SAE Aerospace
An SAE International Group

# AEROSPACE STANDARD

SAE AS1560 | REV. A

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Superseding AS1560

## Modules and Basic Racks of Metric Spur and Helical Gears

RATIONALE

AS1560A has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

This SAE Aerospace Standard (AS) establishes the standard modules for aerospace metric involute gear teeth and establishes the tooth dimensions of aerospace metric involute gear teeth in terms of the conjugate rack type cutter whose counterpart reference profile is called the basic rack profile of the generated gear, having the tooth dimensions expressed in terms proportional to the module.

2. REFERENCES:

2.1 ANSI Publications:

Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO/R 53
ISO/R 54

3. MODULES OF METRIC GEARS:

3.1 Scope:

The standard modules in this standard conform with ISO/R 54 and apply to spur and helical involute cylindrical gears.

3.2 Definition:

3.2.1 Module, m: The ratio of the circular pitch, expressed in millimeters, to the number $\pi$ (or the ratio of the pitch diameter, expressed in millimeters, to the number of teeth).

3.2.1.1 The size of the gear tooth profile is given by its module (m) in the metric system (see Figure 1).*

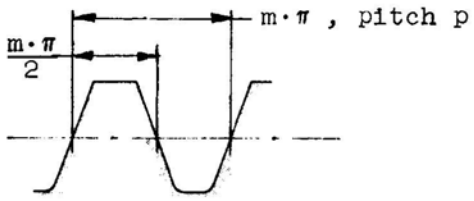


FIGURE 1

In terms of pitch (circular pitch) p, the metric module m is the following ratio:

$$m = \frac{p}{\pi}, \text{ (p is in mm)}$$

* NOTE: The size of the gear tooth profile is given by its diametral pitch (P) in the inch system, where the diametral pitch is the following ratio:

$$P = \pi/p, \text{ (p is in inches)}$$

and the relation between P and m is simply expressed by:

$$mP = 25.4 \text{ or } m = 25.4/P$$

3.2.1.2 In terms of the gear pitch diameter (reference diameter in ISO standards) and number of teeth, the module may be expressed by the following ratio:

$$m = \frac{d}{z}, \text{ where d is the pitch diameter in mm } \left(\frac{pz}{\pi}\right)$$

and z is the number of teeth

which is simplified to $m = \frac{pz}{\pi} \times \frac{1}{z} = \frac{p}{\pi}$

3.3 Standard Modules:

3.3.1 For economy in tooling and in gear design, it is desirable to limit the number of gear pitches by standardizing the number of different pitches and their related modules.

3.3.2 The standard modules (and their corresponding theoretical pitch) are given in Table 1. First preference is to be given to the use of the modules in column 1. The three modules in column 3 should be avoided where possible.

3.3.3 For the purpose of illustrating the relative tooth size, Figure 2 shows the basic rack profile of each first preference module at approximately full size.

TABLE 1 - Standard Modules, m, with the Corresponding Pitches, p

| I Module, m | I Pitch, p mm | II Module, m | II Pitch, p mm | III Module, m | III Pitch, p mm |
|---|---|---|---|---|---|
| 1 | 3.141593 | | | | |
| 1.25 | 3.926991 | 1.125 | 3.534292 | | |
| 1.5 | 4.712389 | 1.375 | 4.319690 | | |
| | | 1.75 | 5.497787 | | |
| 2 | 6.283185 | | | | |
| 2.5 | 7.853982 | 2.25 | 7.068583 | | |
| 3 | 9.424778 | 2.75 | 8.639380 | | |
| | | 3.5 | 10.995574 | 3.25 | 10.210176 |
| 4 | 12.566371 | | | 3.75 | 11.780972 |
| 5 | 15.707963 | 4.5 | 14.137167 | | |
| 6 | 18.849556 | 5.5 | 17.278760 | | |
| | | 7 | 21.991149 | 6.5 | 20.420352 |
| 8 | 25.132741 | | | | |
| 10 | 31.415927 | 9 | 28.274334 | | |
| 12 | 37.699112 | 11 | 34.557519 | | |
| | | 14 | 43.982297 | | |
| 16 | 50.265482 | | | | |
| 20 | 62.831853 | 18 | 56.548668 | | |

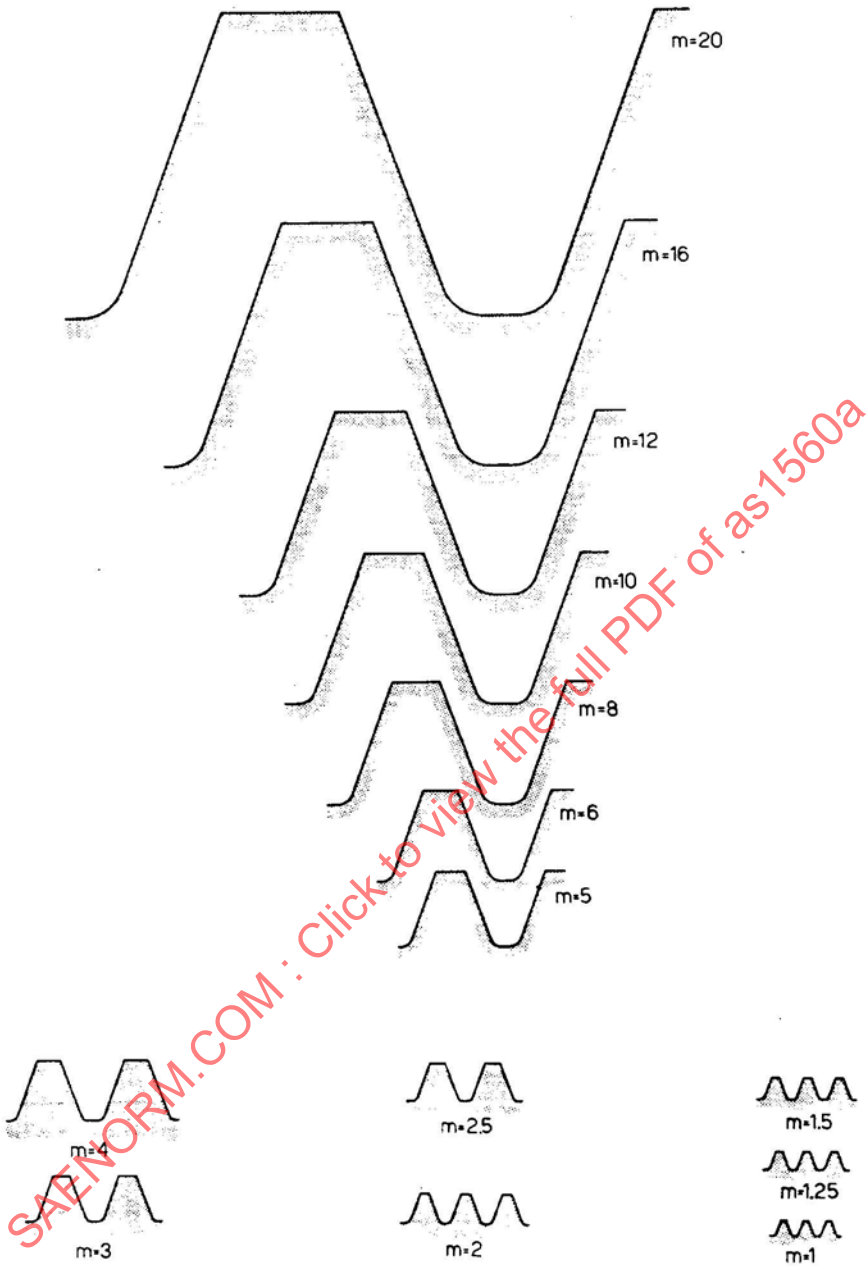




FIGURE 2 - Basic Rack Profile, First Preference Modules
Full Size Approx.

4. BASIC RACKS OF METRIC GEARS:

4.1 Scope:

The 20° pressure angle basic rack in this standard conforms with the ISO/R 53 basic rack and is the recommended standard for general purposes. In addition, the 22.5° and 25° pressure angle basic rack profiles are included since these higher pressure angles are in use for aerospace gearing. The basic rack profiles in this standard are applicable to spur and helical involute cylindrical gears.

4.2 Definitions:

4.2.1 Basic Rack: The basic rack is a section of the tooth surface of a cylindrical gear of infinitely large diameter on a plane at right angles to the tooth surfaces, the profile of which is used as the basis for defining the standard tooth dimensions of a system of involute gears.

NOTE: Cylindrical gears have a basic rack after increasing its number of teeth to infinity and which would be generated by the same cutter as the gear (see Figure 3).

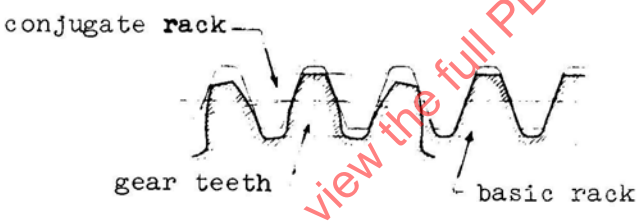


FIGURE 3

4.2.2 Basic Rack Profile of the Cutter: The basic rack profile of the cutter for cylindrical gears is the counterpart profile to the basic rack profile of the gear to be generated, except that the cutter dedendum is larger than the addendum of the gear basic rack by the value of the bottom clearance (see Figure 4).

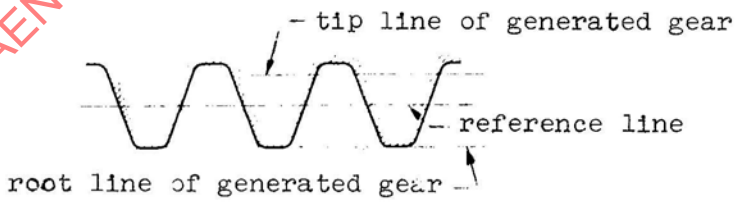


FIGURE 4

4.2.3 Conjugate Profiles: The tooth profiles of an involute gear pair determine each other mutually; that is, the profile of one gear determines the profile of the other gear. Thus, the gear teeth of a pair of gears have a common conjugate rack.

4.2.4 Generating Method: The generating method is based on the development of the involute teeth by enveloping lines formed by successive strokes of a cutting tool, itself having the shape of the basic conjugate rack of the gear, and which performs a rolling motion equivalent to that of meshing with the gear being cut (see Figure 5).

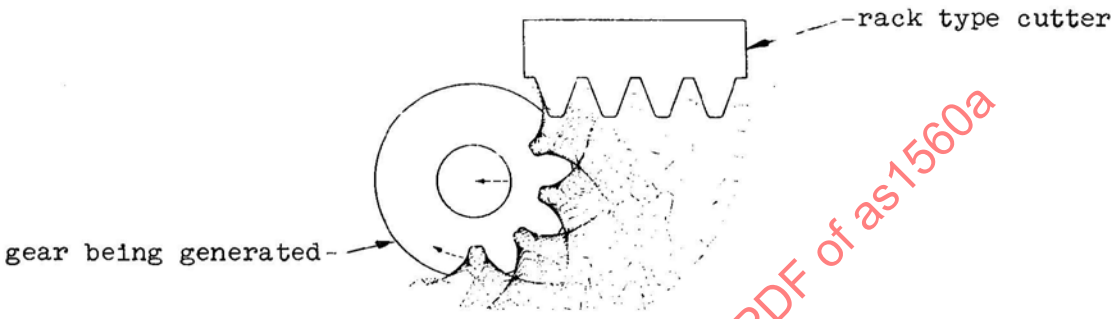


FIGURE 5

4.2.5 Reference Line: The reference line (pitch line) is a straight line on the profile of the basic rack, with reference to which the tooth dimensions are specified.

4.3 Requirements:

4.3.1 The profile of the standard basic racks refers to metric gears with involute teeth having standard modules from 1 through 20.

4.3.2 The basic rack profile of an internal gear relates to the profile of the tooth spaces.

4.3.3 The standard basic rack have straight side flanks at an angle with a perpendicular to the reference line equal to the pressure angle.

4.3.4 The height of tooth of each basic rack is equal to 2.25 times the module (2.25 m).

4.3.5 The tooth thickness on the reference line is equal to half the pitch. Hence, the tooth thickness equals the spacewidth.

4.3.6 The pressure angle (the angle between the normal to the basic rack tooth and the reference line) is 20° for general purposes. 22.5° and 25° pressure angle basic rack profiles are also included.

4.3.7 The addendum is equal to the module; the working depth is equal to 2 times the module (2 m); the bottom clearance is equal to 0.25 times the module (0.25 m).