मानकः पथप्रदर्शकः

COMPENDIUM OF INDIAN STANDARDS ON GEARS AND GEAR BOXES

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Introduction

Gears and gearboxes are integral components in mechanical engineering, forming the backbone of countless machines and systems used across industries such as automotive, aerospace, manufacturing, mining, and power generation. Their primary function is to transmit mechanical power and motion between rotating shafts with varying speeds and torques, enabling controlled and efficient operation of complex equipment.

Gears are toothed mechanical elements that mesh with one another to transfer motion and force. They come in various forms—spur, helical, bevel, worm, and planetary—each designed for specific speed, torque, direction, and space requirements. Gearboxes, on the other hand, are assemblies that house multiple gears in a structured manner to achieve desired gear ratios, torque multiplication, or speed reduction. Together, gears and gearboxes help optimize performance, enhance energy efficiency, and ensure operational reliability in demanding mechanical environments.

With advancements in materials, precision manufacturing, lubrication technologies, and digital design tools, the design and application of gears and gearboxes have evolved significantly. Alongside innovation, adherence to standardized practices for testing, maintenance, and compliance with national and international standards remains crucial for ensuring safety, quality, and longevity.

This compendium presents a consolidated resource on the design principles, classifications, applications, materials, standards, and maintenance of gears and gearboxes. It is intended to serve engineers, designers, quality professionals, and technical personnel as a practical reference guide, facilitating informed decision-making, improved performance, and greater reliability in mechanical systems involving power transmission.

1) IS 4071: 1986 Specification for Master Gears

IS 4071: 1986 specifies requirements for master gears used in inspecting, calibrating, and testing production gears. The standard defines tolerances, accuracy levels, and material properties to ensure high precision in gear manufacturing. It includes guidelines for design, construction, and testing of master gears to verify tooth geometry and pitch accuracy. These provisions ensure consistency and quality in gear production for industries like automotive, aerospace, and industrial machinery. Master gears are critical for quality control in transmission systems, robotics, and medical equipment, ensuring reliable and precise gear performance.

2) IS 19153 (Part 1) : 2025/ ISO 6336-1) Calculation of Load Capacity of Spur and Helical Gears Part 1: Basic Principles Introduction and General Influence Factors

IS 19153 (Part 1): 2025 / ISO 6336-1 outlines the basic principles for calculating the load capacity of spur and helical gears. Key provisions include definitions of gear geometry, operating conditions, and stress types such as contact stress and bending stress. It identifies general influence factors affecting load capacity, including material properties, surface finish, lubrication, temperature, and reliability requirements. The standard provides a framework for calculating safety factors and service life based on standardized methods. It serves as the foundation for subsequent parts of the standard, ensuring consistency and accuracy in gear design, performance assessment, and failure prevention.

3) IS 19153 (Part 2) : 2025/ISO 6336-2 Calculation of load capacity of spur and helical gears Part 2: Calculation of surface durability pitting

IS 19153 (Part 2): 2025 / ISO 6336-2 provides methods for calculating the surface durability (pitting resistance) of spur and helical gears. Key provisions include determining contact stress between meshing gear teeth and comparing it with permissible stress values to assess risk of pitting. It outlines influence factors such as material hardness, gear geometry, surface roughness, load conditions, lubrication quality, and operating environment. The standard introduces safety factors and life modification factors for accurate assessment. These provisions help ensure gear reliability by predicting pitting failures and guiding design

improvements, material selection, and lubrication strategies for enhanced surface durability.

4) **IS 19153 (Part 3) : 2025/ISO 6336-3 Calculation of Load Capacity of Spur and Helical Gears Part 3: Calculation of Tooth Bending Strength**

IS 19153 (Part 3): 2025 / ISO 6336-3 outlines the method for calculating the tooth bending strength of spur and helical gears, which is essential for preventing tooth breakage under load. Key provisions include formulas to calculate bending stress at the tooth root and compare it with the permissible stress. The standard considers factors such as gear geometry, material properties, load type, stress concentration, and life factors. It also accounts for reliability, temperature, and manufacturing quality. Safety factors are provided to ensure durability. These provisions help in designing gears with sufficient strength to withstand repeated loading without failure.

5) **IS 19153 (Part 5) : 2025/ISO 6336-5 Calculation of Load Capacity of Spur and Helical Gears Part 5: Strength and Quality of Materials**

IS 19153 (Part 5): 2025 / ISO 6336-5 specifies guidelines for determining the strength and quality of materials used in spur and helical gears. Key provisions include defining material properties such as allowable stresses for pitting and bending, based on material type, heat treatment, and surface hardness. The standard provides methods for selecting material quality grades and includes factors like cleanliness, microstructure, and mechanical performance. It also outlines how to determine permissible stress numbers using material test data or standardized values. These provisions ensure accurate load capacity calculations by linking gear performance to material strength, consistency, and manufacturing quality.

6) **IS 19153 (Part 6) : 2025/ISO 6336-6 Calculation of Load Capacity of Spur and Helical Gears Part 6 : Calculation of Service Life Under Variable Load**

IS 19153 (Part 6): 2025 / ISO 6336-6 provides guidelines for calculating the service life of spur and helical gears under variable load conditions. Key provisions include methods for evaluating gear performance when subjected to fluctuating loads, speeds, and operating cycles. It introduces load spectrum analysis and cumulative fatigue damage theory (Miner's Rule) to estimate gear life. The standard considers both pitting and bending fatigue under variable

stresses. It also includes influence factors such as load duration, frequency, and environmental conditions. These provisions help engineers design gears with accurate life predictions, ensuring reliability and durability in real-world dynamic applications.

7) IS 11863: 1986 Tolerances for worm gears

IS 11863:1986 specifies the tolerances for worm gears, ensuring proper meshing, smooth operation, and dimensional compatibility between the worm and worm wheel. Key provisions include limits and fits for key parameters such as lead angle, pitch diameter, axial pitch, center distance, and tooth thickness. The standard defines tolerance grades based on application requirements and gear accuracy levels. It also covers allowable deviations in gear geometry, surface finish, and backlash to ensure efficient power transmission and reduce wear. These provisions support precise manufacturing, quality control, and interchangeability of worm gear components in various mechanical systems and industrial applications.

8) IS 3756 : 2002 Method for gear correction - Addendum modification for external cylindrical gears with parallel axes

IS 3756:2002 provides a standardized method for addendum modification (profile shift) of external cylindrical gears with parallel axes. Key provisions include determining the appropriate profile shift coefficients to optimize gear performance, improve load distribution, and avoid undercutting or interference. The standard outlines calculation methods for selecting positive or negative addendum modifications based on gear geometry, operating conditions, and center distance requirements. It also addresses the effects of modification on tooth strength, contact ratio, and backlash. These provisions help gear designers enhance efficiency, reduce noise, and increase the service life of gears by fine-tuning tooth profiles for specific applications.

9) IS 7443 : 2002 Method for load rating of worm gears

IS 7443:2002 outlines the method for load rating of worm gears, providing a standardized approach to determine their safe operating capacity. Key provisions

include calculation of torque transmission capability based on gear geometry, material properties, lubrication, and operating conditions. The standard specifies procedures for determining both wear and strength ratings, considering factors such as sliding velocity, contact stress, and temperature effects. It includes service factors to adjust ratings for various applications and duty cycles. These provisions ensure reliable performance, minimize gear failure risks, and help in selecting appropriately rated worm gears for mechanical systems across industrial applications.