

Specification for

Spur and helical gears —

**Part 2: Basic rack form, modules and
accuracy (1 to 50 metric module)**

Co-operating organizations

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices' Technical Committee	Institute of Marine Engineers*
Association of Consulting Engineers*	Institution of civil Engineers
Association of Mining Electrical and Mechanical Engineers*	Institution of Gas Engineers
Board of Trade	Institution of Heating and Ventilating Engineers
British Chemical Plant Manufacturers' Association	Institution of Mechanical Engineers*
British Compressed Air Society	Institution of Mechanical Engineers (Automobile Division)
British Electrical and Allied Manufacturers' Association*	Institution of Production Engineers*
British Gear Manufacturers' Association*	Locomotive and Allied Manufacturers' Association of Great Britain
British Internal Combustion Engine Manufacturers' Association*	London Transport Board
British Mechanical Engineering Federation	Machine Tool Trades Association*
British Pump Manufacturers' Association	Ministry of Defence
British Steel Industry	Ministry of Defence, Army Department*
Crown Agents for Oversea Governments and Administrations	Ministry of Power
Department of Employment and Productivity (H.M. Factory Inspectorate)	Ministry of Public Building and Works
Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales	Ministry of Technology*
Engineering Equipment Users' Association	Ministry of Technology — National Engineering Laboratory*
Gas Council	Ministry of Transport
	National Coal Board
	National Physical Laboratory
	(Ministry of Technology)
	Royal Institute of British Architects

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard.

Association of Crane Makers	Navy and Vickers Gearing Research Association
British Ship Research Association	North East Coast Institution of Engineers & Shipbuilders
Institute of British Foundrymen	Society of Motor Manufacturers and Traders Ltd.
Institution of Engineering Inspection	
Institution of Engineers & Shipbuilders in Scotland	

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Foreword

This British Standard, which is a companion-work to BS 436, Part 1¹⁾, has been prepared, under the authority of the Mechanical Engineering Industry Standards Committee.

Whereas BS 436, Part 1, is primarily concerned with the basic requirements for general tooth form, diametral pitches, accuracy and accuracy testing procedures, etc., in the inch system, this part of the standard provides similar information centred around metric modules. This enables the two standards to be used in parallel during the general change from the inch to the metric system within the United Kingdom.

The basic rack is generally in agreement with ISO 53 “Cylindrical gears for general and heavy engineering — Basic rack”, and the modules are selected from ISO 54 “Cylindrical gears for general engineering and for heavy engineering — Modules and diametral pitches”. The accuracy requirements are based on ISO 1328 “Parallel involute gears — ISO system of accuracy”. Grades 1 and 2 are intended for use as master gears, and in certain circumstances, Grades 3, 4 and 5 may also be used as master gears. (Master gears are covered by a separate British Standard, BS 3696, Part 1²⁾).

ISO 1328 is already the basis of the national standards of many European countries.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 5 000, fully, indexed and with a note of the contents of each, will be found in the British Standards Yearbook, price £1. The BS Yearbook may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards:

BS 308, *Engineering drawing practice*.

BS 436, *Spur and helical gears — Part 1. Basic rack form, pitches and accuracy (diametral pitch series)*.

BS 1134, *Method for the assessment of surface texture — Part 1. Method and instrumentation*.

BS 2519, *Glossary for gears — Part 1. Geometrical definitions [ISO/R 1122]*.

BS 2519-2, *Notation [ISO 701]*.

BS 3696, *Specification for master gears — Part 1. Spur and helical gears (metric module)*.

BS 4500, *ISO limits and fits — Part 1. General, tolerances and deviations*.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 19 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

¹⁾ BS 436, “Spur and helical gears”, Part 1: “Basic rack form, pitches and accuracy (diametral pitch series)”.

²⁾ BS 3696, “Specification for master gears”, Part 1: “Spur and helical gears (metric module)”.

1 General

1.1 Scope. This British Standard applies to external and internal involute spur and helical gears for use with parallel shafts and having modules not less than 1 mm.

The basic rack and tooth form are specified, together with requirements for terminology and notation, first and second preference modules and fundamental tolerances which determine the grades of gear accuracy.

Twelve grades of accuracy are associated with each gear element (see 4.1.1) and thus the standard can be applied to meet requirements ranging from coarse commercial applications to precision gears for high-speed and/or high-load applications.

1.2 Terminology, definitions and notation. For the purpose of this British Standard the definitions and notation given in BS 2519³⁾, Part 1 [ISO/R 1122] and Part 2 [ISO 701] apply; some of the notation is listed below for convenience.

a	Centre distance
d	Reference circle diameter
d_1	Reference circle diameter, pinion
d_2	Reference circle diameter, wheel
d_a	Tip diameter
d_{a1}	Tip diameter, pinion
d_{a2}	Tip diameter, wheel
y	Centre distance modification coefficient
b	Face width
b_1	Face width, pinion
b_2	Face width, wheel
x	Addendum modification coefficient

x_1	Addendum modification coefficient, pinion
x_2	Addendum modification coefficient, wheel
l	Length of arc
m	module
m_n	Normal module
p_t	Transverse pitch
z	Number of teeth
z_1	Number of teeth, pinion
z_2	Number of teeth, wheel
β	Helix angle at reference cylinder
α	Pressure angle at reference cylinder
α_n	Normal pressure angle at reference cylinder
α_t	Transverse pressure angle at reference cylinder
α_{tw}	Transverse pressure angle, working

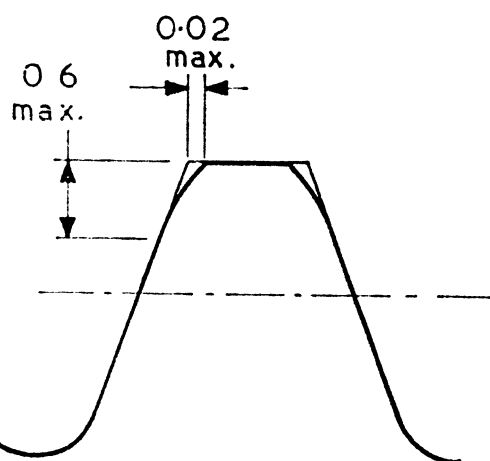
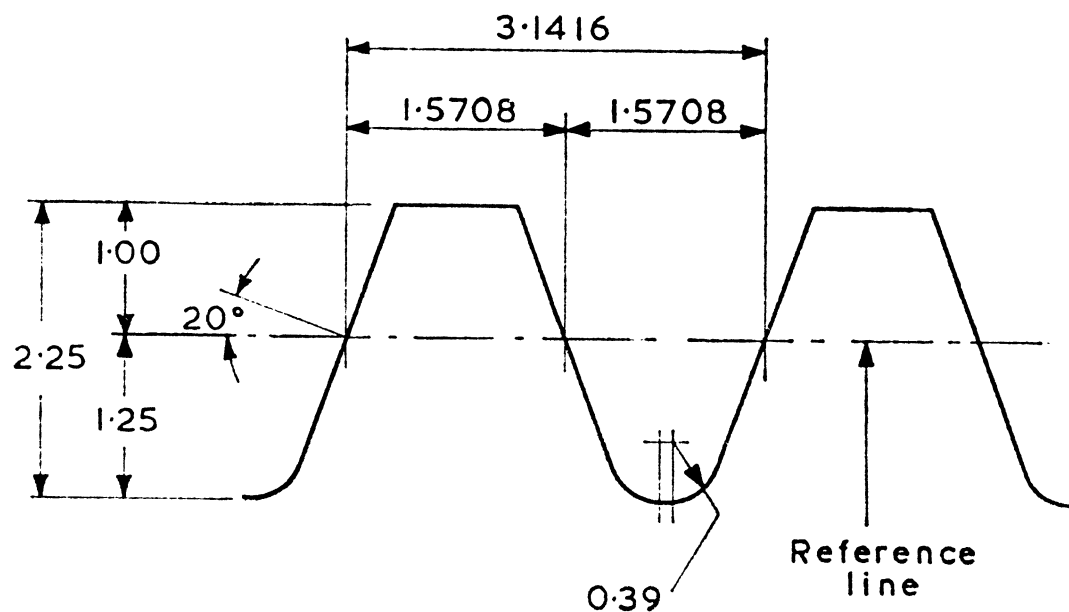
2 Basic rack tooth profile

For the purposes of this British Standard, the basic rack tooth profile, having a pressure angle of 20° and the form as shown in Figure 1, has been adopted.

In practice, the basic rack is usually modified. The extent of modification shall be in accordance with the following:

- 1) Variation of the total depth within the limits 2.25 to 2.40 which permits an increase in root clearance within the limits 0.25 to 0.40 to allow for different manufacturing processes.
- 2) Variation of the root radius within the limits 0.25 to 0.39.
- 3) Application of tip relief within the limits shown in Figure 2.

³⁾ BS 2519, "Glossary for gears". Part 1, "Geometrical definitions" [ISO/R 1122 "Glossary of gears — "Geometrical definitions"]; "Notation" [ISO 701 "International gear notation — Symbols for geometrical data"]



3 Standard normal modules

The normal modules shall be selected from Table 1. Wherever possible selection shall be made from the values given in column 1.

Table 1 — Standard normal modules

(in accordance with ISO 54, “Cylindrical gears for general engineering and for heavy engineering — Modules and diametral pitches”).

1	2
Normal module m_n (mm)	
Preferred modules	Second choice modules
1	1.125
1.25	1.375
1.5	1.75
2	2.25
2.5	2.75
3	3.5
4	4.5
5	5.5
6	7
8	9
10	11
12	14
16	18
20	22
25	28
32	36
40	45
50	

NOTE Preferred diametral pitches are given in Appendix A to BS 436, Part 1. For comparison purposes, the equivalent diametral pitch (inch units) can be obtained by dividing 25.4 by the normal module.

4 Accuracy of manufacture

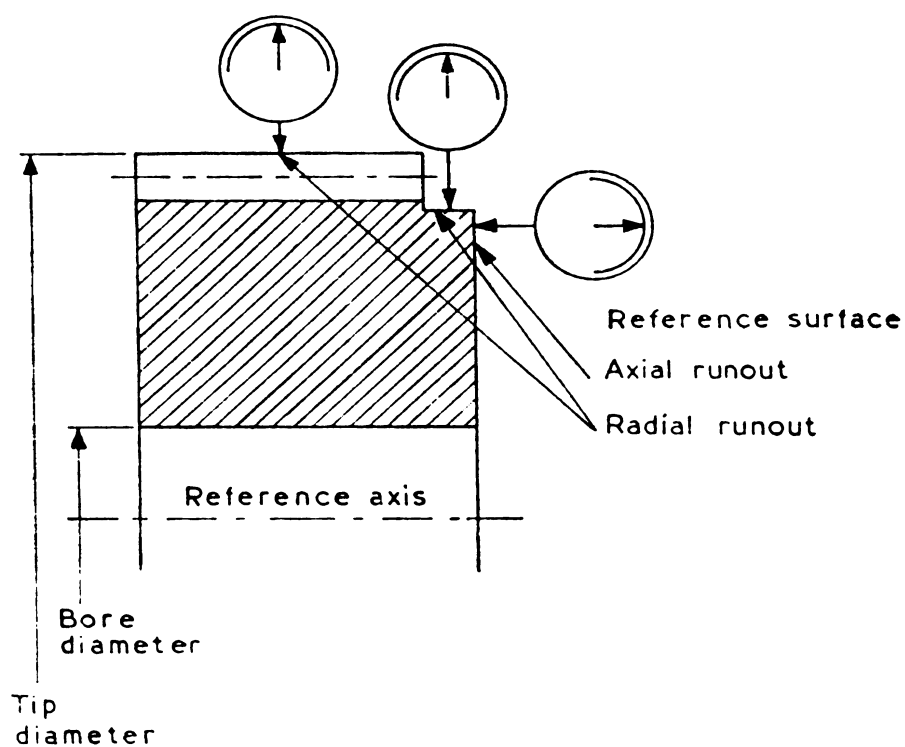
4.1 General

4.1.1 Grading⁴⁾ A gear may be classified as being to a particular grade (see 1.1) by consideration of the tolerances for pitch, tooth profile and tooth alignment. The grade of gear is therefore determined by the highest grade number for the tolerance of any of the elements given in Table 3, Table 4 and Table 5. The tolerances on other elements may be subject to agreement between the purchaser and the manufacturer.

4.1.2 Tolerances⁴⁾ Table 2 to Table 8, which follow, contain the tolerances which are applied to each gear element, these tolerances being appropriate to the particular grade of gear. It should be appreciated that the choice of application of particular elemental tolerances as inspection criteria will often depend upon the accuracy testing procedure employed, the choice of disposition of the fundamental tolerance, assembly and other conditions.

NOTE Generally, the elements of a pair of mating gears are of identical grades but, by agreement between the purchaser and the manufacturer, a finer or coarser grade of accuracy may be adopted for certain elements.

⁴⁾ The grades and elemental tolerances are generally in accord with agreement reached within the International Organization for Standardization (ISO).



In the case of double helical gears it may be desirable to have reference bands on each helix.

Figure 3 — Radial and axial run-out (full indicator movement)