



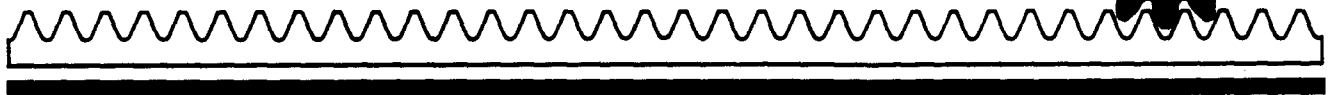
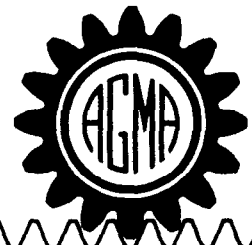
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AMERICAN NATIONAL STANDARD

Gear Materials and Heat Treatment Manual



AGMA STANDARD

Gear Materials And Heat Treatment Manual
AGMA 2004-B89
(Revision of AGMA 240.01)

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ABSTRACT

The *Gear Materials and Heat Treatment Manual* provides information pertaining to engineering materials and material treatments used in gear manufacture. Topics included are definitions, selection guidelines, heat treatment, quality control, life considerations and a bibliography. The material selection includes ferrous, nonferrous and nonmetallic materials. Wrought, cast, and fabricated gear blanks are considered. The heat treatment section includes data on through hardened, flame hardened, induction hardened, carburized, carbonitrided, and nitrided gears. Quenching, distortion, and shot peening are discussed. Quality control is discussed as related to gear blanks, process control, and metallurgical testing on the final products.

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Gear Materials and Heat Treatment Manual

FOREWORD

[The foreword, footnotes, and appendices, if any, are provided for informational purposes only and should not be construed as part of AGMA Standard 2004-B89 (Formerly 240.01), *Gear Materials and Heat Treatment Manual*.]

The Standard provides a broad range of information on gear materials and their heat treatment. It is intended to assist the designer, process engineer, manufacturer and heat treater in the selection and processing of materials for gearing. Data contained herein represents a consensus from metallurgical representatives of member companies of AGMA.

This Standard replaces AGMA 240.01, October 1972. The first draft of AGMA 240.01, *Gear Materials Manual*, was prepared in October 1966. It was approved by the AGMA membership in March 1972. Reprinting of AGMA 240.01 for distribution was discontinued in 1982 because it had been decided in 1979 by the Metallurgy and Materials Committee to revise its format. The initial draft of AGMA 2004-B89 (formerly 240.01) was completed in April, 1983. Work continued on the Standard with numerous additional revised drafts within the Metallurgy and Materials Committee until it was balloted in 1988. It was completed and approved by the AGMA Technical Division Executive Committee in September 1988 and on January 23, 1989 it was approved as an American National Standard.

Suggestions for the improvement of this standard will be welcome. They should be sent to the American Gear Manufacturers Association, 1500 King Street, Suite 201, Alexandria, Virginia 22314.

Gear Materials and Heat Treatment Manual

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Gear Materials and Heat Treatment Manual

1. Scope

This Manual was developed to provide basic information and recommend sources of additional information pertaining to gear materials, their treatments, and other considerations related to the manufacture and use of gearing.

Metallurgical aspects of gearing as related to rating (allowable s_{ac} and s_{at} values) are not included, but, are covered in AGMA rating standards.

2. References and Information

2.1 References.

Abbreviations are used in the references to specific documents in this Standard. The abbreviations include: AGMA, American Gear Manufacturers Association; ASNT, American Society of Nondestructive Testing; ASTM, American Society for Testing Materials; SAE, Society of Automotive Engineers.

The following documents contain provisions which, through reference in this Standard, constitute provisions of this document. At the time of publication, the editions were valid. All publications are subject to revision, and the users of this Standard are encouraged to investigate the possibility of applying the most recent editions of the publications listed.

AGMA 141.01-1984, *Plastics Gearing – Molded, Machined, And Other Methods, A Report on the State of the Art*

AGMA 2001-B88, *Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth*

AGMA 6033-A88, *Standard for Marine Propulsion Gear Units, Part 1 Materials*

ANSI/AGMA 6034-A88, *Practice for Single and Double Reduction Cylindrical-Worm and Helical-Worm Speed Reducers*

ASNT-TC-1A (June 80), *Recommended Practice by American Society for Nondestructive Testing*

ASTM A48-83, *Specification for Gray Iron Castings*

ASTM A148-84, *Steel Castings, High Strength, for Structural Purposes*

ASTM A220-76, *Specification for Pearlitic Malleable Iron Castings*

ASTM A255-67, *Method for End-Quench Test for Hardenability of Steel*

ASTM A290-82, *Carbon and Alloy Steel Forgings for Rings for Reduction Gears*

ASTM A310-77, *Methods and Definitions for Mechanical Testing of Steel Products*

ASTM A311-79, *Specification for Stress Relieved Cold Drawn Carbon Steel Bars Subject to Mechanical Property Requirements*

ASTM A356-84, *Heavy-Walled Carbon, Low Alloy, and Stainless Steel Castings for Steam Turbines*

ASTM A370-77, *Methods and Definitions for Mechanical Testing of Steel Products*

ASTM 388-80, *Recommended Practice for Ultrasonic Examination of Heavy Steel Forgings*

ASTM A400-69(1982), *Recommended Practice for Selection of Steel Bar Compositions According to Section*

ASTM A534-87, *Standard Specification for Carburizing Steels for Anti-Friction Bearings*

ASTM A535-85, *Standard Specification for Special-Quality Ball and Roller Bearing Steel*

ASTM A536-80, *Specification for Ductile Iron Castings*

ASTM A833-84, *Indentation Hardness of Metallic Materials by Comparison Hardness Testers*

ASTM A609-83, *Specification for Steel Castings, Carbon and Low Alloy Ultrasonic Examinations Thereof*

ASTM B427-82, *Specification for Gear Bronze Alloy Castings*

ASTM B505-84, *Specification for Copper-Base Alloy Continuous Castings*

ASTM E8-83, *Methods of Tension Testing of Metallic Materials*

ASTM E10-78, *Test Method for Brinell Hardness of Metallic Materials*

ASTM E18-79, *Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials*

ASTM E54-80, *Method for Chemical Analysis of Special Brasses and Bronzes*

ASTM E112-84, *Methods for Determining Average Grain Size*

SAE J434-June 86, *Automotive Ductile (Nodular) Iron Castings*