
**Calculation of load capacity of spur and
helical gears —**

**Part 5:
Strength and quality of materials**

*Calcul de la capacité de charge des engrenages cylindriques à
dentures droite et hélicoïdale —*

Partie 5: Résistance et qualité des matériaux



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6336-5 was prepared by Technical Committee ISO/TC 60, *Gears*, Subcommittee SC 2, *Gear capacity calculation*.

This second edition cancels and replaces the first edition (ISO 6336-5:1996), which has been technically revised.

ISO 6336 consists of the following parts, under the general title *Calculation of load capacity of spur and helical gears*:

- *Part 1: Basic principles, introduction and general influence factors*
- *Part 2: Calculation of surface durability (pitting)*
- *Part 3: Calculation of tooth bending strength*
- *Part 5: Strength and quality of materials*

Part 6, *Calculation of service life under variable load*, is under preparation.

Introduction

This part of ISO 6336, together with ISO 6336-1, ISO 6336-2 and ISO 6336-3, provides the principles for a coherent system of procedures for the calculation of the load capacity of cylindrical involute gears with external or internal teeth. ISO 6336 is designed to facilitate the application of future knowledge and developments, as well as the exchange of information gained from experience.

Allowable stress numbers, as covered by this part of ISO 6336, may vary widely. Such variation is attributable to defects and variations of chemical composition (charge), structure, the type and extent of hot working (e.g. bar stock, forging, reduction ratio), heat treatment, residual stress levels, etc.

Tables summarize the most important influencing variables and the requirements for the different materials and quality grades. The effects of these influences on surface durability and tooth bending strength are illustrated by graphs.

This part of ISO 6336 covers the most widely used ferrous gear materials and related heat treatment processes. Recommendations on the choice of specific materials, heat treatment processes or manufacturing processes are not included. Furthermore, no comments are made concerning the suitability or otherwise of any materials for specific manufacturing or heat treatment processes.

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Calculation of load capacity of spur and helical gears —

Part 5: Strength and quality of materials

1 Scope

This part of ISO 6336 describes contact and tooth-root stresses, and gives numerical values for both limit stress numbers. It specifies requirements for material quality and heat treatment and comments on their influences on both limit stress numbers.

Values in accordance with this part of ISO 6336 are suitable for use with the calculation procedures provided in ISO 6336-2 and ISO 6336-3 and in the application standards for industrial, high speed and marine gears. They are applicable to the calculation procedures given in ISO 10300 for rating the load capacity of bevel gears. This part of ISO 6336 is applicable to all gearing, basic rack profiles, profile dimensions, design, etc., covered by those standards. The results are in good agreement with other methods for the range indicated in the scope of ISO 6336-1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 53: 1998, *Cylindrical gears for general and heavy engineering — Standard basic rack tooth profile*

ISO 642:1999, *Steel — Hardenability test by end quenching (Jominy test)*

ISO 643:—¹⁾, *Steel — Micrographic determination of the ferritic or austenitic grain size*

ISO 683-1:1987, *Heat-treatable steels, alloy steels and free-cutting steels — Part 1: Direct hardening unalloyed and low alloyed wrought steel in form of different black products*

ISO 683-9:1988, *Heat-treatable steels, alloy steels and free-cutting steels — Part 9: Wrought free-cutting steels*

ISO 683-10:1987, *Heat-treatable steels, alloy steels and free-cutting steels — Part 10: Wrought nitriding steels*

ISO 683-11:1987, *Heat-treatable steels, alloy steels and free-cutting steels — Part 11: Wrought case-hardening steels*

ISO 1122-1:1998, *Vocabulary of gear terms — Part 1: Definitions related to geometry*

1) To be published. (Revision of ISO 643:1983)

ISO 1328-1:1995, *Cylindrical gears — ISO system of accuracy — Part 1: Definitions and allowable values of deviations relevant to corresponding flanks of gear teeth*

ISO 2639:2002, *Steel — Determination and verification of the effective depth of carburized and hardened cases*

ISO 3754:1976, *Steel — Determination of effective depth of hardening after flame or induction hardening*

ISO 4948/2:1981, *Steels — Classification — Part 2: Classification of unalloyed and alloy steels according to main quality classes and main property or application characteristics*

ISO 4967:1998, *Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams*

ISO 6336-1:—²⁾, *Calculation of load capacity of spur and helical gears — Part 1: Basic principles, introduction and general influence factors*

ISO 6336-2:—²⁾, *Calculation of load capacity of spur and helical gears — Part 2: Calculation of surface durability (pitting)*

ISO 6336-3:—²⁾, *Calculation of load capacity of spur and helical gears — Part 3: Calculation of tooth bending strength*

ISO 9443:1991, *Heat-treatable and alloy steels — Surface quality classes for hot-rolled round bars and wire rods — Technical delivery conditions*

ISO 10474:1991, *Steel and steel products — Inspection documents*

ISO 14104:1995, *Gears — Surface temper etch inspection after grinding*

ASTM³⁾ A388-01, *Standard Practice for Ultrasonic Examination of Heavy Steel Forgings*

ASTM E428-00, *Standard Practice for Fabrication and Control of Steel Reference Blocks Used in Ultrasonic Inspection*

ASTM A609-91, *Standard Practice for Castings, Carbon, Low Alloy and Martensitic Stainless Steel, Ultrasonic Examination Thereof*

ASTM E1444-01, *Standard Practice for Magnetic Particle Examination*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 1122-1 and the symbols and units given in ISO 6336-1 apply.

4 Methods for the determination of allowable stress numbers

4.1 General

Allowable stress numbers should be determined for each material and material condition, preferably by means of gear running tests. Test conditions and component dimensions should equate, as nearly as is practicable, to the operating conditions and dimensions of the gears to be rated.

2) Under preparation. (Revisions of ISO 6336-1:1996, ISO 6336-2:1996 and ISO 6336-3:1996, respectively)

3) American Society for Testing and Materials