3 Mo - N</td>
<td>SA-351 Grade CE8MN</td>
</tr>
<tr>
<td>J93370</td>
<td>25 Cr - 5 Ni - 3 Cu - 2 Mo</td>
<td>SA-351 Grade CD4MCu</td>
</tr>
<tr>
<td>J93380</td>
<td>25 Cr - 7 ½ Ni - 3 ½ Mo-N-Cu-W</td>
<td>SA-351 Grade CD3MCuN</td>
</tr>
<tr>
<td>J93400</td>
<td>25 Cr - 12 Ni</td>
<td>SA-351 Grade CH8, SA-451 Grade CPH8</td>
</tr>
<tr>
<td>J93401</td>
<td>24 Cr - 13 Ni - ½ Mo</td>
<td>SA-351 Grade CH10, SA-451 Grade CPH10</td>
</tr>
<tr>
<td>J93402</td>
<td>25 Cr - 12 Ni</td>
<td>SA-351 Grade CH20, SA-451 Grade CPH20</td>
</tr>
<tr>
<td>J93790</td>
<td>22 Cr - 13 Ni - 5 Mn</td>
<td>SA-351 Grade CG6MMN</td>
</tr>
<tr>
<td>J94202</td>
<td>25 Cr - 20 Ni</td>
<td>SA-351 Grade Grade CK20, SA-451 Grade CPK20</td>
</tr>
</tbody>
</table>
Chapter 6

CODE SPECIFICATIONS BY NOMINAL COMPOSITION & BY COMMON NAME

The assigned nominal composition for a given type of material, particularly for ferrous materials, determines its location in the various stress tables of the Code. The following tables in this Chapter were developed to help locate other product forms for a given composition or to find materials with similar compositions. The following is a listing of the various categories of materials covered by tables within this Chapter. Their order does not quite parallel the system used within Section II, Part D stress tables. Also listed in this Chapter are the General Requirements specifications and Methods (testing and examination) specifications. In all of the materials tables within this Chapter, an attempt was made to list all corresponding common names or trade names.

ASME General Requirements Specifications

- Carbon Steels
- Clad Steels
- Cast Irons
- Low Alloy Steels
  - C - Mo steels
  - ½ Cr - 1⅔ Cr steels
  - 1 ⅔ Cr - 3 Cr steels
  - 5 Cr - 9 Cr steels
  - Mn, Mn - Mo, and Si steels
- Nickel steels
- High Alloy Steels
- By increasing chromium content
  - Ni - Cr steels
- Aluminum Alloys (by changes in nominal composition designation)
- Copper Alloys (by increasing alloying element/decreasing copper content)
- Nickel Alloys (by increasing alloying element/decreasing nickel content)
- Special Alloys (typically the higher cobalt-containing alloys)
- Titanium Alloys (by increasing alloying element content)
- Zirconium Alloys (by increasing UNS number)

Abbreviation Note: ASME Material Specifications that are enclosed in brackets and are followed by the letters CC indicate a Code Case material, e.g. (SA-387 CC).

UNS Numbers with round brackets, e.g. (R53400), infers that the particular alloy is not listed in the Metals & Alloys in the Unified Numbering System, but rather the nominal composition of this alloy most closely resembles the UNS Number within the bracket, and is given only for convenience.
### CARBON STEELS BY NOMINAL COMPOSITION

<table>
<thead>
<tr>
<th>Nominal Composition</th>
<th>Specification No.</th>
<th>Grade Designation</th>
<th>UNS No.</th>
<th>Common Name or Trade Name</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>C steel</td>
<td>SA-36</td>
<td>---</td>
<td>K02600</td>
<td>---</td>
<td>Structural</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-53</td>
<td>Type S Grade A</td>
<td>K02504</td>
<td>---</td>
<td>Pipe, welded and seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-53</td>
<td>Type E Grade A</td>
<td>K02504</td>
<td>---</td>
<td>Pipe, welded and seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-53</td>
<td>Type F Grade A</td>
<td>K02504</td>
<td>---</td>
<td>Pipe, welded and seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-53</td>
<td>Type S, Grade B</td>
<td>K03005</td>
<td>---</td>
<td>Pipe, welded and seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-53</td>
<td>Type E, Grade B</td>
<td>K03005</td>
<td>---</td>
<td>Pipe, welded and seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-105</td>
<td>---</td>
<td>K03504</td>
<td>---</td>
<td>Flanges, fittings, etc.</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-106</td>
<td>A</td>
<td>K02501</td>
<td>---</td>
<td>Pipe, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-106</td>
<td>B</td>
<td>K03006</td>
<td>---</td>
<td>Pipe, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-106</td>
<td>C</td>
<td>K03501</td>
<td>---</td>
<td>Pipe, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-135</td>
<td>A</td>
<td>---</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-135</td>
<td>B</td>
<td>---</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-178</td>
<td>A</td>
<td>K01200</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-178</td>
<td>C</td>
<td>K03503</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-178</td>
<td>D</td>
<td>---</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-179</td>
<td>---</td>
<td>K01200</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-181</td>
<td>60 and 70</td>
<td>K03502</td>
<td>---</td>
<td>Flanges, fittings, etc.</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-192</td>
<td>---</td>
<td>K01201</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-194</td>
<td>1</td>
<td>K01503</td>
<td>---</td>
<td>Nuts</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-194</td>
<td>2, 2H, 2HM</td>
<td>K04002</td>
<td>---</td>
<td>Nuts</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-210</td>
<td>A-1</td>
<td>K02707</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-210</td>
<td>C</td>
<td>K03501</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-214</td>
<td>---</td>
<td>K01807</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-216</td>
<td>WCA</td>
<td>J02502</td>
<td>---</td>
<td>Castings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-216</td>
<td>WCB</td>
<td>J03002</td>
<td>---</td>
<td>Castings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-216</td>
<td>WCC</td>
<td>J02503</td>
<td>---</td>
<td>Castings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-226</td>
<td>---</td>
<td>K01201</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-234</td>
<td>WCB</td>
<td>K03006</td>
<td>---</td>
<td>Fittings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-234</td>
<td>WPC</td>
<td>K03501</td>
<td>---</td>
<td>Fittings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-266</td>
<td>1 and 2</td>
<td>K03506</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-266</td>
<td>3</td>
<td>K05001</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-266</td>
<td>Grade 4</td>
<td>K03017</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-283</td>
<td>A, B, C</td>
<td>K02401</td>
<td>---</td>
<td>Plates</td>
</tr>
</tbody>
</table>
### CARBON STEELS BY NOMINAL COMPOSITION (Continued)

<table>
<thead>
<tr>
<th>Nominal Composition</th>
<th>Specification No.</th>
<th>Grade Designation</th>
<th>UNS No.</th>
<th>Common Name or Trade Name</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>C steel</td>
<td>SA-283</td>
<td>D</td>
<td>K02702</td>
<td></td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-285</td>
<td>A</td>
<td>K01700</td>
<td></td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-285</td>
<td>B</td>
<td>K02200</td>
<td></td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-285</td>
<td>C</td>
<td>K02801</td>
<td></td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-299</td>
<td></td>
<td>K02803</td>
<td></td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-307</td>
<td>A, B and C</td>
<td>K03002</td>
<td></td>
<td>Threaded fasteners</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1018, Cl. A</td>
<td>G10180</td>
<td>1018 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1035, Cl. A</td>
<td>G10350</td>
<td>1035 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1045, Cl. A &amp; B</td>
<td>G10450</td>
<td>1045 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1050, Cl. A &amp; B</td>
<td>G10500</td>
<td>1050 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1117, Cl. A</td>
<td>G11170</td>
<td>1117 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1137, Cl. A</td>
<td>G11370</td>
<td>1137 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1141, Cl. A &amp; B</td>
<td>G11410</td>
<td>1141 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1144, Cl. A &amp; B</td>
<td>G11440</td>
<td>1144 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-311</td>
<td>1541, Cl. A &amp; B</td>
<td>G15410</td>
<td>1541 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-325</td>
<td>Type 1</td>
<td>K02706</td>
<td></td>
<td>Bolting</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-333</td>
<td>1</td>
<td>K03008</td>
<td></td>
<td>Pipe, seamless and welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-333</td>
<td>6</td>
<td>K03006</td>
<td></td>
<td>Pipe, seamless and welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-334</td>
<td>1</td>
<td>K03008</td>
<td></td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-334</td>
<td>6</td>
<td>K03006</td>
<td></td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-350</td>
<td>LF1</td>
<td>K03009</td>
<td></td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-350</td>
<td>LF2</td>
<td>K03011</td>
<td></td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-352</td>
<td>LCA</td>
<td>J02504</td>
<td></td>
<td>Castings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-352</td>
<td>LCB</td>
<td>J03003</td>
<td></td>
<td>Castings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-352</td>
<td>LCC</td>
<td>J02505</td>
<td></td>
<td>Castings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-354</td>
<td>BC and BD</td>
<td>K04100</td>
<td></td>
<td>Bolting</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-369</td>
<td>FPA</td>
<td>K02501</td>
<td></td>
<td>Pipe, forged/bored</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-369</td>
<td>FPB</td>
<td>K03006</td>
<td></td>
<td>Pipe, forged/bored</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-372</td>
<td>A</td>
<td>K03002</td>
<td></td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-372</td>
<td>B</td>
<td>K04001</td>
<td></td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-372</td>
<td>C</td>
<td>K04801</td>
<td></td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-414</td>
<td>A</td>
<td>K01501</td>
<td></td>
<td>Sheet</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-414</td>
<td>B</td>
<td>K02201</td>
<td></td>
<td>Sheet</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-414</td>
<td>C</td>
<td>K02503</td>
<td></td>
<td>Sheet</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-414</td>
<td>D</td>
<td>K02505</td>
<td></td>
<td>Sheet</td>
</tr>
</tbody>
</table>
## CARBON STEELS BY NOMINAL COMPOSITION (Continued)

<table>
<thead>
<tr>
<th>Nominal Composition</th>
<th>Specification No.</th>
<th>Grade Designation</th>
<th>UNS No.</th>
<th>Common Name or Trade Name</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>C steel</td>
<td>SA-414</td>
<td>E</td>
<td>K02704</td>
<td>---</td>
<td>Sheet</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-414</td>
<td>F</td>
<td>K03102</td>
<td>---</td>
<td>Sheet</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-414</td>
<td>G</td>
<td>K03103</td>
<td>---</td>
<td>Sheet</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-420</td>
<td>WPL6</td>
<td>K03006</td>
<td>---</td>
<td>Fittings, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-449</td>
<td>---</td>
<td>K04200</td>
<td>---</td>
<td>Bolts and studs</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-455</td>
<td>---</td>
<td>K03300</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-508</td>
<td>1</td>
<td>K13502</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-508</td>
<td>Grade 1A</td>
<td>K13502</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-515</td>
<td>60</td>
<td>K02401</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-515</td>
<td>65</td>
<td>K02800</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-515</td>
<td>70</td>
<td>K03101</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-516</td>
<td>55</td>
<td>K01800</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-516</td>
<td>60</td>
<td>K02100</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-516</td>
<td>65</td>
<td>K02403</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-516</td>
<td>70</td>
<td>K02700</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-524</td>
<td>I and II</td>
<td>K02104</td>
<td>---</td>
<td>Pipe, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-537</td>
<td>1, 2 and 3</td>
<td>K12437</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-541</td>
<td>1A</td>
<td>---</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-541</td>
<td>1</td>
<td>K03506</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-556</td>
<td>A2</td>
<td>K01807</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-556</td>
<td>B2</td>
<td>K02707</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-556</td>
<td>C2</td>
<td>K03006</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-557</td>
<td>A2</td>
<td>K01807</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-557</td>
<td>B2</td>
<td>K03007</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-557</td>
<td>C2</td>
<td>K03505</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-563</td>
<td>O, A, B, C</td>
<td>K05802</td>
<td>---</td>
<td>Nuts</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-563</td>
<td>D</td>
<td>K05801</td>
<td>---</td>
<td>Nuts</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-563</td>
<td>DH</td>
<td>K03800</td>
<td>---</td>
<td>Nuts</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-587</td>
<td>---</td>
<td>K11500</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-612</td>
<td>---</td>
<td>K02900</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-620</td>
<td>---</td>
<td>K00040</td>
<td>---</td>
<td>Sheet, CR for drawing</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-649</td>
<td>2</td>
<td>K05001</td>
<td>---</td>
<td>Forged rolls</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-649</td>
<td>4</td>
<td>---</td>
<td>---</td>
<td>Forged rolls</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-660</td>
<td>WCA</td>
<td>J02504</td>
<td>---</td>
<td>Pipe, centrifugal cast</td>
</tr>
<tr>
<td>C steel</td>
<td>SA-660</td>
<td>WCB</td>
<td>J03003</td>
<td>---</td>
<td>Pipe, centrifugal cast</td>
</tr>
</tbody>
</table>
### LOW ALLOY STEELS BY NOMINAL COMPOSITION (C - Mo) (Continued)

<table>
<thead>
<tr>
<th>Nominal Composition</th>
<th>Specification No.</th>
<th>Grade Designation</th>
<th>UNS No.</th>
<th>Common Name or Trade Name</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>C - ½ Mo</td>
<td>SA-250</td>
<td>T1a</td>
<td>K12023</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-250</td>
<td>T1b</td>
<td>K11422</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-335</td>
<td>P1</td>
<td>K11522</td>
<td>---</td>
<td>Pipe, seamless</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-336</td>
<td>F1</td>
<td>K12520</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-352</td>
<td>LC1</td>
<td>J12522</td>
<td>---</td>
<td>Castings</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-369</td>
<td>FP1</td>
<td>K11522</td>
<td>---</td>
<td>Pipe, forged/bored</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-426</td>
<td>CP1</td>
<td>J12521</td>
<td>---</td>
<td>Pipe, centrifugal cast</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-672</td>
<td>L65</td>
<td>K11820</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-672</td>
<td>L70</td>
<td>K12020</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-672</td>
<td>L75</td>
<td>K12320</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-691</td>
<td>CM65</td>
<td>K11820</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-691</td>
<td>CM70</td>
<td>K12020</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C - ½ Mo</td>
<td>SA-691</td>
<td>CM75</td>
<td>K12320</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C - ½ Mo - B</td>
<td>SA-517</td>
<td>J</td>
<td>K11625</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>C - ½ Mo - B</td>
<td>SA-671</td>
<td>CJ109</td>
<td>K11625</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>C - ½ Mo - Si</td>
<td>SA-426</td>
<td>CP15</td>
<td>J11522</td>
<td>---</td>
<td>Pipe, centrifugal cast</td>
</tr>
</tbody>
</table>

### LOW ALLOY STEELS BY NOMINAL COMPOSITION (½ Cr - 1 ¼ Cr)

<table>
<thead>
<tr>
<th>Nominal Composition</th>
<th>Specification No.</th>
<th>Grade Designation</th>
<th>UNS No.</th>
<th>Common Name or Trade Name</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-372</td>
<td>Grade G</td>
<td>K13049</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-372</td>
<td>Grade H</td>
<td>K13547</td>
<td>---</td>
<td>Forgings</td>
</tr>
<tr>
<td>½ Cr - ½ Mo - V - B</td>
<td>SA-517</td>
<td>B</td>
<td>K11630</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>½ Cr - ½ Mo - V - B</td>
<td>SA-671</td>
<td>CJ102</td>
<td>K11630</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>½ Cr - ¼ Mo - Si</td>
<td>SA-517</td>
<td>A</td>
<td>K11856</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>½ Cr - ¼ Mo - Si</td>
<td>SA-592</td>
<td>A</td>
<td>K11856</td>
<td>---</td>
<td>Fittings</td>
</tr>
<tr>
<td>½ Cr - ¼ Mo - Si</td>
<td>SA-671</td>
<td>CJ101</td>
<td>K11856</td>
<td>---</td>
<td>Pipe, welded</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-182</td>
<td>F2</td>
<td>K12122</td>
<td>---</td>
<td>Flanges, fittings, etc.</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-213</td>
<td>T2</td>
<td>K11547</td>
<td>---</td>
<td>Tubes, seamless</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-250</td>
<td>T2</td>
<td>---</td>
<td>---</td>
<td>Tubes, welded</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-335</td>
<td>P2</td>
<td>K11547</td>
<td>---</td>
<td>Pipe, seamless</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-369</td>
<td>FP2</td>
<td>K11547</td>
<td>---</td>
<td>Pipe, forged/bored</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-387</td>
<td>2</td>
<td>K12143</td>
<td>---</td>
<td>Plates</td>
</tr>
<tr>
<td>½ Cr - ½ Mo</td>
<td>SA-426</td>
<td>CP2</td>
<td>J11547</td>
<td>---</td>
<td>Pipe, centrifugal cast</td>
</tr>
</tbody>
</table>
Chapter 7

FERROUS SPECIFICATIONS BY COMMON NAME

This Chapter provides yet another cross index—this one is based first on the common name or trade name. In many cases, these designations will correspond with the grade designation within a given specification. The first part of this cross index listing is by material’s numerical designations. Within this portion of the cross index, one needs to closely examine the “system” used. Numbers such as “2304” come before 253MA, because the second digit from the left determines its placement within those numerical designations beginning with “2”.

The second portion of this cross index for ferrous materials is an alphabetical listing of common or trade names. These cover most of the materials shown later in Table 9, even if they are not yet approved for use in any specific Code construction.
### CODE FERROUS ALLOYS BY COMMON NAME OR TRADE NAME

<table>
<thead>
<tr>
<th>Common Name or Trade Name</th>
<th>Product Form</th>
<th>Nominal Composition</th>
<th>Spec. No.</th>
<th>Grade Designation</th>
<th>UNS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1018 Steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1018, Cl. A</td>
<td>G10180</td>
</tr>
<tr>
<td>1035 Steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1035, Cl. A</td>
<td>G10350</td>
</tr>
<tr>
<td>1045 Steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1045, Cl. A &amp; B</td>
<td>G10450</td>
</tr>
<tr>
<td>1050 Steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1050, Cl. A &amp; B</td>
<td>G10500</td>
</tr>
<tr>
<td>1117 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1117, Cl. A</td>
<td>G11170</td>
</tr>
<tr>
<td>1137 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1137, Cl. A</td>
<td>G11370</td>
</tr>
<tr>
<td>1141 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1141, Cl. A &amp; B</td>
<td>G11410</td>
</tr>
<tr>
<td>1144 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1144, Cl. A &amp; B</td>
<td>G11440</td>
</tr>
<tr>
<td>13-8 Mo PH or XM-13</td>
<td>Bars and shapes</td>
<td>13 Cr - 8 Ni - 2 Mo</td>
<td>SA-564</td>
<td>XM-13</td>
<td>S13800</td>
</tr>
<tr>
<td>13-8 Mo PH or XM-13</td>
<td>Plate, sheet, strip</td>
<td>13 Cr - 8 Ni - 2 Mo</td>
<td>SA-693</td>
<td>XM-13</td>
<td>S13800</td>
</tr>
<tr>
<td>13-8 Mo PH or XM-13</td>
<td>Forgings</td>
<td>13 Cr - 8 Ni - 2 Mo</td>
<td>SA-705</td>
<td>XM-13</td>
<td>S13800</td>
</tr>
<tr>
<td>153 MA</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 9 Ni - N - Ce</td>
<td>SA-240</td>
<td>---</td>
<td>S30415</td>
</tr>
<tr>
<td>153 MA</td>
<td>Tubes, welded</td>
<td>18 Cr - 9 Ni - N - Ce</td>
<td>SA-249</td>
<td>---</td>
<td>S30415</td>
</tr>
<tr>
<td>153 MA</td>
<td>Pipe, seamless and welded</td>
<td>18 Cr - 9 Ni - N - Ce</td>
<td>SA-312</td>
<td>---</td>
<td>S30415</td>
</tr>
<tr>
<td>153 MA</td>
<td>Pipe, welded</td>
<td>18 Cr - 9 Ni - N - Ce</td>
<td>SA-358</td>
<td>---</td>
<td>S30415</td>
</tr>
<tr>
<td>1541 steel</td>
<td>Bars, stress-relieved, cold drawn</td>
<td>C steel</td>
<td>SA-311</td>
<td>1541, Cl. A &amp; B</td>
<td>G15410</td>
</tr>
<tr>
<td>15-5 PH or XM-12</td>
<td>Bars and shapes</td>
<td>15 Cr - 5 Ni - 3 Cu</td>
<td>SA-564</td>
<td>Type XM-12</td>
<td>S15500</td>
</tr>
<tr>
<td>15-5 PH or XM-12</td>
<td>Plate, sheet, strip</td>
<td>15 Cr - 5 Ni - 3 Cu</td>
<td>SA-693</td>
<td>Type XM-12</td>
<td>S15500</td>
</tr>
<tr>
<td>15-5 PH or XM-12</td>
<td>Forgings</td>
<td>15 Cr - 5 Ni - 3 Cu</td>
<td>SA-705</td>
<td>Type XM-12</td>
<td>S15500</td>
</tr>
<tr>
<td>15-7 Mo PH</td>
<td>Bars and shapes</td>
<td>15 Cr - 7 Ni - 2½ Mo - 1 Al</td>
<td>SA-564</td>
<td>Type 632</td>
<td>S15700</td>
</tr>
<tr>
<td>15-7 Mo PH</td>
<td>Plate, sheet, strip</td>
<td>15 Cr - 7 Ni - 2½ Mo - 1 Al</td>
<td>SA-693</td>
<td>Type 632</td>
<td>S15700</td>
</tr>
<tr>
<td>15-7 Mo PH</td>
<td>Forgings</td>
<td>15 Cr - 7 Ni - 2½ Mo - 1 Al</td>
<td>SA-705</td>
<td>Type 632</td>
<td>S15700</td>
</tr>
<tr>
<td>17-4 PH</td>
<td>Bars and shapes</td>
<td>17 Cr - 4 Ni - 4 Cu</td>
<td>SA-564</td>
<td>Type 630</td>
<td>S17400</td>
</tr>
<tr>
<td>17-4 PH</td>
<td>Plate, sheet, strip</td>
<td>17 Cr - 4 Ni - 4 Cu</td>
<td>SA-693</td>
<td>Type 630</td>
<td>S17400</td>
</tr>
<tr>
<td>17-4 PH</td>
<td>Forgings</td>
<td>17 Cr - 4 Ni - 4 Cu</td>
<td>SA-705</td>
<td>Type 630</td>
<td>S17400</td>
</tr>
<tr>
<td>17-7 PH</td>
<td>Bars and shapes</td>
<td>17 Cr - 7 Ni - 1 Al</td>
<td>SA-564</td>
<td>Type 631</td>
<td>S17700</td>
</tr>
<tr>
<td>17-7 PH</td>
<td>Plate, sheet, strip</td>
<td>17 Cr - 7 Ni - 1 Al</td>
<td>SA-693</td>
<td>Type 631</td>
<td>S17700</td>
</tr>
<tr>
<td>17-7 PH</td>
<td>Forgings</td>
<td>17 Cr - 7 Ni - 1 Al</td>
<td>SA-705</td>
<td>Type 631</td>
<td>S17700</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Forgings</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>SA-182</td>
<td>F46</td>
<td>S30600</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Tubes, seamless</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>(SA-213 CC)</td>
<td>---</td>
<td>S30600</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>SA-240</td>
<td>---</td>
<td>S30600</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Tubes, welded</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>(SA-249 CC)</td>
<td>---</td>
<td>S30600</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Pipe, seamless and welded</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>SA-312</td>
<td>---</td>
<td>S30600</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Forgings</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>SA-336</td>
<td>F46</td>
<td>S30600</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Pipe, welded</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>SA-358</td>
<td>---</td>
<td>S30600</td>
</tr>
<tr>
<td>Common Name or Trade Name</td>
<td>Product Form</td>
<td>Nominal Composition</td>
<td>Spec. No.</td>
<td>Grade Designation</td>
<td>UNS No.</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>18-15 LC Si</td>
<td>Bars and shapes</td>
<td>18 Cr - 15 Ni - 4 Si</td>
<td>SA-479</td>
<td></td>
<td>S30600</td>
</tr>
<tr>
<td>18-17 LC</td>
<td>Forgings</td>
<td>18 Cr - 17 Ni - 5.3 Si</td>
<td>(SA-182 CC)</td>
<td></td>
<td>S30601</td>
</tr>
<tr>
<td>18-17 LC</td>
<td>Tubes, seamless</td>
<td>18 Cr - 17 Ni - 5.3 Si</td>
<td>(SA-213 CC)</td>
<td></td>
<td>S30601</td>
</tr>
<tr>
<td>18-17 LC</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 17 Ni - 5.3 Si</td>
<td>SA-240</td>
<td></td>
<td>S30601</td>
</tr>
<tr>
<td>18-17 LC</td>
<td>Tubes, welded</td>
<td>18 Cr - 17 Ni - 5.3 Si</td>
<td>(SA-249 CC)</td>
<td></td>
<td>S30601</td>
</tr>
<tr>
<td>18-17 LC</td>
<td>Tubes, seamless and welded</td>
<td>18 Cr - 17 Ni - 5.3 Si</td>
<td>(SA-268 CC)</td>
<td></td>
<td>S30601</td>
</tr>
<tr>
<td>18-17 LC</td>
<td>Pipe, seamless and welded</td>
<td>18 Cr - 17 Ni - 5.3 Si</td>
<td>(SA-312 CC)</td>
<td></td>
<td>S30601</td>
</tr>
<tr>
<td>18-17 LC</td>
<td>Bars and shapes</td>
<td>18 Cr - 17 Ni - 5.3 Si</td>
<td>(SA-479 CC)</td>
<td></td>
<td>S30601</td>
</tr>
<tr>
<td>18-18-2</td>
<td>Tubes, seamless</td>
<td>18 Cr - 18 Ni - 2 Si</td>
<td>SA-213</td>
<td>TP XM-15</td>
<td>S38100</td>
</tr>
<tr>
<td>18-18-2</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 18 Ni - 2 Si</td>
<td>SA-240</td>
<td>Type XM-15</td>
<td>S38100</td>
</tr>
<tr>
<td>18-18-2</td>
<td>Tubes, welded</td>
<td>18 Cr - 18 Ni - 2 Si</td>
<td>SA-249</td>
<td>TPXM-15</td>
<td>S38100</td>
</tr>
<tr>
<td>18-2</td>
<td>Tubes, seamless</td>
<td>18 Cr - 2 Mo</td>
<td>SA-213</td>
<td>18 Cr - 2 Mo</td>
<td>S44400</td>
</tr>
<tr>
<td>18-2</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 2 Mo</td>
<td>SA-240</td>
<td>Type 18 Cr - 2 Mo</td>
<td>S44400</td>
</tr>
<tr>
<td>18-2</td>
<td>Tubes, seamless and welded</td>
<td>18 Cr - 2 Mo</td>
<td>SA-268</td>
<td>18 Cr - 2 Mo</td>
<td>S44400</td>
</tr>
<tr>
<td>18-2</td>
<td>Bars and shapes</td>
<td>18 Cr - 2 Mo</td>
<td>SA-479</td>
<td>18 Cr - 2 Mo</td>
<td>S44400</td>
</tr>
<tr>
<td>18-2</td>
<td>Pipe, seamless and welded</td>
<td>18 Cr - 2 Mo</td>
<td>SA-731</td>
<td>18 Cr - 2 Mo</td>
<td>S44400</td>
</tr>
<tr>
<td>18-2</td>
<td>Tubes, welded</td>
<td>18 Cr - 2 Mo</td>
<td>SA-803</td>
<td>18 Cr - 2 Mo</td>
<td>S44400</td>
</tr>
<tr>
<td>18-3 Mn</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 3 Ni - 12 Mn</td>
<td>SA-240</td>
<td>Type XM-29</td>
<td>S24000</td>
</tr>
<tr>
<td>18-3 Mn</td>
<td>Tubes, welded</td>
<td>18 Cr - 3 Ni - 12 Mn</td>
<td>SA-249</td>
<td>TPMX-29</td>
<td>S24000</td>
</tr>
<tr>
<td>18-3 Mn</td>
<td>Pipe, seamless and welded</td>
<td>18 Cr - 3 Ni - 12 Mn</td>
<td>SA-312</td>
<td>TPMX-29</td>
<td>S24000</td>
</tr>
<tr>
<td>18-3 Mn</td>
<td>Pipe, welded</td>
<td>18 Cr - 3 Ni - 12 Mn</td>
<td>SA-358</td>
<td>XM-29</td>
<td>S24000</td>
</tr>
<tr>
<td>18-3 Mn</td>
<td>Bars and shapes</td>
<td>18 Cr - 3 Ni - 12 Mn</td>
<td>SA-479</td>
<td>Type XM-29</td>
<td>S24000</td>
</tr>
<tr>
<td>18-3 Mn</td>
<td>Tubes, welded</td>
<td>18 Cr - 3 Ni - 12 Mn</td>
<td>SA-688</td>
<td>TPMX-29</td>
<td>S24000</td>
</tr>
<tr>
<td>18-3 Mn</td>
<td>Pipe, welded</td>
<td>18 Cr - 3 Ni - 12 Mn</td>
<td>SA-813</td>
<td>TPMX-29</td>
<td>S24000</td>
</tr>
<tr>
<td>19-9DL</td>
<td>Bolting</td>
<td>19 Cr - 9 Ni - Mo - W</td>
<td>SA-453</td>
<td>651</td>
<td>S63198</td>
</tr>
<tr>
<td>201 SS</td>
<td>Tubes, seamless</td>
<td>17 Cr - 4 Ni - 6 Mn</td>
<td>SA-213</td>
<td>TP201</td>
<td>S20100</td>
</tr>
<tr>
<td>201 SS</td>
<td>Plate, sheet, strip</td>
<td>17 Cr - 4 Ni - 6 Mn</td>
<td>SA-240</td>
<td>Type 201 (-1 and -2)</td>
<td>S20100</td>
</tr>
<tr>
<td>201 SS</td>
<td>Tubes, welded</td>
<td>17 Cr - 4 Ni - 6 Mn</td>
<td>SA-249</td>
<td>TP201</td>
<td>S20100</td>
</tr>
<tr>
<td>201 SS</td>
<td>Plate, sheet, strip</td>
<td>17 Cr - 4 Ni - 6 Mn</td>
<td>SA-666</td>
<td>Type 201 (-1 and -2)</td>
<td>S20100</td>
</tr>
<tr>
<td>201L SS</td>
<td>Plate, sheet, strip</td>
<td>17 Cr - 4 Ni - 7 Mn</td>
<td>SA-240</td>
<td>Type 201L</td>
<td>S20103</td>
</tr>
<tr>
<td>201LN SS</td>
<td>Plate, sheet, strip</td>
<td>17 Cr - 4 Ni - 7 Mn - N</td>
<td>SA-240</td>
<td>Type 201LN</td>
<td>S20153</td>
</tr>
<tr>
<td>Common Name or Trade Name</td>
<td>Product Form</td>
<td>Nominal Composition</td>
<td>Spec. No.</td>
<td>Grade Designation</td>
<td>UNS No.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------</td>
<td>---------------------</td>
<td>-----------</td>
<td>------------------</td>
<td>--------</td>
</tr>
<tr>
<td>202 SS</td>
<td>Tubes, seamless</td>
<td>18 Cr - 5 Ni - 9 Mn</td>
<td>SA-213</td>
<td>TP202</td>
<td>S20200</td>
</tr>
<tr>
<td>202 SS</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 5 Ni - 9 Mn</td>
<td>SA-240</td>
<td>Type 202</td>
<td>S20200</td>
</tr>
<tr>
<td>202 SS</td>
<td>Tubes, welded</td>
<td>18 Cr - 5 Ni - 9 Mn</td>
<td>SA-249</td>
<td>TP202</td>
<td>S20200</td>
</tr>
<tr>
<td>205 SS</td>
<td>Plate, sheet, strip</td>
<td>18 Cr - 5 Ni - 9 Mn</td>
<td>SA-666</td>
<td>Type 202</td>
<td>S20200</td>
</tr>
<tr>
<td>205 SS</td>
<td>Plate, sheet, strip</td>
<td>17 Cr - 1½ Ni - 15 Mn</td>
<td>SA-666</td>
<td>---</td>
<td>S20500</td>
</tr>
<tr>
<td>2205</td>
<td>Forgings</td>
<td>22 Cr - 5 Ni - 3 Mo - N</td>
<td>SA-182</td>
<td>F51</td>
<td>S31803</td>
</tr>
<tr>
<td>2205</td>
<td>Plate, sheet, strip</td>
<td>22 Cr - 5 Ni - 3 Mo - N</td>
<td>SA-240</td>
<td>S31803</td>
<td>S31803</td>
</tr>
<tr>
<td>2205</td>
<td>Bars and shapes</td>
<td>22 Cr - 5 Ni - 3 Mo - N</td>
<td>SA-479</td>
<td>S31803</td>
<td>S31803</td>
</tr>
<tr>
<td>2205</td>
<td>Tubes, seamless and welded</td>
<td>22 Cr - 5 Ni - 3 Mo - N</td>
<td>SA-789</td>
<td>S31803</td>
<td>S31803</td>
</tr>
<tr>
<td>2205</td>
<td>Pipe, seamless and welded</td>
<td>22 Cr - 5 Ni - 3 Mo - N</td>
<td>SA-790</td>
<td>S31803</td>
<td>S31803</td>
</tr>
<tr>
<td>2205</td>
<td>Fittings</td>
<td>22 Cr - 5 Ni - 3 Mo - N</td>
<td>SA-815</td>
<td>S31803</td>
<td>S31803</td>
</tr>
<tr>
<td>22V</td>
<td>Forgings</td>
<td>2¼ Cr - 1 Mo - ¼ V</td>
<td>SA-182</td>
<td>F22V</td>
<td>K31835</td>
</tr>
<tr>
<td>22V</td>
<td>Forgings</td>
<td>2¼ Cr - 1 Mo - ¼ V</td>
<td>SA-336</td>
<td>F22V</td>
<td>K31835</td>
</tr>
<tr>
<td>22V</td>
<td>Forgings</td>
<td>2¼ Cr - 1 Mo - ¼ V</td>
<td>SA-541</td>
<td>22V</td>
<td>K31835</td>
</tr>
<tr>
<td>22V</td>
<td>Plates</td>
<td>2¼ Cr - 1 Mo - ¼ V</td>
<td>SA-542</td>
<td>Type D</td>
<td>---</td>
</tr>
<tr>
<td>22V</td>
<td>Plates</td>
<td>2¼ Cr - 1 Mo - ¼ V</td>
<td>SA-832</td>
<td>22V</td>
<td>K31835</td>
</tr>
<tr>
<td>2304</td>
<td>Plate, sheet, strip</td>
<td>23 Cr - 4 Ni - Mo - Cu</td>
<td>SA-240</td>
<td>S32304</td>
<td>S32304</td>
</tr>
<tr>
<td>2304</td>
<td>Tubes, seamless and welded</td>
<td>23 Cr - 4 Ni - Mo - Cu</td>
<td>SA-789</td>
<td>S32304</td>
<td>S32304</td>
</tr>
<tr>
<td>2304</td>
<td>Pipe, seamless and welded</td>
<td>23 Cr - 4 Ni - Mo - Cu</td>
<td>SA-790</td>
<td>S32304</td>
<td>S32304</td>
</tr>
<tr>
<td>253 MA</td>
<td>Forgings</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-182</td>
<td>F45</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Tubes, seamless</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-213</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Plate, sheet, strip</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-240</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Tubes, welded</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-249</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Pipe, seamless and welded</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-312</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Pipe, welded</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-358</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Pipe, welded</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-409</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Bars and shapes</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-479</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Pipe, welded</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-813</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>253 MA</td>
<td>Pipe, welded</td>
<td>21 Cr - 11 Ni - N</td>
<td>SA-814</td>
<td>S30815</td>
<td>S30815</td>
</tr>
<tr>
<td>254 SMO</td>
<td>Forgings</td>
<td>20 Cr - 18 Ni - 6 Mo</td>
<td>SA-182</td>
<td>F44</td>
<td>S31254</td>
</tr>
<tr>
<td>254 SMO</td>
<td>Bolting</td>
<td>20 Cr - 18 Ni - 6 Mo</td>
<td>SA-193</td>
<td>B8MLCuN/B8MLCuNA</td>
<td>S31254</td>
</tr>
<tr>
<td>254 SMO</td>
<td>Nuts</td>
<td>20 Cr - 18 Ni - 6 Mo</td>
<td>SA-194</td>
<td>8MLCuN/8MLCuNA</td>
<td>S31254</td>
</tr>
<tr>
<td>254 SMO</td>
<td>Plate, sheet, strip</td>
<td>20 Cr - 18 Ni - 6 Mo</td>
<td>SA-240</td>
<td>S31254</td>
<td>S31254</td>
</tr>
<tr>
<td>254 SMO</td>
<td>Tubes, welded</td>
<td>20 Cr - 18 Ni - 6 Mo</td>
<td>SA-249</td>
<td>S31254</td>
<td>S31254</td>
</tr>
<tr>
<td>254 SMO</td>
<td>Pipe, seamless and welded</td>
<td>20 Cr - 18 Ni - 6 Mo</td>
<td>SA-312</td>
<td>S31254</td>
<td>S31254</td>
</tr>
</tbody>
</table>
Chapter 8

NONFERROUS SPECIFICATIONS BY COMMON NAME

This Chapter parallels Chapter 7, except covering nonferrous materials. Alloys are first listed numerically when their common name or trade name identifies them in such a manner. Likewise, the second portion of this index is an alphabetical listing of common or trade names associated with nonferrous alloys—with no particular attempt to segregate the various basic types of nonferrous alloys (e.g. Al, Cu, Ni, Ti and Zr).
<table>
<thead>
<tr>
<th>Common Name or Trade Name</th>
<th>Product Form</th>
<th>Nominal Composition</th>
<th>Specification No.</th>
<th>UNS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - Cb 3</td>
<td>Fittings</td>
<td>35 Ni - 35 Fe - 20 Cr - Cb</td>
<td>SB-366</td>
<td>N08020</td>
</tr>
<tr>
<td>20 - Cb 3</td>
<td>Forgings</td>
<td>35 Ni - 35 Fe - 20 Cr - Cb</td>
<td>SB-462</td>
<td>N08020</td>
</tr>
<tr>
<td>20 - Cb 3</td>
<td>Plate, sheet, strip</td>
<td>35 Ni - 35 Fe - 20 Cr - Cb</td>
<td>SB-463</td>
<td>N08020</td>
</tr>
<tr>
<td>20 - Cb 3</td>
<td>Pipe, seamless and welded</td>
<td>35 Ni - 35 Fe - 20 Cr - Cb</td>
<td>SB-464</td>
<td>N08020</td>
</tr>
<tr>
<td>20 - Cb 3</td>
<td>Tubes, seamless and welded</td>
<td>35 Ni - 35 Fe - 20 Cr - Cb</td>
<td>SB-468</td>
<td>N08020</td>
</tr>
<tr>
<td>20 - Cb 3</td>
<td>Bar and wire</td>
<td>35 Ni - 35 Fe - 20 Cr - Cb</td>
<td>SB-473</td>
<td>N08020</td>
</tr>
<tr>
<td>20 - Cb 3</td>
<td>Pipe and tube, seamless</td>
<td>35 Ni - 35 Fe - 20 Cr - Cb</td>
<td>SB-729</td>
<td>N08020</td>
</tr>
<tr>
<td>20 - Mo 4</td>
<td>Forgings</td>
<td>37 Ni - 33 Fe - 24 Cr - 4 Mo</td>
<td>SB-462</td>
<td>N08024</td>
</tr>
<tr>
<td>20 - Mo 4</td>
<td>Plate, sheet, strip</td>
<td>37 Ni - 33 Fe - 24 Cr - 4 Mo</td>
<td>SB-463</td>
<td>N08024</td>
</tr>
<tr>
<td>20 - Mo 4</td>
<td>Pipe, seamless and welded</td>
<td>37 Ni - 33 Fe - 24 Cr - 4 Mo</td>
<td>SB-464</td>
<td>N08024</td>
</tr>
<tr>
<td>20 - Mo 4</td>
<td>Tubes, seamless and welded</td>
<td>37 Ni - 33 Fe - 24 Cr - 4 Mo</td>
<td>SB-468</td>
<td>N08024</td>
</tr>
<tr>
<td>20 - Mo 4</td>
<td>Bar and wire</td>
<td>37 Ni - 33 Fe - 24 Cr - 4 Mo</td>
<td>SB-473</td>
<td>N08024</td>
</tr>
<tr>
<td>20 - Mo 4</td>
<td>Pipe and tube, seamless</td>
<td>37 Ni - 33 Fe - 24 Cr - 4 Mo</td>
<td>SB-729</td>
<td>N08024</td>
</tr>
<tr>
<td>20 - Mo 6</td>
<td>Forgings</td>
<td>35 Ni - 30 Fe - 24 Cr - 6 Mo - 3 Cu</td>
<td>SB-462</td>
<td>N08026</td>
</tr>
<tr>
<td>20 - Mo 6</td>
<td>Plate, sheet, strip</td>
<td>35 Ni - 30 Fe - 24 Cr - 6 Mo - 3 Cu</td>
<td>SB-463</td>
<td>N08026</td>
</tr>
<tr>
<td>20 - Mo 6</td>
<td>Pipe, seamless and welded</td>
<td>35 Ni - 30 Fe - 24 Cr - 6 Mo - 3 Cu</td>
<td>SB-464</td>
<td>N08026</td>
</tr>
<tr>
<td>20 - Mo 6</td>
<td>Tubes, seamless and welded</td>
<td>35 Ni - 30 Fe - 24 Cr - 6 Mo - 3 Cu</td>
<td>SB-468</td>
<td>N08026</td>
</tr>
<tr>
<td>20 - Mo 6</td>
<td>Bar and wire</td>
<td>35 Ni - 30 Fe - 24 Cr - 6 Mo - 3 Cu</td>
<td>SB-473</td>
<td>N08026</td>
</tr>
<tr>
<td>20 - Mo 6</td>
<td>Pipe and tube, seamless</td>
<td>35 Ni - 30 Fe - 24 Cr - 6 Mo - 3 Cu</td>
<td>SB-729</td>
<td>N08026</td>
</tr>
<tr>
<td>20 Mod.</td>
<td>Pipe, welded</td>
<td>26 Ni - 43 Fe - 22 Cr - 5 Mo</td>
<td>SB-619</td>
<td>N08320</td>
</tr>
<tr>
<td>20 Mod.</td>
<td>Plate, sheet, strip</td>
<td>26 Ni - 43 Fe - 22 Cr - 5 Mo</td>
<td>SB-620</td>
<td>N08320</td>
</tr>
<tr>
<td>20 Mod.</td>
<td>Rod</td>
<td>26 Ni - 43 Fe - 22 Cr - 5 Mo</td>
<td>SB-621</td>
<td>N08320</td>
</tr>
<tr>
<td>20 Mod.</td>
<td>Pipe and tube, seamless</td>
<td>26 Ni - 43 Fe - 22 Cr - 5 Mo</td>
<td>SB-622</td>
<td>N08320</td>
</tr>
<tr>
<td>20 Mod.</td>
<td>Tubes, welded</td>
<td>26 Ni - 43 Fe - 22 Cr - 5 Mo</td>
<td>SB-626</td>
<td>N08320</td>
</tr>
<tr>
<td>20 or Beta C</td>
<td>Plate, sheet, strip</td>
<td>Ti - 8 V - 6 Cr - Mo - Zr - Al - Pd</td>
<td>SB-265</td>
<td>R58645</td>
</tr>
<tr>
<td>2014</td>
<td>Bars, rod and wire</td>
<td>Al - 4 Cu - Si - Mn</td>
<td>SB-211</td>
<td>A92014</td>
</tr>
<tr>
<td>2014</td>
<td>Forgings</td>
<td>Al - 4 Cu - Si - Mn</td>
<td>SB-247</td>
<td>A92014</td>
</tr>
<tr>
<td>2024</td>
<td>Bars, rod and wire</td>
<td>Al - 4 Cu - Mg</td>
<td>SB-211</td>
<td>A92024</td>
</tr>
<tr>
<td>2024</td>
<td>Bars, rods and shapes</td>
<td>Al - 4 Cu - Mg</td>
<td>SB-221</td>
<td>A92024</td>
</tr>
<tr>
<td>204.0</td>
<td>Castings</td>
<td>Al - Cu - Mg</td>
<td>SB-26</td>
<td>A02040</td>
</tr>
<tr>
<td>204.0</td>
<td>Castings</td>
<td>Al - Cu - Mg</td>
<td>SB-108</td>
<td>A02040</td>
</tr>
<tr>
<td>21</td>
<td>Plate, sheet, strip</td>
<td>Ti - 15 Mo - 3 Al - Cb</td>
<td>SB-265</td>
<td>---</td>
</tr>
<tr>
<td>23</td>
<td>Plate, sheet, strip</td>
<td>Ti - 6 Al - 4V</td>
<td>SB-265</td>
<td>---</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Plate, sheet, strip</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SA-240</td>
<td>N08926</td>
</tr>
<tr>
<td>Common Name or Trade Name</td>
<td>Product Form</td>
<td>Nominal Composition</td>
<td>Specification No.</td>
<td>UNS No.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------</td>
<td>---------------------</td>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Forgings</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>(SB-462 CC)</td>
<td>N08926</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Plate, sheet, strip</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SB-625</td>
<td>N08926</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Bar and wire</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SB-649</td>
<td>N08926</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Pipe, welded</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SB-673</td>
<td>N08926</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Tubes, welded</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SB-674</td>
<td>N08926</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Pipe and tube, seamless</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SB-677</td>
<td>N08926</td>
</tr>
<tr>
<td>25-6 Mo</td>
<td>Pipe, welded</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SB-804</td>
<td>N08926</td>
</tr>
<tr>
<td>25-6 Mo/CR1925N/WP1925N</td>
<td>Fittings</td>
<td>28 Ni - 39 Fe - 16 Cr - 4 Cu</td>
<td>SB-366</td>
<td>N08926</td>
</tr>
<tr>
<td>Alloy 33</td>
<td>Forgings</td>
<td>33 Cr - 31 Ni - 1.5 Mo - 0.6 Cu - N</td>
<td>SB-366</td>
<td>R20033</td>
</tr>
<tr>
<td>Alloy 33</td>
<td>Pipe, welded</td>
<td>33 Cr - 31 Ni - 1.5 Mo - 0.6 Cu - N</td>
<td>SB-619</td>
<td>R20033</td>
</tr>
<tr>
<td>Alloy 33</td>
<td>Pipe and tube, seamless</td>
<td>33 Cr - 31 Ni - 1.5 Mo - 0.6 Cu - N</td>
<td>SB-622</td>
<td>R20033</td>
</tr>
<tr>
<td>Alloy 33</td>
<td>Plate, sheet, strip</td>
<td>33 Cr - 31 Ni - 1.5 Mo - 0.6 Cu - N</td>
<td>(SB-625 CC)</td>
<td>R20033</td>
</tr>
<tr>
<td>Alloy 33</td>
<td>Tubes, welded</td>
<td>33 Cr - 31 Ni - 1.5 Mo - 0.6 Cu - N</td>
<td>SB-626</td>
<td>R20033</td>
</tr>
<tr>
<td>Alloy 33</td>
<td>Bar and wire</td>
<td>33 Cr - 31 Ni - 1.5 Mo - 0.6 Cu - N</td>
<td>(SB-649 CC)</td>
<td>R20033</td>
</tr>
<tr>
<td>Alloy 803</td>
<td>Forgings</td>
<td>35 Ni - 27 Cr - Al - Ti</td>
<td>(SA-182 CC)</td>
<td>S35045</td>
</tr>
<tr>
<td>Alloy 803</td>
<td>Plate, sheet, strip</td>
<td>35 Ni - 27 Cr - Al - Ti</td>
<td>(SA-240 CC)</td>
<td>S35045</td>
</tr>
<tr>
<td>Alloy 803</td>
<td>Tubes, seamless and welded</td>
<td>35 Ni - 27 Cr - Al - Ti</td>
<td>(SA-268 CC)</td>
<td>S35045</td>
</tr>
<tr>
<td>Alloy 803</td>
<td>Pipe, seamless and welded</td>
<td>35 Ni - 27 Cr - Al - Ti</td>
<td>(SA-312 CC)</td>
<td>S35045</td>
</tr>
<tr>
<td>Alloy 803</td>
<td>Fittings</td>
<td>35 Ni - 27 Cr - Al - Ti</td>
<td>(SA-403 CC)</td>
<td>S35045</td>
</tr>
<tr>
<td>Alloy 803</td>
<td>Bars and shapes</td>
<td>35 Ni - 27 Cr - Al - Ti</td>
<td>(SA-479 CC)</td>
<td>S35045</td>
</tr>
<tr>
<td>904L, AL4X</td>
<td>Plate, sheet, strip</td>
<td>44 Fe - 25 Ni - 21 Cr - Mo</td>
<td>SB-625</td>
<td>N08904</td>
</tr>
<tr>
<td>904L, AL4X</td>
<td>Bar and wire</td>
<td>44 Fe - 25 Ni - 21 Cr - Mo</td>
<td>SB-649</td>
<td>N08904</td>
</tr>
<tr>
<td>904L, AL4X</td>
<td>Pipe, welded</td>
<td>44 Fe - 25 Ni - 21 Cr - Mo</td>
<td>SB-673</td>
<td>N08904</td>
</tr>
<tr>
<td>904L, AL4X</td>
<td>Tubes, welded</td>
<td>44 Fe - 25 Ni - 21 Cr - Mo</td>
<td>SB-674</td>
<td>N08904</td>
</tr>
<tr>
<td>904L, AL4X</td>
<td>Pipe and tube, seamless</td>
<td>44 Fe - 25 Ni - 21 Cr - Mo</td>
<td>SB-677</td>
<td>N08904</td>
</tr>
<tr>
<td>925</td>
<td>Pipe and tube, seamless</td>
<td>42 Ni-22 Fe-21 Cr-Mo-Ti-Cu</td>
<td>(SB-423 CC)</td>
<td>N09925</td>
</tr>
<tr>
<td>925</td>
<td>Plate, sheet, strip</td>
<td>42 Ni-22 Fe-21 Cr-Mo-Ti-Cu</td>
<td>(SB-424 CC)</td>
<td>N09925</td>
</tr>
<tr>
<td>925</td>
<td>Rod and bar</td>
<td>42 Ni-22 Fe-21 Cr-Mo-Ti-Cu</td>
<td>(SB-425 CC)</td>
<td>N09925</td>
</tr>
<tr>
<td>925</td>
<td>forgings</td>
<td>42 Ni-22 Fe-21 Cr-Mo-Ti-Cu</td>
<td>(SB-564 CC)</td>
<td>N09925</td>
</tr>
<tr>
<td>Admiralalty metal, antimonial</td>
<td>Tubes, seamless</td>
<td>71 Cu - 28 Zn - Sn</td>
<td>SB-111</td>
<td>C44400</td>
</tr>
<tr>
<td>Admiralalty metal, antimonial</td>
<td>Plates</td>
<td>71 Cu - 28 Zn - Sn</td>
<td>SB-171</td>
<td>C44400</td>
</tr>
<tr>
<td>Admiralalty metal, antimonial</td>
<td>Tubes, seamless with fins</td>
<td>71 Cu - 28 Zn - Sn</td>
<td>SB-359</td>
<td>C44400</td>
</tr>
<tr>
<td>Admiralalty metal, antimonial</td>
<td>Tubes, seamless - U</td>
<td>71 Cu - 28 Zn - Sn</td>
<td>SB-395</td>
<td>C44400</td>
</tr>
<tr>
<td>Common Name or Trade Name</td>
<td>Product Form</td>
<td>Nominal Composition</td>
<td>Specification No.</td>
<td>UNS No.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------</td>
<td>---------------------</td>
<td>-------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Admiralty metal, antimonial</td>
<td>Tubes, welded</td>
<td>71 Cu - 28 Zn - Sn - Sb</td>
<td>SB-543</td>
<td>C44400</td>
</tr>
<tr>
<td>Admiralty metal, arsenical</td>
<td>Tubes, seamless</td>
<td>71 Cu - 28 Zn - Sn - As</td>
<td>SB-111</td>
<td>C44300</td>
</tr>
<tr>
<td>Admiralty metal, arsenical</td>
<td>Plates</td>
<td>71 Cu - 28 Zn - Sn - As</td>
<td>SB-171</td>
<td>C44300</td>
</tr>
<tr>
<td>Admiralty metal, arsenical</td>
<td>Tubes, seamless with fins</td>
<td>71 Cu - 28 Zn - Sn - As</td>
<td>SB-359</td>
<td>C44300</td>
</tr>
<tr>
<td>Admiralty metal, arsenical</td>
<td>Tubes, seamless - U</td>
<td>71 Cu - 28 Zn - Sn - As</td>
<td>SB-395</td>
<td>C44300</td>
</tr>
<tr>
<td>Admiralty metal, arsenical</td>
<td>Tubes, welded</td>
<td>71 Cu - 28 Zn - Sn - As</td>
<td>SB-111</td>
<td>C44500</td>
</tr>
<tr>
<td>Admiralalty metal, arsenical</td>
<td>Tubes, seamless</td>
<td>71 Cu - 28 Zn - Sn - P</td>
<td>SB-171</td>
<td>C44500</td>
</tr>
<tr>
<td>Admiralalty metal, arsenical</td>
<td>Plates</td>
<td>71 Cu - 28 Zn - Sn - P</td>
<td>SB-171</td>
<td>C44500</td>
</tr>
<tr>
<td>Admiralalty metal, arsenical</td>
<td>Tubes, seamless with fins</td>
<td>71 Cu - 28 Zn - Sn - P</td>
<td>SB-359</td>
<td>C44500</td>
</tr>
<tr>
<td>Admiralalty metal, arsenical</td>
<td>Tubes, seamless - U</td>
<td>71 Cu - 28 Zn - Sn - P</td>
<td>SB-395</td>
<td>C44500</td>
</tr>
<tr>
<td>Admiralalty metal, arsenical</td>
<td>Tubes, welded</td>
<td>71 Cu - 28 Zn - Sn - P</td>
<td>SB-543</td>
<td>C44500</td>
</tr>
<tr>
<td>AL-6X</td>
<td>Pipe, welded</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo</td>
<td>SB-675</td>
<td>N08366</td>
</tr>
<tr>
<td>AL-6X</td>
<td>Tubes, welded</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo</td>
<td>SB-676</td>
<td>N08366</td>
</tr>
<tr>
<td>AL-6X</td>
<td>Plate, sheet, strip</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo</td>
<td>SB-688</td>
<td>N08366</td>
</tr>
<tr>
<td>AL-6X</td>
<td>Pipe and tube, seamless</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo</td>
<td>SB-690</td>
<td>N08366</td>
</tr>
<tr>
<td>AL-6X</td>
<td>Rod, bar and wire</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo</td>
<td>SB-691</td>
<td>N08366</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Fittings</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-366</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Forgings</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-462</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Forgings</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-564</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Pipe, welded</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-675</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Tubes, welded</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-676</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Plate, sheet, strip</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-688</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Pipe and tube, seamless</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-690</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Rod, bar and wire</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-691</td>
<td>N08367</td>
</tr>
<tr>
<td>AL-6XN</td>
<td>Pipe, welded</td>
<td>46 Fe - 24 Ni - 21 Cr - 6 Mo - Cu - N</td>
<td>SB-804</td>
<td>N08367</td>
</tr>
<tr>
<td>Alclad 3003</td>
<td>Sheet and plate</td>
<td>---</td>
<td>SB-209</td>
<td>A83003</td>
</tr>
<tr>
<td>Alclad 3003</td>
<td>Tubes, seamless</td>
<td>---</td>
<td>SB-210</td>
<td>A83003</td>
</tr>
<tr>
<td>Alclad 3003</td>
<td>Tubes, seamless</td>
<td>---</td>
<td>SB-234</td>
<td>A83003</td>
</tr>
<tr>
<td>Alclad 3003</td>
<td>Pipe and tubes, seamless</td>
<td>---</td>
<td>SB-241</td>
<td>A83003</td>
</tr>
<tr>
<td>Alclad 3004</td>
<td>Sheet and plate</td>
<td>---</td>
<td>SB-209</td>
<td>A83004</td>
</tr>
<tr>
<td>Alclad 6061</td>
<td>Sheet and plate</td>
<td>---</td>
<td>SB-209</td>
<td>A86061</td>
</tr>
<tr>
<td>Allicor</td>
<td>Forgings</td>
<td>51 Ni - 31 Cr - 10 Mo - W</td>
<td>SB-564</td>
<td>N06110</td>
</tr>
<tr>
<td>Alloy 230</td>
<td>Welding fittings</td>
<td>53 Ni - 22 Cr - 14 W - Co - Fe - Mo</td>
<td>SB-366</td>
<td>N06230</td>
</tr>
<tr>
<td>Alloy 230</td>
<td>Sheet and plate</td>
<td>53 Ni - 22 Cr - 14 W - Co - Fe - Mo</td>
<td>SB-435</td>
<td>N06230</td>
</tr>
</tbody>
</table>
Chapters 9 and 10 are the “heart” of this Materials Index - they form the bases for development of all other cross indexes (e.g., Chapters 5 through 8). Development of Chapters 9 and 10 was described in Chapter 2 of this book. Listing all ASME specification materials and materials permitted by Code cases involved going through over 4000 pages in four Code books. Defining which materials are permitted for each type of Code construction then required review of 3500-4000 individual stress lines in Tables 1-4 of Section II, Part D and the two stress tables of Section IV. Next, Table QW-422, spawning over 50 pages in Section IX was reviewed line-by-line to verify proper use of welding P/Group numbers.

This latest version of the Materials Index now addresses those specific materials permitted in Section IV and Section VIII-3 construction. To facilitate this expansion in scope of the tables found in Chapters 9 and 10, two columns had to be eliminated, namely “IX QW-422” and “Notes”. The first was considered to be redundant since it was only checked if a P/Group number had already been shown. The “Notes” column was found to be of little use and essential information was transferred to other parts of the Chapter 9/10 tables. When space in the following tables of Chapters 9 and 10 is limited, the following abbreviations may appear to describe “Product Form.”

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Product Form</th>
<th>Abbreviation</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ba</td>
<td>Bars</td>
<td>PI Co</td>
<td>Plates for Coating</td>
</tr>
<tr>
<td>Bi</td>
<td>Bars and Billets</td>
<td>Ro</td>
<td>Rods</td>
</tr>
<tr>
<td>Bo</td>
<td>Bolting</td>
<td>RP</td>
<td>Rolled Products</td>
</tr>
<tr>
<td>Ca</td>
<td>Castings</td>
<td>Sa</td>
<td>Shapes</td>
</tr>
<tr>
<td>CC</td>
<td>Centrifugal Castings</td>
<td>Sd</td>
<td>Studs</td>
</tr>
<tr>
<td>CCP</td>
<td>Centrifugal Cast Pipe</td>
<td>Sh</td>
<td>Sheet</td>
</tr>
<tr>
<td>CR</td>
<td>Cold Rolled</td>
<td>SHS</td>
<td>Socket Head Screws</td>
</tr>
<tr>
<td>CR Sh Dr</td>
<td>CR Sheet for Drawing</td>
<td>Sm</td>
<td>Seamless</td>
</tr>
<tr>
<td>CWP</td>
<td>Cast/Worked Pipe</td>
<td>SP</td>
<td>Seamless Pipe</td>
</tr>
<tr>
<td>CWWP</td>
<td>Cold worked welded pipe</td>
<td>ST</td>
<td>Structural</td>
</tr>
<tr>
<td>Fa</td>
<td>Fasteners</td>
<td>Std Fa</td>
<td>Standard Fasteners</td>
</tr>
<tr>
<td>FBP</td>
<td>Forged and Bored Pipe</td>
<td>STl</td>
<td>Steel</td>
</tr>
<tr>
<td>Fi</td>
<td>Fittings</td>
<td>Str</td>
<td>Strip</td>
</tr>
<tr>
<td>Fi</td>
<td>Flanges</td>
<td>Va</td>
<td>Valves</td>
</tr>
<tr>
<td>Fo</td>
<td>Forgings</td>
<td>Va</td>
<td>Valves</td>
</tr>
<tr>
<td>Fo Cor Ro</td>
<td>Forged Corrugated Rolls</td>
<td>W and SP</td>
<td>Welded and Seamless Pipe</td>
</tr>
<tr>
<td>Gen. Req.</td>
<td>General Requirements</td>
<td>W and SP</td>
<td>Welded and Seamless Pipe</td>
</tr>
<tr>
<td>Pa</td>
<td>Parts</td>
<td>W Fi</td>
<td>Welded Fittings</td>
</tr>
<tr>
<td>PF</td>
<td>Piping Fittings</td>
<td>WP</td>
<td>Welded Pipe</td>
</tr>
<tr>
<td>Pl</td>
<td>Plates</td>
<td>WT</td>
<td>Welded Tubes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wi</td>
<td>Wire</td>
</tr>
</tbody>
</table>
HEAT TREAT CONDITIONS & OTHER ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sol’n (Treated)</td>
<td>Solution (Treated)</td>
</tr>
<tr>
<td>ST</td>
<td>Solution Treated</td>
</tr>
<tr>
<td>Norm’d</td>
<td>Normalized</td>
</tr>
<tr>
<td>Q &amp; T</td>
<td>Quench and Tempered</td>
</tr>
<tr>
<td>N &amp; T</td>
<td>Normalized and Tempered</td>
</tr>
<tr>
<td>Cond’n (Heat Treated)</td>
<td>Condition (Heat Treated)</td>
</tr>
<tr>
<td>CR</td>
<td>Cold Rolled</td>
</tr>
<tr>
<td>HR</td>
<td>Hot Rolled</td>
</tr>
<tr>
<td>IS</td>
<td>Intermediate Strength</td>
</tr>
<tr>
<td>HS</td>
<td>High Strength</td>
</tr>
<tr>
<td>incl.</td>
<td>inclusive</td>
</tr>
</tbody>
</table>

TESTING SPECIFICATIONS

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA-275</td>
<td>Test Method for Magnetic Particle Examination of Steel Forgings</td>
</tr>
<tr>
<td>SA-370</td>
<td>Test Methods and Definitions for Mechanical Testing of Steel Products</td>
</tr>
<tr>
<td>SA-388</td>
<td>Practice for Ultrasonic Examination of Heavy Steel Forgings</td>
</tr>
<tr>
<td>SA-435</td>
<td>Specification for Straight-Beam Ultrasonic Examination of Steel Plates for Pressure Vessels</td>
</tr>
<tr>
<td>SA-450</td>
<td>Specification for General Requirements for Carbon, Ferritic Alloy, Austenitic Alloy Steel Tubes</td>
</tr>
<tr>
<td>SA-480</td>
<td>Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip</td>
</tr>
<tr>
<td>SA-484</td>
<td>Specification for General Requirements for Stainless and Heat-Resisting Steel Bars, Billets, and Forgings</td>
</tr>
<tr>
<td>SA-530</td>
<td>Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe</td>
</tr>
<tr>
<td>SA-577</td>
<td>Specification for Ultrasonic Angle-Beam Examination of Steel Plates</td>
</tr>
<tr>
<td>SA-578</td>
<td>Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications</td>
</tr>
<tr>
<td>SA-609</td>
<td>Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof</td>
</tr>
<tr>
<td>SA-703</td>
<td>Specification for Steel Castings, General Requirements, for Pressure-Containing Parts</td>
</tr>
<tr>
<td>SA-745</td>
<td>Practice for Ultrasonic Examination of Austenitic Steel Forgings</td>
</tr>
<tr>
<td>SA-751</td>
<td>Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products</td>
</tr>
<tr>
<td>SA-770</td>
<td>Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications</td>
</tr>
<tr>
<td>SA-781</td>
<td>Specification for Castings, Steel, and Alloy, Common Requirements for General Industrial Use</td>
</tr>
<tr>
<td>SA-788</td>
<td>Specification for Steel Forgings, General Requirements</td>
</tr>
<tr>
<td>SA-834</td>
<td>Specification for Common Requirements for Iron Castings for General Industrial Use</td>
</tr>
<tr>
<td>SPEC. NO.</td>
<td>GRADE - Gr</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>SA-36</td>
<td>C Stl</td>
</tr>
<tr>
<td>SA-47</td>
<td>Gr 32510</td>
</tr>
<tr>
<td>SA-53</td>
<td>Ty S - Gr A</td>
</tr>
<tr>
<td>SA-105</td>
<td>C Stl</td>
</tr>
<tr>
<td>SA-106</td>
<td>Gr A</td>
</tr>
<tr>
<td>Gr B</td>
<td>C Stl</td>
</tr>
<tr>
<td>Gr C</td>
<td>C Stl</td>
</tr>
<tr>
<td>SA-134</td>
<td>(A283A) C Stl</td>
</tr>
<tr>
<td>(A283B) C Stl</td>
<td></td>
</tr>
<tr>
<td>(A283C) C Stl</td>
<td></td>
</tr>
<tr>
<td>(A283D) C Stl</td>
<td></td>
</tr>
<tr>
<td>SA-135</td>
<td>Gr A</td>
</tr>
<tr>
<td>Gr B</td>
<td>C Stl</td>
</tr>
<tr>
<td>SA-178</td>
<td>Gr A</td>
</tr>
<tr>
<td>Gr C</td>
<td>C Stl</td>
</tr>
<tr>
<td>Gr D</td>
<td>C Stl</td>
</tr>
<tr>
<td>SA-179</td>
<td>---</td>
</tr>
<tr>
<td>SA-181</td>
<td>Cl 60</td>
</tr>
<tr>
<td>Cl 70</td>
<td>C Stl</td>
</tr>
<tr>
<td>SA-182</td>
<td>Gr F1</td>
</tr>
<tr>
<td>Gr F2</td>
<td>½ Cr-½ Mo</td>
</tr>
<tr>
<td>Gr F3V</td>
<td>3 Cr-1 Mo-¼ V</td>
</tr>
</tbody>
</table>

Note 1 - The UNS number may also be K02595-K02599 for plate, as a function of thickness; K02600 covers only shapes.

Note 2 - Steel from which piping is made may also conform to A285, A570 or A36.

CASTI Guidebook to ASME Section II - 2000 Materials Index
<table>
<thead>
<tr>
<th>SPEC. NO.</th>
<th>GRADE - Gr CLASS - Cl</th>
<th>HT CONDITION</th>
<th>NOMINAL COMPOSITION DESIGNATION</th>
<th>PRODUCT FORM</th>
<th>SIZE LIMITS, IN.</th>
<th>WELD NO.</th>
<th>UNS NO.</th>
<th>COMMON NAME OR TRADE NAME OR REF. SPEC.</th>
<th>STRENGTH LEVEL, ksi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973 N245</td>
<td>Gr F3Vcb</td>
<td>3 Cr-1 Mo-½ V-Cb Forgings</td>
<td>85-110</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2183</td>
<td>Gr F6b</td>
<td>13 Cr- ½ Mo</td>
<td>110-135</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973 N253</td>
<td>Gr F6NM</td>
<td>13 Cr -4½ Ni-Mo</td>
<td>115</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9173 N253</td>
<td>Gr F9</td>
<td>9 Cr-1 Mo</td>
<td>85</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973 N253</td>
<td>Gr F91</td>
<td>9 Cr-1 Mo-V</td>
<td>85</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Gr F10</td>
<td>20 Ni-8 Cr</td>
<td>80</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973 N201</td>
<td>Gr F11, Cl 1</td>
<td>1¼ Cr-½ Mo-Si</td>
<td>60</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973 N201</td>
<td>Gr F11, Cl 2</td>
<td>1¼ Cr-½ Mo-Si</td>
<td>70</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973 N201</td>
<td>Gr F11, Cl 3</td>
<td>1¼ Cr-½ Mo-Si</td>
<td>75</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2183</td>
<td>Gr F12, Cl 1</td>
<td>1 Cr-½ Mo</td>
<td>60</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973 N253</td>
<td>Gr F12, Cl 2</td>
<td>1 Cr-½ Mo</td>
<td>70</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973 N253</td>
<td>Gr F21</td>
<td>3 Cr-1 Mo</td>
<td>75</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017 N253</td>
<td>Gr F22, Cl 1</td>
<td>2½ Cr-1 Mo</td>
<td>60</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2033</td>
<td>Gr F44</td>
<td>20Cr-18Ni-6Mo</td>
<td>94</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1953</td>
<td>Gr F46</td>
<td>18 Cr-15 Ni-4 Si</td>
<td>78</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N636</td>
<td>Gr F47</td>
<td>19 Cr-15 Ni-4 Mo</td>
<td>75</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N636</td>
<td>Gr F48</td>
<td>19 Cr-15½ Ni-4 Mo</td>
<td>80</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N636</td>
<td>Gr F50</td>
<td>25 Cr-6 Ni-Mo-N</td>
<td>100-130</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2067 N635</td>
<td>Gr F51</td>
<td>22 Cr-5 Ni-3 Mo-N</td>
<td>90</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2067 N635</td>
<td>Gr F56</td>
<td>27 Cr-32 Ni-Cb</td>
<td>73</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2033</td>
<td>Gr FR</td>
<td>2 Ni-1 Cu</td>
<td>63</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1953</td>
<td>Gr FXM-11</td>
<td>21 Cr-6 Ni-9 Mn</td>
<td>90</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 10

NONFERROUS CODE MATERIALS SPECIFICATIONS BY SECTION USE

The first page of Chapter 9 describes the evolution of this Chapter. When space permits, Product Form will be defined—if abbreviation must be used, the following will be used:

PRODUCT FORM ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Product Form</th>
<th>Abbreviation</th>
<th>Product Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ba</td>
<td>Bars</td>
<td>Sm</td>
<td>Seamless</td>
</tr>
<tr>
<td>Ca</td>
<td>Castings</td>
<td>Pipe, S &amp; W</td>
<td>Seamless and Welded Pipe</td>
</tr>
<tr>
<td>CC</td>
<td>Centrifugal Castings</td>
<td>Tube, S &amp; W</td>
<td>Seamless and Welded Tubes</td>
</tr>
<tr>
<td>Fo</td>
<td>Forgings</td>
<td>SP</td>
<td>Seamless Pipe</td>
</tr>
<tr>
<td>Hex(s)</td>
<td>Hexagonal(s) (shape)</td>
<td>Sq(s)</td>
<td>Square(s) (shape)</td>
</tr>
<tr>
<td>Pl</td>
<td>Plates</td>
<td>St</td>
<td>Structural</td>
</tr>
<tr>
<td>Oct(s)</td>
<td>Octagonal(s) (shape)</td>
<td>ST</td>
<td>Seamless Tube</td>
</tr>
<tr>
<td>Rect’s</td>
<td>Rectagonals</td>
<td>Str</td>
<td>Strip</td>
</tr>
<tr>
<td>Ro</td>
<td>Rods</td>
<td>W Fi</td>
<td>Welded Fittings</td>
</tr>
<tr>
<td>Sa</td>
<td>Shapes</td>
<td>WP</td>
<td>Welded Pipe</td>
</tr>
<tr>
<td>SFT</td>
<td>Seamless/Finned Tubes</td>
<td>WT</td>
<td>Welded Tubes</td>
</tr>
<tr>
<td>Sh</td>
<td>Sheet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HEAT TREAT CONDITIONS & OTHER ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cond’n (Treated)</td>
<td>Condition (Treated)</td>
</tr>
<tr>
<td>HT</td>
<td>Heat Treated</td>
</tr>
<tr>
<td>SHT</td>
<td>Solution Heat Treated</td>
</tr>
<tr>
<td>Stab</td>
<td>Stabilized</td>
</tr>
<tr>
<td>PH</td>
<td>Precipitation Hardened</td>
</tr>
<tr>
<td>HR</td>
<td>Hot Rolled</td>
</tr>
<tr>
<td>HF</td>
<td>Hot Finished</td>
</tr>
<tr>
<td>HW</td>
<td>Hot Worked</td>
</tr>
<tr>
<td>CD</td>
<td>Cold Drawn</td>
</tr>
<tr>
<td>CR</td>
<td>Cold Rolled</td>
</tr>
<tr>
<td>CW</td>
<td>Cold Worked</td>
</tr>
<tr>
<td>SR</td>
<td>Stress Relieved</td>
</tr>
<tr>
<td>WT</td>
<td>Wall Thickness</td>
</tr>
<tr>
<td>incl.</td>
<td>inclusive</td>
</tr>
</tbody>
</table>

CASTI Guidebook to ASME Section II - 2000 Materials Index
<table>
<thead>
<tr>
<th>SPEC. NO.</th>
<th>GRADE - Gr</th>
<th>CLASS - Cl</th>
<th>TYPE - Ty</th>
<th>HT CONDITION</th>
<th>NOMINAL COMPOSITION DESIGNATION</th>
<th>PRODUCT FORM</th>
<th>SIZE LIMITS, IN.</th>
<th>Weld No.</th>
<th>UNS No.</th>
<th>COMMON NAME OR TRADE NAME OR REF. SPEC.</th>
<th>STRENGTH LEVEL, ksi</th>
<th>SECTION II, PART D COVERAGE</th>
<th>SECTION IV</th>
<th>SECTION VIII-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB-26</td>
<td>204.0</td>
<td>4</td>
<td>061</td>
<td>T4</td>
<td>Al-Cu-Mg</td>
<td>Castings</td>
<td>31</td>
<td></td>
<td>C10200</td>
<td>OF Cu</td>
<td>40</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>356.0</td>
<td>6</td>
<td>061</td>
<td>T6</td>
<td>Al-Si-Mg</td>
<td>(21) Old SG 70A</td>
<td>20</td>
<td></td>
<td>A03560</td>
<td>45 28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>356.0</td>
<td>71</td>
<td>061</td>
<td>T71</td>
<td>Al-Si-Mg</td>
<td>(21) Old SG 70A</td>
<td>18</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B443.0</td>
<td>F</td>
<td>050</td>
<td></td>
<td></td>
<td>Al-Si</td>
<td>(21) Old SSA</td>
<td>6</td>
<td></td>
<td>A24430</td>
<td>17 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-42</td>
<td>C10200</td>
<td>061</td>
<td>99.95 Cu</td>
<td>Pipe, smls</td>
<td>31 C10200 OF Cu</td>
<td>30 9</td>
<td>17 6</td>
<td></td>
<td>A02040</td>
<td>45 28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C10200</td>
<td>H80</td>
<td>99.95 Cu</td>
<td>¼ to 2</td>
<td>31 C10200 OF Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>30 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C10200</td>
<td>H55</td>
<td>99.95 Cu</td>
<td>2½ to 12</td>
<td>31 C10200 OF Cu</td>
<td>36 30</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>061</td>
<td>99.90 Cu+P</td>
<td>Pipe, smls</td>
<td>31 C12200 DLP Cu</td>
<td>30 9</td>
<td>36 30</td>
<td></td>
<td>A02040</td>
<td>30 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H80</td>
<td>99.90 Cu+P</td>
<td>¼ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H55</td>
<td>99.90 Cu+P</td>
<td>2½ to 12</td>
<td>31 C12200 DHP Cu</td>
<td>36 30</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>30 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-43</td>
<td>C23000</td>
<td>061</td>
<td>85 Cu-15 Zn</td>
<td>Pipe, smls</td>
<td>32 C23000 Red Brass</td>
<td>40 12</td>
<td>36 30</td>
<td></td>
<td>A02040</td>
<td>30 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Case only) 058 85 Cu-15 Zn</td>
<td>40 12</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>30 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-61</td>
<td>C92200</td>
<td>M01</td>
<td>88 Cu-6 Sn-4½ Zn-Pb</td>
<td>Castings</td>
<td>107 C92200 Alloy 2A Valve Bronze</td>
<td>34 16</td>
<td>36 30</td>
<td></td>
<td>A02040</td>
<td>30 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-62</td>
<td>C83600</td>
<td>M01</td>
<td>85 Cu-5 Sn-5 Zn-5 Pb</td>
<td>Castings</td>
<td>107 C83600 Alloy 85 or 85-5-5-5</td>
<td>30 14</td>
<td>36 30</td>
<td></td>
<td>A02040</td>
<td>30 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-75</td>
<td>C10200</td>
<td>050</td>
<td>99.95 Cu</td>
<td>Tubes, smls</td>
<td>31 C10200 OF Cu</td>
<td>30 9</td>
<td>30 9</td>
<td></td>
<td>A03560</td>
<td>30 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C10200</td>
<td>H80</td>
<td>99.95 Cu</td>
<td>½ to 2</td>
<td>31 C10200 OF Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>060</td>
<td>99.95 Cu</td>
<td>½ to 2</td>
<td>31 C12200 OF Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H55</td>
<td>99.95 Cu</td>
<td>½ to 2</td>
<td>31 C12200 OF Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H58</td>
<td>99.95 Cu</td>
<td>½ to 2</td>
<td>31 C12200 OF Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H80</td>
<td>99.95 Cu</td>
<td>½ to 2</td>
<td>31 C12200 OF Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H80</td>
<td>99.90 Cu+P</td>
<td>½ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H55</td>
<td>99.90 Cu+P</td>
<td>½ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H55</td>
<td>99.90 Cu+P</td>
<td>½ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H58</td>
<td>99.90 Cu+P</td>
<td>½ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H80</td>
<td>99.90 Cu+P</td>
<td>½ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H80</td>
<td>99.90 Cu+P</td>
<td>½ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C12200</td>
<td>H80</td>
<td>99.90 Cu+P</td>
<td>½ to 2</td>
<td>31 C12200 DLP Cu</td>
<td>45 40</td>
<td>36 30</td>
<td></td>
<td>A03560</td>
<td>25 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPEC. NO.</td>
<td>GRADE - Gr</td>
<td>CLASS - Cl</td>
<td>HT CONDITION</td>
<td>NOMINAL COMPOSITION DESIGNATION</td>
<td>PRODUCT FORM</td>
<td>SIZE LIMITS, IN.</td>
<td>WELD NO.</td>
<td>UNS NO.</td>
<td>COMMON NAME OR TRADE NAME OR REF. SPEC.</td>
<td>STRENGTH LEVEL, ksi</td>
<td>SECTION II, PART D COVERAGE</td>
<td>SECTION IV</td>
<td>SECTION VIII-3</td>
<td>CODE CASE COVERAGE</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>------------</td>
<td>--------------</td>
<td>-------------------------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>-----------</td>
<td>---------</td>
<td>------------------------------------------</td>
<td>----------------------</td>
<td>-----------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>SB-96</td>
<td>C65500</td>
<td>061</td>
<td>97 Cu-3 Si</td>
<td>Pt, Sh, Str &amp; Ba</td>
<td>33</td>
<td>C65500</td>
<td>Cu-Si Alloy A</td>
<td>50-67</td>
<td>18</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>SB-98</td>
<td>C65100</td>
<td>060</td>
<td>98.5 Cu-1.5 Si</td>
<td>Ro, Ba &amp; Sa</td>
<td>33</td>
<td>C65100</td>
<td>Cu-Si Alloy B</td>
<td>40</td>
<td>12</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C65100</td>
<td>H02</td>
<td>98.5 Cu-1.5 Si</td>
<td></td>
<td></td>
<td>33</td>
<td>C65100</td>
<td>Cu-Si Alloy B</td>
<td>55</td>
<td>20</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C65100</td>
<td>H06</td>
<td>98.5 Cu-1.5 Si</td>
<td>≤ ½</td>
<td></td>
<td>33</td>
<td>C65100</td>
<td>Cu-Si Alloy B</td>
<td>85</td>
<td>55</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C65100</td>
<td>H06</td>
<td>98.5 Cu-1.5 Si</td>
<td>&gt; ½ to 1, incl.</td>
<td></td>
<td>33</td>
<td>C65100</td>
<td>Cu-Si Alloy B</td>
<td>75</td>
<td>45</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C65500</td>
<td>060</td>
<td>97 Cu-3 Si</td>
<td></td>
<td></td>
<td>33</td>
<td>C65500</td>
<td>Cu-Si Alloy A</td>
<td>52</td>
<td>15</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C65500</td>
<td>H01</td>
<td>97 Cu-3 Si</td>
<td></td>
<td></td>
<td>33</td>
<td>C65500</td>
<td>Cu-Si Alloy A</td>
<td>55</td>
<td>24</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C65500</td>
<td>H02</td>
<td>97 Cu-3 Si</td>
<td></td>
<td></td>
<td>33</td>
<td>C65500</td>
<td>Cu-Si Alloy A</td>
<td>70</td>
<td>38</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C66100</td>
<td>H01</td>
<td>94 Cu-3 Si-Pb</td>
<td></td>
<td></td>
<td>33</td>
<td>C66100</td>
<td>Cu-Si Alloy D</td>
<td>52</td>
<td>15</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C66100</td>
<td>H02</td>
<td>94 Cu-3 Si-Pb</td>
<td></td>
<td></td>
<td>33</td>
<td>C66100</td>
<td>Cu-Si Alloy D</td>
<td>55</td>
<td>24</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>SB-108</td>
<td>204.0</td>
<td>T4</td>
<td>Al-Cu-Mg</td>
<td>Castings</td>
<td>A02040</td>
<td>48</td>
<td>29</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>356.0</td>
<td>T6</td>
<td>Al-Si-Mg</td>
<td></td>
<td></td>
<td>A03560</td>
<td>22</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Case only) Overaged</td>
<td>Al-Si-Mg</td>
<td>A03570</td>
<td>27</td>
<td>20</td>
<td>2239</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Case only) Overaged</td>
<td>Al-Si-Mg-Cu</td>
<td>A13660</td>
<td>26</td>
<td>19</td>
<td>2239</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Case only) T61</td>
<td>Al-Si-Mg</td>
<td>A03560</td>
<td>37</td>
<td>26</td>
<td>2153</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB-111</td>
<td>C10200</td>
<td>H55</td>
<td>99.95 Cu</td>
<td>Tubes, smls</td>
<td>31</td>
<td>C10200</td>
<td>OF Cu</td>
<td>36</td>
<td>30</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C10200</td>
<td>H80</td>
<td>99.95 Cu</td>
<td></td>
<td></td>
<td>31</td>
<td>C10200</td>
<td>OF Cu</td>
<td>45</td>
<td>40</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C12000</td>
<td>H55</td>
<td>99.90 Cu</td>
<td></td>
<td></td>
<td>31</td>
<td>C12000</td>
<td>DLP Cu</td>
<td>36</td>
<td>30</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C12000</td>
<td>H80</td>
<td>99.90 Cu</td>
<td></td>
<td></td>
<td>31</td>
<td>C12000</td>
<td>DLP Cu</td>
<td>45</td>
<td>40</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C12200</td>
<td>H55</td>
<td>99.9 Cu + P</td>
<td></td>
<td></td>
<td>31</td>
<td>C12200</td>
<td>DHP Cu</td>
<td>36</td>
<td>30</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C12200</td>
<td>H80</td>
<td>99.9 Cu + P</td>
<td></td>
<td></td>
<td>31</td>
<td>C12200</td>
<td>DHP Cu</td>
<td>45</td>
<td>40</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C14200</td>
<td>H55</td>
<td>99.40 Cu + As + P</td>
<td></td>
<td></td>
<td>31</td>
<td>C14200</td>
<td>DPA Cu</td>
<td>36</td>
<td>30</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C14200</td>
<td>H80</td>
<td>99.40 Cu + As + P</td>
<td></td>
<td></td>
<td>31</td>
<td>C14200</td>
<td>DPA Cu</td>
<td>45</td>
<td>40</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C19200</td>
<td>061</td>
<td>98.7 Cu + Fe + P</td>
<td></td>
<td></td>
<td>31</td>
<td>C19200</td>
<td>Phosphorized 1% iron</td>
<td>38</td>
<td>12</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C23000</td>
<td>061</td>
<td>85 Cu-15 Zn</td>
<td></td>
<td></td>
<td>32</td>
<td>C23000</td>
<td>Red brass</td>
<td>40</td>
<td>12</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C29000</td>
<td>061</td>
<td>60 Cu-40 Zn</td>
<td></td>
<td></td>
<td>32</td>
<td>C28000</td>
<td>Muntz metal</td>
<td>50</td>
<td>20</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>C44300</td>
<td>061</td>
<td>71 Cu-28 Zn-Sn-As</td>
<td></td>
<td></td>
<td>32</td>
<td>C44300</td>
<td>Admiralty B or Arsenal</td>
<td>45</td>
<td>15</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
# ASME SPECIFICATION DESIGNATIONS AND TITLES

## ASME FERROUS SPECIFICATION DESIGNATIONS AND TITLES

### LISTED BY PRODUCT FORM

<table>
<thead>
<tr>
<th>Steel Pipe</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA-53</td>
<td>Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless</td>
</tr>
<tr>
<td>SA-106</td>
<td>Seamless Carbon Steel Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-134</td>
<td>Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)</td>
</tr>
<tr>
<td>SA-135</td>
<td>Electric-Resistance-Welded Steel Pipe</td>
</tr>
<tr>
<td>SA-312/SA-312M</td>
<td>Seamless and Welded Austenitic Stainless Steel Pipe</td>
</tr>
<tr>
<td>SA-333/SA-333M</td>
<td>Seamless and Welded Steel Pipe for Low-Temperature Service</td>
</tr>
<tr>
<td>SA-335/SA-335M</td>
<td>Seamless Ferritic Alloy Steel Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-358/SA-358M</td>
<td>Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High Temperature Service</td>
</tr>
<tr>
<td>SA-369/SA-369M</td>
<td>Carbon and Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-376/SA-376M</td>
<td>Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service</td>
</tr>
<tr>
<td>SA-409/SA-409M</td>
<td>Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service</td>
</tr>
<tr>
<td>SA-426</td>
<td>Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-430/SA-430M</td>
<td>Austenitic Steel Forged and Bored Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-451</td>
<td>Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-452</td>
<td>Centrifugally Cast Austenitic Steel Cold-Wrought Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-524</td>
<td>Seamless Carbon Steel Pipe for Atmospheric and Lower Temperatures</td>
</tr>
<tr>
<td>SA-530/SA-530M</td>
<td>General Requirements for Specialized Carbon and Alloy Steel Pipe</td>
</tr>
<tr>
<td>SA-587</td>
<td>Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry</td>
</tr>
<tr>
<td>SA-660</td>
<td>Centrifugally Cast Carbon Steel Pipe for High-Temperature Service</td>
</tr>
<tr>
<td>SA-671</td>
<td>Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures</td>
</tr>
<tr>
<td>SA-672</td>
<td>Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures</td>
</tr>
<tr>
<td>SA-691</td>
<td>Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures</td>
</tr>
<tr>
<td>SA-727/SA-727M</td>
<td>Forgings. Carbon Steel, for Piping Components with Inherent Notch Toughness</td>
</tr>
<tr>
<td>SA-731/SA-731M</td>
<td>Seamless and Welded Ferritic, Martensitic Stainless Steel Pipe</td>
</tr>
<tr>
<td>SA-790/SA-790M</td>
<td>Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe</td>
</tr>
<tr>
<td>SA-813/SA-813M</td>
<td>Single- or Double-Welded Austenitic Stainless Steel Pipe</td>
</tr>
<tr>
<td>SA-814/SA-814M</td>
<td>Cold-Worked Welded Austenitic Stainless Steel Pipe</td>
</tr>
</tbody>
</table>
### Steel Tubes

<table>
<thead>
<tr>
<th>Specification Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA-178/SA-178M</td>
<td>Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes</td>
</tr>
<tr>
<td>SA-179/SA-179M</td>
<td>Seamless Cold-Drawn Low-Carbon Steel Heat Exchanger and Condenser Tubes</td>
</tr>
<tr>
<td>SA-192/SA-192M</td>
<td>Seamless Carbon Steel Boiler Tubes for High-Pressure Service</td>
</tr>
<tr>
<td>SA-199/SA-199M</td>
<td>Seamless Cold-Drawn Intermediate Alloy Steel Heat Exchanger and Condenser Tubes</td>
</tr>
<tr>
<td>SA-210/SA-210M</td>
<td>Seamless Medium-Carbon Steel Boiler and Superheater Tubes</td>
</tr>
<tr>
<td>SA-213/SA-213M</td>
<td>Seamless Ferritic and Austenitic Alloy Steel Boiler, Superheater, and Heat Exchanger Tubes</td>
</tr>
<tr>
<td>SA-209/SA-209M</td>
<td>Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes</td>
</tr>
<tr>
<td>SA-249/SA-249M</td>
<td>Welded Austenitic Steel Boiler, Superheater, Heat Exchanger, and Condenser Tubes</td>
</tr>
<tr>
<td>SA-250/SA-250M</td>
<td>Electric-Resistance-Welded Ferritic Alloy Steel Boiler and Superheater Tubes</td>
</tr>
<tr>
<td>SA-268/SA-268M</td>
<td>Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service</td>
</tr>
<tr>
<td>SA-334/SA-334M</td>
<td>Seamless and Welded Carbon and Alloy Steel Tubes for Low-Temperature Service</td>
</tr>
<tr>
<td>SA-423/SA-423M</td>
<td>Seamless and Electric-Welded Low-Alloy Steel Tubes</td>
</tr>
<tr>
<td>SA-450/SA-450M</td>
<td>General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes</td>
</tr>
<tr>
<td>SA-556/SA-556M</td>
<td>Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes</td>
</tr>
<tr>
<td>SA-557/SA-557M</td>
<td>Electric-Resistance-Welded Carbon Steel Feedwater Heater Tubes</td>
</tr>
<tr>
<td>SA-688/SA-688M</td>
<td>Welded Austenitic Stainless Steel Feedwater Heater Tubes</td>
</tr>
<tr>
<td>SA-789/SA-789M</td>
<td>Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service</td>
</tr>
<tr>
<td>SA-803/SA803M</td>
<td>Welded Ferritic Stainless Steel Feedwater Heater Tubes</td>
</tr>
</tbody>
</table>

### Steel Flanges, Fittings, Valves, and Parts

<table>
<thead>
<tr>
<th>Specification Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA-105/SA-105M</td>
<td>Forgings, Carbon Steel, for Piping Applications</td>
</tr>
<tr>
<td>SA-181/SA-181M</td>
<td>Forgings, Carbon Steel, for General-Purpose Piping</td>
</tr>
<tr>
<td>SA-182/SA-182M</td>
<td>Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service</td>
</tr>
<tr>
<td>SA-216/SA-216M</td>
<td>Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service</td>
</tr>
<tr>
<td>SA-217/SA-217M</td>
<td>Steel Castings, Martensitic Stainless and Alloy, for Pressure Containing Parts Suitable for High-Temperature Service</td>
</tr>
<tr>
<td>SA-232/SA-232M</td>
<td>Chromium-Vanadium Alloy Steel Valve Spring Quality Wire</td>
</tr>
<tr>
<td>SA-234/SA-234M</td>
<td>Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures</td>
</tr>
<tr>
<td>SA-350/SA-350M</td>
<td>Forgings, Carbon and Low-Alloy Steel, Requiring Notch Toughness Testing for Piping Components</td>
</tr>
<tr>
<td>SA-351/SA-351M</td>
<td>Castings, Austenitic, Austenitic-Ferritic (Duplex) for Pressure-Containing Parts</td>
</tr>
<tr>
<td>SA-352/SA-352M</td>
<td>Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts Suitable for Low-Temperature Service</td>
</tr>
<tr>
<td>SA-403/SA-403M</td>
<td>Wrought Austenitic Stainless Steel Piping Fittings</td>
</tr>
<tr>
<td>SA-420/SA-420M</td>
<td>Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service</td>
</tr>
<tr>
<td>SA-522/SA-522M</td>
<td>Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service</td>
</tr>
<tr>
<td>SA-592/SA-592M</td>
<td>High-Strength Quenched and Tempered Low-Alloy Steel Forged Fittings and Parts for Pressure Vessels</td>
</tr>
<tr>
<td>SA-815/SA-815M</td>
<td>Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings</td>
</tr>
<tr>
<td>SA-905</td>
<td>Steel Wire, Pressure Vessel Winding</td>
</tr>
</tbody>
</table>
Appendix 1

UNIT CONVERSION TABLES
<table>
<thead>
<tr>
<th>To Convert From</th>
<th>To</th>
<th>Multiply By</th>
<th>To Convert From</th>
<th>To</th>
<th>Multiply By</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Angle</strong></td>
<td></td>
<td></td>
<td><strong>Mass per unit length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>degree</td>
<td>rad</td>
<td>1.745 329 E -02</td>
<td>lb/ft</td>
<td>kg/m</td>
<td>1.488 164 E + 00</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td></td>
<td></td>
<td><strong>Mass per unit time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in.²</td>
<td>mm²</td>
<td>6.451 600 E + 02</td>
<td>lb/ft</td>
<td>kg/m</td>
<td>1.785 797 E + 01</td>
</tr>
<tr>
<td>in.²</td>
<td>cm²</td>
<td>6.451 600 E + 00</td>
<td>lb/h</td>
<td>kg/s</td>
<td>1.259 979 E - 04</td>
</tr>
<tr>
<td>in.²</td>
<td>m²</td>
<td>6.451 600 E - 04</td>
<td>lb/min</td>
<td>kg/s</td>
<td>7.559 873 E - 03</td>
</tr>
<tr>
<td>ft²</td>
<td>m²</td>
<td>9.290 304 E - 02</td>
<td>lb/s</td>
<td>kg/s</td>
<td>4.535 924 E - 01</td>
</tr>
<tr>
<td><strong>Bending moment or torque</strong></td>
<td></td>
<td><strong>Mass per unit volume (includes density)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lbf - in.</td>
<td>N - m</td>
<td>1.129 848 E - 01</td>
<td>g/cm³</td>
<td>kg/m³</td>
<td>1.000 000 E + 03</td>
</tr>
<tr>
<td>lbf - ft</td>
<td>N - m</td>
<td>1.355 818 E + 00</td>
<td>lb/ft³</td>
<td>g/cm³</td>
<td>1.601 846 E - 02</td>
</tr>
<tr>
<td>kgf - m</td>
<td>N - m</td>
<td>9.806 650 E + 00</td>
<td>lb/ft³</td>
<td>kg/m³</td>
<td>1.601 846 E + 01</td>
</tr>
<tr>
<td>ozf - in.</td>
<td>N - m</td>
<td>7.061 552 E - 03</td>
<td>lb/in.³</td>
<td>g/cm³</td>
<td>2.767 990 E + 01</td>
</tr>
<tr>
<td><strong>Bending moment or torque per unit length</strong></td>
<td></td>
<td></td>
<td><strong>Power</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lbf - in./in.</td>
<td>N - m/m</td>
<td>4.448 222 E + 00</td>
<td>Btu/s</td>
<td>kW</td>
<td>1.055 056 E + 00</td>
</tr>
<tr>
<td>lbf - ft/in.</td>
<td>N - m/m</td>
<td>5.337 866 E + 01</td>
<td>Btu/s</td>
<td>kW</td>
<td>1.758 426 E - 02</td>
</tr>
<tr>
<td><strong>Corrosion rate</strong></td>
<td></td>
<td></td>
<td><strong>Pressure (fluid)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mils/yr</td>
<td>mm/yr</td>
<td>2.540 000 E - 02</td>
<td>Btu/min</td>
<td>kW</td>
<td>2.928 751 E - 01</td>
</tr>
<tr>
<td>mils/yr</td>
<td>µ/yr</td>
<td>2.540 000 E + 01</td>
<td>Btu/h</td>
<td>W</td>
<td>1.000 000 E - 07</td>
</tr>
<tr>
<td><strong>Current density</strong></td>
<td></td>
<td></td>
<td><strong>Electricity and magnetism</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A/in.²</td>
<td>A/cm²</td>
<td>1.550 003 E - 01</td>
<td>ft - lbf/s</td>
<td>W</td>
<td>1.355 818 E + 00</td>
</tr>
<tr>
<td>A/in.²</td>
<td>A/mm²</td>
<td>1.550 003 E - 03</td>
<td>ft - lbf/min</td>
<td>W</td>
<td>2.259 697 E - 02</td>
</tr>
<tr>
<td>A/ft²</td>
<td>A/m²</td>
<td>1.076 400 E + 01</td>
<td>ft - lbf/h</td>
<td>W</td>
<td>3.766 161 E - 04</td>
</tr>
<tr>
<td><strong>Energy (impact other)</strong></td>
<td></td>
<td></td>
<td><strong>Specific heat</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ft - lbf</td>
<td>J</td>
<td>1.355 818 E + 00</td>
<td>torr (mm Hg, 0 C)</td>
<td>Pa</td>
<td>1.333 220 E + 02</td>
</tr>
<tr>
<td>Btu (thermochemical)</td>
<td>J</td>
<td>1.054 350 E + 03</td>
<td>Btu/lb - F</td>
<td>J/kg - K</td>
<td>4.186 800 E + 03</td>
</tr>
<tr>
<td>cal (thermochemical)</td>
<td>J</td>
<td>4.184 000 E + 00</td>
<td>cal/g - C</td>
<td>J/kg - K</td>
<td>4.186 800 E + 03</td>
</tr>
<tr>
<td>W - h</td>
<td>J</td>
<td>3.600 000 E + 03</td>
<td>Btu/lb - F</td>
<td>J/kg - K</td>
<td>4.186 800 E + 03</td>
</tr>
<tr>
<td><strong>Flow rate</strong></td>
<td></td>
<td></td>
<td><strong>Stress (force per unit area)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ft³/h</td>
<td>L/min</td>
<td>4.719 475 E - 01</td>
<td>kgf/mm²</td>
<td>MPa</td>
<td>1.378 951 E + 01</td>
</tr>
<tr>
<td>ft³/min</td>
<td>L/min</td>
<td>2.831 000 E + 01</td>
<td>ksi</td>
<td>MPa</td>
<td>9.806 650 E + 00</td>
</tr>
<tr>
<td>gal/h</td>
<td>L/min</td>
<td>6.309 020 E - 02</td>
<td>lb/in.²</td>
<td>psi</td>
<td>6.894 757 E - 03</td>
</tr>
<tr>
<td>gal/min</td>
<td>L/min</td>
<td>3.785 412 E + 00</td>
<td>MN/m²</td>
<td>MPa</td>
<td>1.000 000 E + 00</td>
</tr>
</tbody>
</table>
Appendix

2

HARDNESS CONVERSION TABLES
### APPROPRIATE HARDNESS CONVERSION NUMBERS FOR NONAUSTENITIC STEELS

<table>
<thead>
<tr>
<th>Rockwell C 150 kgf Diamond Vickers HV</th>
<th>Brinell 3000 kgf 10mm ball HB</th>
<th>Knoop 500 gf HK</th>
<th>Rockwell A 60 kgf Diamond HRA</th>
<th>Rockwell Superficial 15 kgf Diamond HR15N</th>
<th>Rockwell Superficial 30 kgf Diamond HR30N</th>
<th>Hardness 45 kgf Diamond HR45N</th>
<th>Approx. Tensile Strength ksi (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>68 940  ---  920  85.6  93.2  84.4  75.4  ---</td>
<td>67 900  ---  895  85.0  92.9  83.6  74.2  ---</td>
<td>66 865  ---  870  84.5  92.5  82.8  73.3  ---</td>
<td>65 832  739d  846  83.9  92.2  81.9  72.0  ---</td>
<td>64 800  722d  822  83.4  91.8  81.1  71.0  ---</td>
<td>63 772  706d  799  82.8  91.4  80.1  69.9  ---</td>
<td>62 746  688d  776  82.3  91.1  79.3  68.8  ---</td>
<td>61 720  670d  754  81.8  90.7  78.4  67.7  ---</td>
</tr>
<tr>
<td>60 697  654d  732  81.2  90.2  77.5  66.6  ---</td>
<td>59 674  634d  710  80.7  89.8  76.6  65.5  351 (2420)</td>
<td>58 653  615  690  80.1  89.3  75.7  64.3  338 (2330)</td>
<td>57 633  595  670  79.6  88.9  74.8  63.2  325 (2240)</td>
<td>56 613  577  650  79.0  88.3  73.9  62.0  313 (2160)</td>
<td>55 595  560  630  78.5  87.9  73.0  60.9  301 (2070)</td>
<td>54 577  543  612  78.0  87.4  72.0  59.8  292 (2010)</td>
<td>53 560  525  594  77.4  86.9  71.2  58.6  283 (1950)</td>
</tr>
<tr>
<td>52 544  512  576  76.8  86.4  70.2  57.4  273 (1880)</td>
<td>51 528  496  558  76.3  85.9  69.4  56.1  264 (1820)</td>
<td>50 513  482  542  75.9  85.5  68.5  55.0  255 (1760)</td>
<td>49 498  468  526  75.2  85.0  67.6  53.8  246 (1700)</td>
<td>48 484  455  510  74.7  84.5  66.7  52.5  238 (1640)</td>
<td>47 471  442  495  74.1  83.9  65.8  51.4  229 (1580)</td>
<td>46 458  432  480  73.6  83.5  64.8  50.3  221 (1520)</td>
<td>45 446  421  466  73.1  83.0  64.0  49.0  215 (1480)</td>
</tr>
<tr>
<td>44 434  409  452  72.5  82.5  63.1  47.8  208 (1430)</td>
<td>43 423  400  438  72.0  82.0  62.2  46.7  201 (1390)</td>
<td>42 412  390  426  71.5  81.5  61.3  45.5  194 (1340)</td>
<td>41 402  381  414  70.9  80.9  60.4  44.3  188 (1300)</td>
<td>40 392  371  402  70.4  80.4  59.5  43.1  182 (1250)</td>
<td>39 382  362  391  69.9  79.9  58.6  41.9  177 (1220)</td>
<td>38 372  353  380  69.4  79.4  57.7  40.8  171 (1180)</td>
<td>37 363  344  370  68.9  78.8  56.8  39.6  166 (1140)</td>
</tr>
<tr>
<td>36 354  336  360  68.4  78.3  55.9  38.4  161 (1110)</td>
<td>35 345  327  351  67.9  77.7  55.0  37.2  156 (1080)</td>
<td>34 336  319  342  67.4  77.2  54.2  36.1  152 (1050)</td>
<td>33 327  311  334  66.8  76.6  53.3  34.9  149 (1030)</td>
<td>32 318  301  326  66.3  76.1  52.1  33.7  146 (1010)</td>
<td>31 310  294  318  65.8  75.6  51.3  32.5  141 (970)</td>
<td>30 302  286  311  65.3  75.0  50.4  31.3  138 (950)</td>
<td>29 294  279  304  64.6  74.5  49.5  30.1  135 (930)</td>
</tr>
<tr>
<td>28 286  271  297  64.3  73.9  48.6  28.9  131 (900)</td>
<td>27 279  264  290  63.8  73.3  47.7  27.8  128 (880)</td>
<td>26 272  258  284  63.3  72.8  46.8  26.7  125 (860)</td>
<td>25 266  253  278  62.8  72.2  45.9  25.5  123 (850)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Richard A. Moen earned his Bachelor of Science degree in Metallurgical Engineering in 1962 from South Dakota School of Mines and Technology. He has over 33 years of experience in the development, selection, specification, and characterization of structural materials. These work experiences have spanned the entire spectrum from research and development to plant design, construction, operation, and maintenance. Most of the work was in support of nuclear energy, including light water, gas, and liquid cooled systems. Many of the materials applications required extensions of the bases of knowledge and engineering extrapolations. Some of these applications even required extension of ASME Code rules, which is what led the author to Code committee work.

Beginning in late 1969, Mr. Moen became involved with the ASME Boiler and Pressure Vessel Code in committees associated with design limits for materials used in elevated temperature nuclear construction. Over the years, his ASME Code involvement increased to the extent that he is now a member of the Main Committee, the Subcommittee on Materials, and the Subcommittee on Nuclear Power, Subgroup on Materials, Fabrication and Examination (SCIII), and the Subgroup on Strength of Ferrous Alloys, and the Special Working Group on Environmental Effects.

After 33 years of continuous employment in industry, Mr. Moen is now self-employed as President of Moen Technical Services, providing consultation, support, and training services on a wide range of materials issues. Prior training in business administration and experience in supervision and management, coupled with his organizational skills, provide additional dimensions to the services offered.