



IS 2004 : 1991 Carbon Steel Forgings For General Engineering Purposes — Specification

IS 2004: 1991 outlines the requirements for carbon steel forgings used in general engineering applications. These forgings are components made from carbon steel, shaped through compressive forces such as hammering or pressing. They are widely used in various industries like automotive, machinery, construction, and defense, valued for their strength, toughness, and cost-effectiveness. The process of forging, dating back to ancient civilizations like the Hittites around 1200 BCE and later refined by the Romans, involves shaping metal by applying pressure. Over time, forging techniques were perfected, and by the Industrial Revolution, it became a critical process for mass production in industries such as transportation, construction, and defense.

The IS 2004: 1991 standard categorizes carbon steel forgings into nine classes (Classes 1, 1A, 2, 2A, 3, 3A, 4, 5, and 6) based on their carbon content, chemical composition, and mechanical properties for use in general engineering applications. The carbon content in these forgings ranges from 0.10% to 0.70%, which significantly affects the material's hardness, strength, and resistance to wear. This wide range of carbon content offers versatility, making carbon steel forgings suitable for various applications that demand different mechanical properties. The forgings are produced through processes like open-die, closed-die, and upset forging, which help ensure the creation of reliable parts for uses in machinery, automotive components, structural supports, and more.

Customers expect carbon steel forgings to meet high standards of quality and performance, particularly for use in demanding environments. The key expectations include:

- **Chemical Composition:** The performance of steel forgings is heavily influenced by the balance of elements such as carbon, silicon, manganese, phosphorus, and sulfur. These elements impact the material's strength, toughness, and wear resistance, so proper composition is crucial to achieving the desired mechanical characteristics.
- **Mechanical Strength:** The forgings must meet specific requirements for tensile strength, yield strength, elongation, and hardness, ensuring they can endure operational stresses without failure.
- **Dimensional Accuracy:** To ensure proper function and fit in their final applications, forgings must be produced within precise dimensional tolerances. This ensures the quality and performance of the final product.
- **Consistent Heat Treatment:** Heat treatment is critical to achieving the desired mechanical properties, including strength, toughness, and ductility. The standard specifies certain heat treatment processes to guarantee uniformity across all forgings.
- **Traceability:** The forgings must be marked with identification information, allowing traceability back to the manufacturer and ensuring they meet all quality standards.

IS 2004: 1991 provides a framework to meet these expectations, outlining comprehensive specifications for manufacturing, testing, and heat treatment. The standard specifies chemical and mechanical property requirements like tensile strength and hardness to ensure that the forgings

perform reliably. It also allows flexibility in the carbon content of forgings, ranging from 0.10% to 0.70%, to accommodate varying strength and hardness needs across the different classes.

The raw materials used for forging must comply with IS 1875: 1991, ensuring defect-free production. Dimensional tolerances are also clearly defined in the standard, which ensures that each forging meets the required shape and fit for its intended application. These tolerances are governed by standards such as IS 1366 (Part 2) for drop and press forgings, and IS 1366 (Part 3) for upset forgings. This ensures precise dimensions are maintained, which is critical for applications in high-performance sectors like automotive, aerospace, and heavy machinery.

Heat treatment plays a crucial role in the forging process, enhancing mechanical properties like strength, toughness, and hardness. The standard outlines several heat treatment options:

- **Normalizing:** This process refines the grain structure and enhances toughness.
- **Annealing:** Used to increase ductility, relieve internal stresses, and reduce hardness for easier machining.
- **Hardening and Tempering:** These processes increase wear resistance and strength while reducing brittleness.
- **Special Treatments:** Manufacturers can apply additional heat treatments by agreement with the purchaser to meet specific requirements.
- **As-Forged Condition:** For less demanding applications, forgings may also be supplied without additional heat treatment.

The standard also specifies testing protocols to ensure compliance with the set specifications. These include tensile tests, bend tests, and non-destructive testing methods like ultrasonic and Magnaflux inspections, which verify the integrity and quality of the forgings.

Marking and traceability are emphasized in the standard. Each forging must be marked with the class, cast number, and other relevant identification information, ensuring traceability throughout the manufacturing process and confirming that the forgings meet the specified quality standards.

For customers who prioritize reliable, high-performance products, it is crucial to choose ISI-marked carbon steel forgings from BIS-certified manufacturers. These forgings comply with the rigorous requirements of IS 2004: 1991, ensuring consistent performance, durability, and safety across a wide range of general engineering applications