

Forming of AUSTENITIC
CHROMIUM-NICKEL
STAINLESS STEELS

Forming of AUSTENITIC CHROMIUM - NICKEL STAINLESS STEELS

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FOREWORD

The first edition of this book was published in 1947, about twenty years after the first production of chromium-nickel stainless steels in this country. During those twenty years, production had risen to a level of 400,000 tons per year—in the past ten years there has been a further increase to about 650,000 tons per year—in spite of the handicaps of defense requirement limitations on the supply of nickel available for civilian uses of stainless steel.

Such expansion in usage of stainless steel has been made possible, on the one hand by the ability of the producers to make high quality stainless steel available in all the required forms and, on the other, by the resourcefulness and skill of users in pioneering new applications and working out new fabrication techniques as these were required. In most instances, these advances in handling stainless steels resulted from individual efforts in several plants without much opportunity or means for sharing their accumulated experience.

The first, 1947, edition of this book on the forming of stainless steels was the result of the activity of the Development and Research Division of The International Nickel Company, Inc. in reaping the advantage of the willingness of many fabricators of stainless steel to pool their information for their common benefit by supplying the detailed knowledge assembled in this book. The reception given the first edition justified the effort and required two additional printings.

In this second edition the contents have been brought up to date by describing new and improved methods of forming on the basis of information provided through a continuation of the cooperation by fabricators which made the first edition possible.

In this second printing of the second edition an appendix has been added to provide available knowledge of the forming characteristics of the manganese modified lower nickel content austenitic steels which have been designated by the American Iron and Steel Institute as types 201 and 202. These grades have been introduced in an effort to stretch the available supply of nickel in the several applications for which these alloys will be satisfactory.

The essential cooperation of so many companies and individuals in this endeavor has been most gratifying and is acknowledged with much appreciation by The International Nickel Company, Inc.

F. L. LAQUE, *Vice President and Manager,*
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FIRST EDITION

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VSEVOLOD N. KRIVOBOK
GEORGE SACHS

SECOND EDITION

Although much of the contents of the first edition is retained in this volume, a number of revisions, necessitated by changes in practices on conventional equipment, were introduced. Descriptions of newly developed processes and their characteristics are offered. Thus, we have brought the book up to date as much as possible. For their helpful and pertinent suggestions on these changes and for their assistance on the technical aspects of this manuscript dealing with the newly developed processes, we are indebted to the following professional and personal friends:

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It is fully realized that the information contained in this volume cannot be complete in every detail, no matter how painstakingly the factual data were collected and appraised. Suggestions as to alternative methods of forming, additional information that would make the volume more complete, and any other data and constructive criticism are earnestly solicited.

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INTRODUCTION

The descriptive words “stainless steels” are applied to many iron-base alloys, all of which contain at least 10.5 per cent chromium with or without additions of other alloying elements in small or appreciable amounts. The outstanding property of stainless steels is their resistance to corrosion in numerous, but not all, corrosive environments.

The steels which contain at least 6.0 per cent of nickel in addition to chromium constitute a very important class of stainless alloys. These alloys or steels contain, generally, 16.0 to 26.0 per cent chromium, 6.0 to 22.0 per cent nickel, appreciable carbon and occasionally some other elements added to develop certain specific properties.

Contrary to the chromium stainless steels, the chromium-nickel steels are not hardenable by heat treatment, that is to say, the phase transformation is suppressed and austenite is retained, regardless of the rate of cooling—fast or slow—of these steels from high temperatures. For this reason, they are known as “austenitic chromium-nickel stainless steels.” Changes in mechanical properties can be brought about only by “cold working,” that is, by rolling or otherwise working the metal at normal temperatures. In this manner, the steels can be made to possess high strength. Ordinarily, austenitic stainless steels are non-magnetic, but certain compositions do become appreciably magnetic through cold working.

An additional outstanding property of the austenitic chromium-nickel stainless steels is their exceptional adaptability to forming and other fabricating processes. The latter, together with the above mentioned resistance to corrosion, and mechanical properties at least equal to those of other engineering alloys, are responsible for the wide and continually growing industrial applications of austenitic stainless steels. This volume presents, primarily, a detailed description of the modern forming procedures as applied to chromium-nickel stainless steels in various forms.