American
Gear Manufacturers
Association

Technical Resources

AGMA Information Sheet

Metallurgical Specifications for Powder Metallurgy, PM, Steel Gearing

AGMA 942-A12

American Gear Manufacturers Association

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[Tables or other self–supporting sections may be referenced. Citations should read: See AGMA 942–A12, *Metallurgical Specifications for Powder Metallurgy, PM, Steel Gearing,* published by the American Gear Manufacturers Association, 1001 N. Fairfax Street, Suite 500, Alexandria, Virginia 22314, http://www.agma.org.]

Approved August 16, 2012

ABSTRACT

This information sheet provides the metallurgical requirements for powder metallurgy (PM) gearing. Four different powder metallurgy processes are identified: as–sintered, through hardened or sinter hardened, carburized case hardened, and induction hardened. In addition, the requirements are coded by process and class number, the latter based on the density of the PM gear teeth. Product requirements are tabulated in four data tables by process and class.

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Foreword

[The foreword, footnotes and annexes, if any, in this document are provided for informational purposes only and are not to be construed as a part of AGMA Information Sheet, 942–A12, *Metallurgical Specifications for Powder Metallurgy, PM, Steel Gearing.*]

This document provides the critical metallurgical characteristics of powder metallurgy, PM, gears that will ensure the metallurgical quality of the teeth. The format of the document has been modeled on AGMA 923–B05, *Metallurgical Specifications for Steel Gearing,* and may be considered a companion document for gear designers seeking the same type of metallurgical features in PM steel gears as found in wrought gears. By using AGMA 923–B05 as a guide the gear designer can easily evaluate a PM material–process system based on the familiar features of wrought steel gears.

This information sheet is dedicated to Howard Sanderow. His participation and inspiration led to the development of this information sheet. His thoroughness and enthusiasm for the powder metallurgy industry, along with his contributions, as well as the contributions of his fellow committee members brought out the best from the committee as a whole.

The first draft of AGMA 942–A12 was made in May, 2007. It was approved by the AGMA membership in August 16, 2012.

Suggestions for improvement of this standard will be welcome. They should be sent to the American Gear Manufacturers Association, 1001 N. Fairfax Street, Suite 500, Alexandria, Virginia 22314.

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American Gear Manufacturers Association –

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1 Scope

This information sheet recommends powder metallurgy, PM, steel materials and metallurgical quality characteristics for use in specifying PM gearing. It identifies specifications and requirements for various PM steel materials for as-sintered, through hardened or sinter hardened, carburized case hardened, and induction hardened gearing. Characteristics covered include material composition, density, sinter processing (conventional, high temperature and sinter hardening), secondary heat treatments and post heat treatment processing, and their associated inspections. Topics related to gear design and rating such as case depth, stress (bending fatigue and contact fatigue capacity) and quality control systems are not included.

2 Normative references

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

2.1 Gear related specifications

AGMA 923-B05, *Metallurgical Specifications for Steel Gearing*

AGMA 938-A05, *Shot Peening of Gears*

2.2 Steel related specifications

ASTM A751-11, *Standard Test Methods, Practices and Terminology for Chemical Analysis of Steel Products*

ASTM E3-11, *Standard Guide for Preparation of Metallographic Specimens*

ASTM E18-11, *Standard Test Methods for Rockwell Hardness of Metallic Materials*

ASTM E92-04, *Standard Test Method for Vickers Hardness of Metallic Materials*

ASTM E384-11, *Standard Test Method for Knoop and Vickers Hardness of Materials*

ASTM E407-07, *Standard Practice for Microetching Metals and Alloys*

ASTM E415-08, *Standard Test Method for Atomic Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel*

ASTM E1019-11, *Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques*

ASTM E1077-01, *Standard Test Method for Estimating the Depth of Decarburization of Steel Specimens*

ASTM E1184-10, *Standard Practice for Determination of Elements by Graphite Furnace Atomic Absorption Spectrometry*