

The Complete Technology Book on Steel and Steel Products (Fasteners, Seamless Tubes, Casting, Rolling of Flat Products & others)

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Iron and steel have played a leading role in the development of human civilization and their techniques. Together with its derivative, steel, iron has no real rival in its particular fields of application and has become a synonym of progress, being an essential element in mankind's greatest technological achievements. It was at the origin of the industrial and scientific revolutions and at the heart of all the great discoveries which have marked the history of humanity from the manufacture of high quality swords in ancient times to today's architectural wonders. Steel is an alloy that consists mostly of iron and has carbon content between 0.2% and 2.1% by weight, depending on the grade. Carbon is the most common alloying material for iron, but various other alloying elements are used, such as manganese, chromium, vanadium, and tungsten. Rolling is a metal forming process in which metal stock is passed through a pair of rolls. Rolling is classified according to the temperature of the metal rolled. Steelmaking is the second step in producing steel from iron ore. Processing of steel results in special steel products with required properties, for example; vacuum treated steel for forging ingots; pre-strengthened stress-relieved elongated steel, metallurgical addition product, forging powder alloy steels, etc. Fasteners are used to join and hold two or more pieces of metal either temporarily or more pieces of metal either temporarily or permanently. Some of the most common are bolts, screws, nuts, rivets and pins. Packaging steels differ from other sheet products particularly in terms of their thickness, mechanical properties and coatings, together with their aptitude to satisfy specific industrial and marketing requirements related to high production rates, design factors etc. Small gauge welded tubes have an extremely wide range of applications, including metallic roof frames, mechanical construction in public work and industrial engineering sector, agricultural machinery, fluid distribution circuits, piston, etc. India is among the top producers of all forms of steel in the world. Easy availability of low cost manpower and presence of abundant reserves make India competitive in the global setup. The steel industry in India has witnessed an increase in demand due to expanding oil and gas sector, huge spending on infrastructural facilities coupled with growth in housing, consumer durables and auto sectors. This book basically deals with structural changes in steel during hot rolling, structural changes during reheating, kinds of grain restoration process, dynamic restoration process, static restoration process, effect of initial grain, size of static recrystallization, effects of temperature and micro alloying, fundamental principles of the metal rolling process, preparing and heating the initial materials, preparations for rolling heating before rolling operations, bolt and nut manufacturing technology, casting of steel for flat products etc.

The present book covers different important aspects of steel processing with the casting method of steel for flat products, rolling of rails, wheels and rings, rolling of different steel products, production of fasteners, welded pipes, steel products for the building trade and many more. The book is very useful for everybody who wants the thorough study on steel and steel products or wants to diversify in to this field.

1. Structural Changes in Steel during Hot Rolling

Structural Changes during Reheating

Kinds of Grain Restoration Process

Dynamic Restoration Process

Static Restoration Process

Effect of Initial Grain Size of Static Recrystallization

Effects of Temperature and Microalloying

Effect of Amount of Deformation

Factors Affecting Critical Reduction for
Recrystallization

Grain Growth after Deformation

Structural Changes in Steel during Cooling

Effect of Steel Structure on Flow Stress

2. Fundamental Principles of the Metal Rolling Process

3. Steels for Magnetic Applications

Electrical Steels-Metallurgy and Properties

Introduction

Utilization and Property Requirements

Optimization of Magnetic Properties

Type of Electrical Steel

Classification

Steel Grades

Market Segmentation

Conclusions

4. Preparing and Heating the Initial Materials

Preparations for Rolling

Heating before Rolling Operations

5. Hot Seamless Tube Rolling Processes

Elements of Skew Rolling Theory

Tube Rolling in Plug Mill Type Seamless Tube Mills

Tube Rolling in Continuous Seamless Tube Mills

Tube Rolling in Three-Roll Mills

Tube Rolling in Pilger Mills

Seamless Tube Production by the Extrusion Process

Seamless Tube Finishing Operations

6. Bolt and Nut Manufacturing Technology

Introduction

Fundamentals of Mechanically Working and Cutting Metals

(a) Cold Forming

(b) Hot Forging

(c) Metal Cutting

Manufacturing Technologies

(a) Cold Forming of Bolts

(b) Cold Forming of Nuts

(c) Hot Forging of Bolts

- (d) Hot Forging of Nuts
- (e) Machining of Bolts and Nuts from Hexagon Bar
- Steel Pre-Processing
 - (a) Steel Making
 - (b) Surface Treatments and Wire Drawing
- Fastener Steels and Heat Treatments
 - (a) Alloying Elements
 - (b) Heat Treatments
- Finishing Operations
- 7. Casting of Steel for Flat Products
 - Type of Cast Products
 - Casting of Ingot
 - Types of Ingots
 - Methods of Continuous Casting of Thick Slabs
 - Continuous Casting of Thick Slabs
 - Slab Width Control
 - Continuous Casting of Thin Slabs and Strip
 - Requirements for Continuously Cast Steels
 - Oxide Inclusions in Concast Steel
 - Formation of Oxide Phases
 - Influence of Caster Type on Steel Quality
- 8. The Rolling of Rails, Wheels and Rings
 - Introduction
 - Early Types of Rails and their Production
 - The Evolution for the Rail Mill
 - Modern Rail Mills
 - Rail Joints and their Manufacture
 - The Forging and Rolling of Wheels
 - Ring Rolling
- 9. Mill Automation for the Rolling of Flat Products
 - Automation of Flying Shear Operation in a Continuous Hot-Rolling Mill
 - Automation of Coiler Operation for Hot Strip
 - Automation of Strip Measuring Gauges for Hot Rolling
 - Automation of Continuous Pickle Line Operation
 - Automation of Strip Thickness Gauges for Cold Reduction
 - Automation of Strip Thickness Control by the Screw-Down Gear
- 10. General Steelmaking Processes
 - Welding Material for Super Low Temperature Steels
 - Refining Steel by Blowing Oxygen Beneath the Surface
 - Cold Reduced Aluminum Stabilized Steel having High Drawability
 - Sulfide Modification of Steel
 - Steel Sheets having Excellent Enamellability
 - Liquid Sintering with Titanium Alloys
 - Liquid-Solid Alloys for Casting
 - Rimmed Unkilled Enamelling Steel
 - Producing an Enamelling Steel Sheet
 - Deep Drawable Deoxidized Steel
 - Alloying Steel with Highly Reactive Materials
 - Prevention of Surface Cracking during Steel Reheating
 - Prestrengthened Stress Relieved Elongated Steel

Vacuum Treated Steel for Forging Ingots
Metallurgical Addition Product
Uncropped, Unworked, Elongated Lead Steel Casting
Adding Alloys to Steel
Production of Low Carbon Ferroalloys
Forging Powder Alloy Steels
Production of Lead Steel
Low Carbon Ferrochromium
High Explosive Fragmentation Munition
11. Varnishing and Printing of Packaging Steels
Introduction
General Aspects of Organic Coatings used for
Varnishing and Printing
Definition
Types of Organic Coating
Organic Coating Constituents
Application and Curing of Organic Coatings
Application with Roller Varnishing Machines
Curing
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Printing and Decoration of Metallic Packaging
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Phases in Hypoeutectoid Steel
Phases in Eutectoid Steel
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13. Optimization and Modernization of Hot Strip
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Energy Consumption Requirements
Yield Requirements
Product Quality Requirements
Analysis of Temperature Conditions in Hot Strip Mill
Methods of Optimizing Temperature Conditions

Optimizing Operating Parameters
Close Coupling of Continuous Rougher with Finishing Mill
Close Coupling of a Reversing Rougher with Finishing Mill
Combining a Reversing Rougher with Finishing Mill
Coilbox
Intermediate Steckel Mill
Reradiating Thermal Cover System
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Requirements for the Evaluation Models
Evaluation of the Solutions for Mill Modernization
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Low Temperature High Strength Tough Steel
Alloy Steel for Arctic Service
High Strength Cold Rolled Steel with High Press Formability
Production of High Strength Cold Rolled Steel Sheet
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Full Continuous Annealing Process
High Strength Killed Wire Rods and Bars
High Formability High Strength Steel
High-Strength Cold-Workable TI Added AL Killed Steel
Improving Strength and Toughness by Controlled Cooling
High Strength Notch Tough Steel
Hot Rolled High Strength Low Alloy Steel
Preparation of Hot Rolled Niobium Structural Steel
Hot Rolled Flat Steel for Cryogenic Service
High Strength Structural Steel with Good Weldability
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Hot Rolling Processes for Plate and Sheet in Various Types of Mills
Rolling Steel Strip in a Planetary Mill
Finishing of Hot-Rolled Flat Products
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Cap Screws

Machine Screws

Set Screws

Thread-forming Screws

Stove Bolts

Carriage Bolts

Stud Bolts

Nuts

Castle Nuts

Jam Nuts

Cap or Acorn Nuts

Wing Nut

Washers

Rivets

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19. Production of Welded Pipe

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Electric Resistance Welded Pipe and Tubing Production

High Frequency Electric Resistance Welding in Pipe and Tubing Production

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20. Sheet Forming for Packaging Applications

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Wall Ironing

Necking and Flanging

Full Operture Easy-Open Can Ends

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Score Line Shape in the Plane of the LID

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Steel Grades

Can End Seaming

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21. Mill Automation for Pipe and Tubing Production

- 22. Steels for Small Gage Welded Tubes
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 - Steel Products used in the Manufacture of SWTâ€™s
 - Major Property Requirements
 - Conditions to be Met in SWT Manufacture
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 - Coating Selection Guide
 - Utilization and Maintenance Precautions
 - Additional Products
 - Condensation-proof • Coatings
 - Acoustic Insulation
 - Thermal Insulation
 - Solconfort Sandwich Sheets
 - Isofran Sandwich Sheets
 - Typical Applications
 - Walling and Roofing
 - Facing Systems
 - Flooring
 - Conclusions

About NIIR

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