

**BUREAU OF INDIAN STANDARDS**

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*भारतीय मानक मसौदा*

**आंतरिक दहन इंजनों के लिए स्टार्टर रिंग गियर्स  
भाग 1 जड़ता और सोलनॉइड पूर्व-संलग्न स्टार्टर्स के लिए गियर — विशिष्टि  
(पहला पुनरीक्षण)**

*Draft Indian Standard*

**STARTER RING GEARS FOR INTERNAL COMBUSTION ENGINES  
PART 1 GEARS FOR INERTIA AND SOLENOID PRE-ENGAGED STARTERS —  
SPECIFICATION  
(First Revision)**

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Automotive Primemovers, Transmission Systems and Internal Combustion Engine Sectional Committee, TED 2

## FOREWORD

*(Formal Clause to be added later)*

This standard covers ring gears for automobile applications for inertia and solenoid pre-engaged starters and does not cover axial and coaxial starters which are used for heavy duty applications. Ring gears for axial and coaxial starters are covered in Part 2 of this standard.

In this first revision of the standard the referencing standards have been updated and the amendment has been incorporated in the standard itself. A separate clause for references has also been introduced for ease of interpretation.

Requirements of this standard are so chosen that they meet the requirements of self-starter endurance test specified in IS 3141: 2007 'Starter motors for internal combustion engines used for automotive and other applications - Specification (*Second Revision*).

The composition of the Committee responsible for the formulation of this standard is given in ANNEX A (Will be added later).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2: 2022. 'Rules for rounding off numerical values (*second revision*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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**STARTER RING GEARS FOR INTERNAL COMBUSTION ENGINES  
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## **1 SCOPE**

This standard specifies gear profile, dimensions, material and other requirements for involute spur ring gears for inertia or pre-engaged starters having hardened pinions used for starting internal combustion engines.

**1.1** This is also applicable to engines used on road vehicles.

**1.2** This standard is not applicable to ring gears for heavy duty applications which generally have 4 module pinions and gears.

## **2 REFERENCES**

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 5517: 1993	Specification for steels for hardening and tempering ( <i>Second Revision</i> )

## **3 TERMINOLOGY**

**3.1 Inertia Starter** — A starter whose power is derived from the kinetic energy of a rotating mass.

**3.2 Inertia Engagement** — Engagement effected by axial movement of the pinion along a helically splined sleeve, due to inertia of the pinion when the shaft is rotated.

**3.3 Solenoid Pre-engagement** — Engagement of pinion effected through a lever external to the motor car case and operated by a power device, such as a solenoid.

**3.4 Inboard Starter** — A starter so constructed that pinion and ring gear engagement is effected by movement of the pinion towards the starter motor.

**3.5 Outboard Starter** — A starter so constructed that pinion and ring gear engagement is effected by movement of the pinion away from the starter.

## 4 DIMENSIONS AND TOLERANCES

Gear profile and dimensions are given in Table 1. Other dimensions are subject to agreement between the purchaser and supplier. The tolerances shall be specified according to any of the methods given in Table 2.

### 4.1 Face Width of Teeth

Recommended values for interchangeability between inboard inertia starters and outboards pre-engaged starters are as follows:

Type of Engine	Starting Torque Nm	Width mm
Small petrol engines	Up to 20	9.5
Medium and large petrol engines	Above 20 up to 35	11
Medium and large diesel engines	Above 35	13, 16 or 19

### 4.2 Tooth-Chamfer

Tooth chamfer is generally required for 3 and 2.5 module ring gears and is essential when inertia type starters are used. When chamfering is required, non-pressure flank should be chamfered on both sides to allow for both inertia and pre-engaged type starters (*see* Fig. in Table 1).

**4.2.1** Ring gears of 2.25 module may not be required to be chamfered generally since they are of pre-engaged type.

### 4.3 Working Clearance

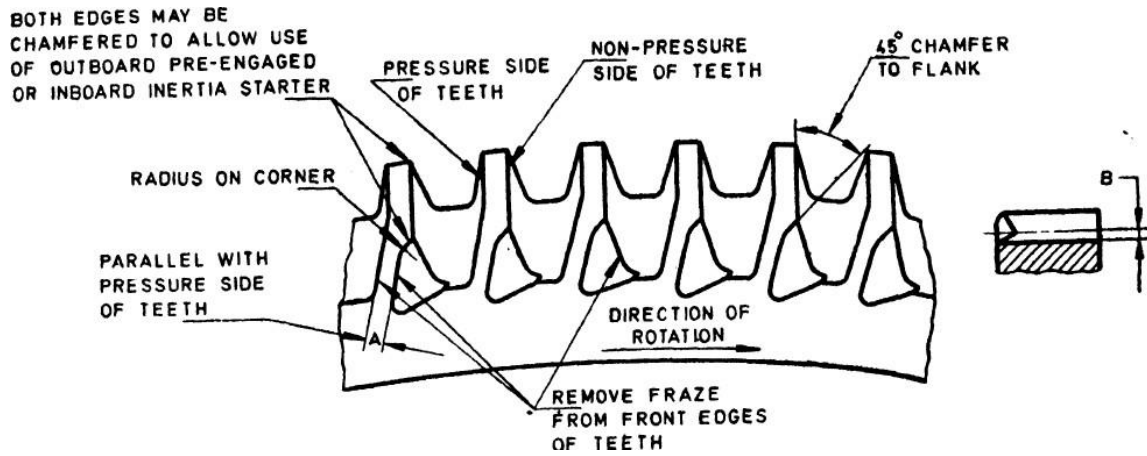
Shall be 0.13 mm minimum backlash under adverse tolerance conditions. For shrunk on type ring gears an additional diametral allowance of 0.5 mm shall be provided.

## 5 MATERIALS

Steel C40 or C45 according to IS 5517. The sulphur content for these steels may go up to 0.06 percent maximum.

**Table 1 Dimensions for Ring Gears for Inertia and Solenoid Pre-Engaged Starters**  
*(Clauses 4 and 4.2)*

All dimensions in millimetres.



Module	Dimensions	
	<i>A</i>	<i>B</i>
1.75 to 2.0	$1.15_0^{+0.13}$	0.8
2.25 to 2.5	$1.15_0^{+0.13}$	0.8
2.5 to 3	$1.15_0^{+0.13}$	0.8
3 to 4	$1.65_0^{+0.25}$	1.0

**Table 2 Recommended Methods of Measurements for Starter Ring Gears**  
(Clause 4)

All dimensions in millimetres.

		<b>METHOD I Span Over Given Number of Teeth<sup>1)</sup> Base Tangent Length</b>	<b>METHOD II Dimensions Over Roller Using Roller</b>	<b>METHOD III Chordal Measurement</b>	
				<b>Chordal height</b>	<b>Chordal Thickness</b>
Before shrink fit	<i>Max</i>				
	<i>Min</i>				
After shrink fit <sup>2)</sup> (For a nominal shrinkage of 0.5 mm) <sup>3)</sup>	<i>Max</i>				
	<i>Min</i>				

**NOTES —**

<sup>1)</sup> Given number of teeth depends on total number of teeth on ring gear and pressure angle.

<sup>2)</sup> Not applicable for bolted type of ring gears.

<sup>3)</sup> Recommended practice is to have 0.028 mm shrinkage allowance per 25 mm of inside diameter (to maintain a hoop stress of not more than 227.5 N/mm<sup>2</sup>).

**6 DESIGNATION**

Shall include:

- a) Name;
- b) Symbol I or PE for inertia or pre-engaged type;
- c) Module; and
- d) No. of this standard.

*Example:*

A ring gear for pre-engaged starter of module 3 shall be designated as:

Ring Gear PE 3 IS 7657 (Part I)

## 7 HARDNESS

The hardening of the tooth engaging face on the pitch line shall be as follows:

<i>Module</i>	<i>Hardness, HV</i>
2.25 to 2.5	520 to 600
2.5 to 3	520 to 600
3 to 4	470 to 550

**7.1** Hardness values other than those specified in **7** may be used subject to agreement between the purchaser and the manufacturer.

**7.2** The minimum depth of hardness shall be 2.5 mm over the whole profile.

## 8 ASSEMBLY ON FLYWHEEL

### 8.1 Manual Gear Box Vehicles

The gear ring can be bolted on to the flywheel or can be shrunk on. With shrunk on gear rings this operation is sometimes combined with tempering. If tempering has been done separately, the ring should not be heated to more than 200°C to avoid softening of gear teeth. This is of special importance when replacement rings are fitted by service stations. A shoulder or step on the flywheel is recommended to ensure that the ring is located equally with the correct out of mesh clearance when fitted to the engine.

### 8.2 Automatic Gear Box Vehicles

The ring gear can be bolted or shrunk on, but it is also common practice for the ring gear to be welded to a flexible plate. In the latter case, the ring gear is made to the finished size since there is no expansion of the ring during fitting. It should be noted that the inherently more flexible location usually results in a higher noise level, although wear rates can be similar to that of the other methods. Particular attention should be paid to accuracy of location.

## 9 MARKING

### 9.1 BIS Certification Marking

Each gears for inertia and solenoid pre-engaged starters may also be marked with the Standard Mark.

**9.1.1** The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

**ANNEX A**  
*(Foreword)*

**COMMITTEE COMPOSITION**

AUTOMOTIVE PRIMEMOVERS, TRANSMISSION SYSTEMS AND INTERNAL  
COMBUSTION ENGINE SECTIONAL COMMITTEE, TED 02

Will Be Added Later