मानकः पथप्रदर्शकः

COMPENDIUM OF STANDARDS ON

TURBINES

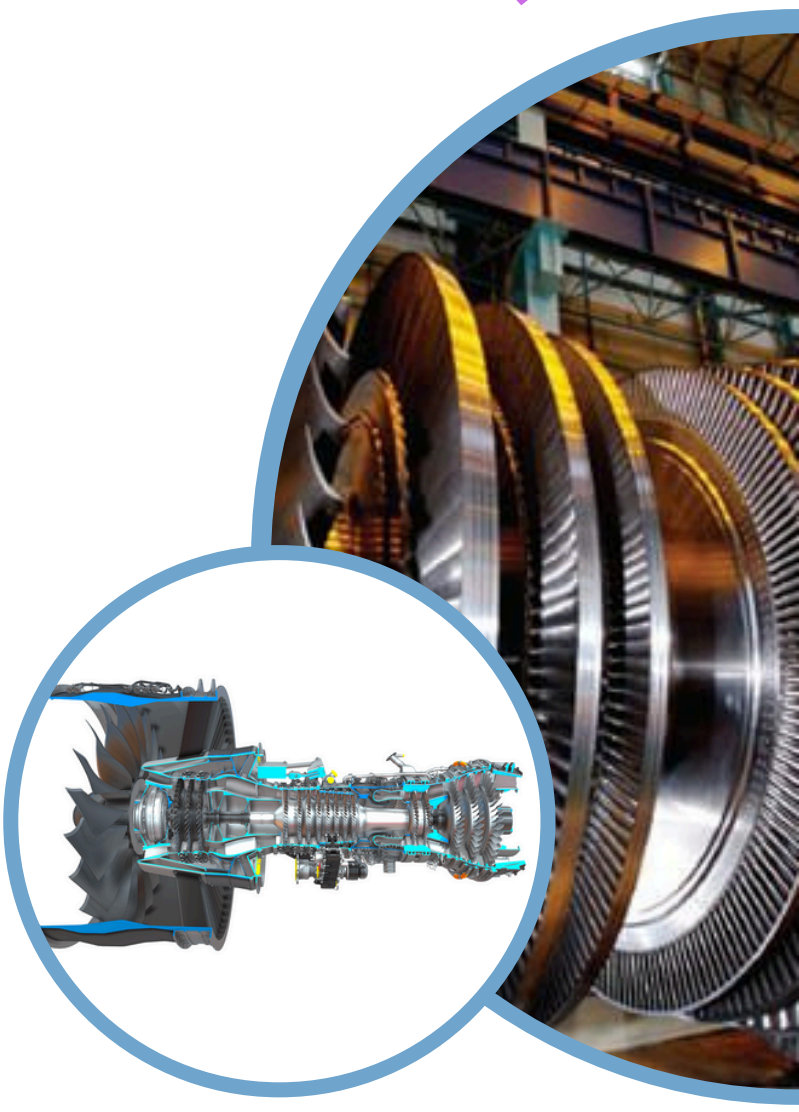

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Table of Contents

Introduction

Turbine is a machine that transforms fluid or air energy into usable work or electricity. It consists of a device with a rotor assembly (shaft or drum with blades) that converts fluid or air energy into rotational energy which in turn is converted to usable work or electricity.

A compressor is a mechanical device that increases the pressure of air or other gases by reducing its volume. An air compressor is a specific type of gas compressor. Many compressors can be staged, that is, the gas is compressed several times in steps or stages, to increase discharge pressure.

This compendium aims at providing an overview of Indian Standards on compressors and turbines, offering insights into their varieties.

By compiling relevant standards on turbines in a single document, this compendium serves as a ready reference for professionals involved in manufacture of compressors which are efficient, reliable and safe.

1. IS 11461: 2024 Code of Practice for Compressor Safety

Scope: This standard outline safety requirements for the safe design and construction of air compressors for general use.

Key Provisions:

- Defines Maximum Allowable Working Pressure, Speed and Temperature for compressors.
- Compressor Categories- Air compressors are grouped into the following three categories- a) Oil-free compressors b) Oil-lubricated compressors c) Oil-flooded rotary compressors.
- Specifies the potential hazards associated with air compressors.
- Emphasizes the importance of proper installation, operation, and maintenance to ensure safety.

2. IS 11563: 2022 Technical Supply Conditions for Dynamic Compressors

Scope: This standard covers the minimum requirement for the supply of dynamic compressors used for handling air, gas, or gas mixtures.

Key Provisions:

- **Enquiry Specifications**: Emphasizes the necessity for customers to provide clear technical specifications to vendors to ensure satisfactory offers.
- **Alternative Designs**: Allows vendors to offer alternative designs if required, ensuring flexibility in meeting specific customer needs.
- **Design and Performance Requirements**: Details requirements for materials, shaft seals, couplings, and other components to ensure reliability and efficiency.
- **Testing and Inspection**: Outlines procedures for testing and inspection to verify compliance with the specified requirements.

3. IS 14205 (Part 1): 1994 Steam Turbine – Part 1: Specification

Scope: This Indian Standard provides the technical specifications for steam turbines, primarily those used to drive generators in electric power systems.

The purpose of this part is to help **purchasers** clearly define their technical requirements for steam turbines. To assist **manufacturers** in understanding customer expectations and providing suitable offers.

Key Provisions:

- Defines the various types of Turbines, Methods of initial steam admissions, and Terminal Conditions.
- Covers general requirements, design criteria, and performance parameters for steam turbines.

- Specifies testing methods and acceptance criteria to validate turbine performance.

4. IS 17093: 2019 Technical Supply Conditions for Reciprocating Air Compressors for General Purpose and Industrial Applications

Scope: This standard outlines the technical requirements for reciprocating air compressors used in stationary applications, operating under intermittent or continuous duty.

Key Provisions:

- **Design and Construction**: Specifies requirements for materials, frame design, base plates, and components to ensure durability and minimize vibrations.
- Includes guidelines for installation, operation, and maintenance to ensure efficiency and safety.
- Addresses environmental considerations, such as noise and vibration control.

5. Air Receivers for Compressed Air Installation (IS 7938)

Scope: Air receiver is any fusion-welded vessel intended to contain air or inert gas above atmospheric pressure but not exceeding 25 bar. Air receivers help to dampen out pulsations due to reciprocating actions and shall help to condense and trap, as much as possible the moisture in the compressed air, and also to let oil and other impurities settle down before air passes into the piping. Air receiver shall provide a 'flywheel effect', that is, it shall meet the varying demands without compressor regulation functioning incessantly. Air receivers are, therefore, also used for the storage of air.

Manufacturing: Air receivers shall be manufactured according to IS 2825 but the design pressure shall be assumed as maximum working pressure plus 10 percent. Receivers up to a pressure of 3.5 bar shall be regarded as Class III vessels and those with higher pressures as Class II.

Mountings: Mountings such as safety valve, drain valve, pressure gauge, fusible plugs are used in the compressor for the safe operation of the air receiver.

Access and Inspection Openings: Each air receiver shall be provided with openings for cleaning and inspection. Holes for pipe connection may be used for this, purpose provided they are of sufficient size.

Inspection and Tests:
The requirements of inspection shall be as given in IS 2825. Periodic inspection of the air receivers shall be carried out once in every 5 years as per Petroleum and Explosives Safety Organization's (PESO) guidelines.

Every receiver shall be tested at the manufacturer's works by hydraulic pressure to 1.5 times the design pressure. While under pressure the air receiver shall be struck with a hammer on both sides and close to welded seams and a thorough examination made.
The pressure shall be maintained for 30 minutes.

6. Mobile Air Compressor for Construction Purposes (IS 6430)

Scope: Mobile Air Compressor for Construction Purposes covers internal combustion-engine or electric-motor-driven mobile air compressor plants with positive displacement which include reciprocating, rotary and screw-type compressors for construction purposes with pressure up to 20 bar. It also includes wheel and skid-mounted plants but does not cover the truck-mounted or self-propelled compressors driven by the prime mover of the vehicle itself.

Designation and Sizes: The size of the compressor shall be specified by its capacity in terms of free air delivered at the specified working pressure.

Operating and Storage Conditions: The compressor shall normally be capable of working and being stored without any defect at temperatures 5 °C to 45 °C, 95 percent relative humidity at all temperatures below 27 °C ambient and shall be capable of giving its rated output up to 300 m altitude.

Performance: The compressor shall be capable of delivering specified free air flow at rated discharge pressure measured in accordance with IS 5456. The temperature of the coolant in the radiator header tank shall be lower than the boiling point of the coolant by at least 7 °C. The temperature of the oil in the compressor and engine shall not exceed 120 oC when the plant is running continuously at full load. The mobile compressor shall traverse 80 km on a rough cross-country road at a speed of not less than 15 km/h without damage to its any component and without in any way affecting its performance. The plant shall be capable of operating satisfactorily even when tilted at an angle of one in seven in any direction.

Dismantlability: During design, consideration may be kept for a purchaser's requirement who wants the plant to be made dismantlable into convenient independent small loads, as mutually agreed upon by the purchaser and the manufacturer, for transportation in inaccessible areas.

7. Breathing Air Compressor Package (IS 15879)

Scope: Breathing air compressor packages used for supply of high-pressure breathing air and filling of compressed air cylinders. It covers compressors of maximum working pressure 41.4 MPa or less. Sizing of the package in terms of capacity (that is now) to supply the breathing air at specified charging rate. System capacity shall be in 'Iitres per min (lpm)' or 'Standard Cubic Metre per hour (Sm^3/h).

Breathing and Air Quality Requirements: The quality of breathing air is of utmost importance, as being life support system.

Design: The breathing air compressor package shall be designed to deliver high pressure air ranging from 20 MPa to 41.4 MPa or less that meets the requirements of respiratory quality air.

Compressor: The compressor shall be a three or four stage, three to four cylinders, single acting, and reciprocating type; designed for continuous duty at specified working pressure with the specified charging rate.

Air Purification System: Compressed breathing air systems shall be supplemented with a purifier to remove common contaminants from compressed breathing air.

Breathing Air Storage: Air storage system shall include breathing air storage cylinders/vessels consisting of two or four seamless cylinders/vessels as per IS 7285 (Part-1) or IS 7285 (Part-2).

Pressure Reducing Station and Manifold: The breathing air manifold shall beprovided, which shall be the termination point for the breathing air supply piping. A pressure reducing station shall also be installed in the discharge header which shall assure that air pressure to the respirator(s) does not exceed a preset limit.

Accessories: Accessories of compressor package may be prime mover, drive arrangement, guards for moving parts, nameplate and rotation arrow.

8. Petroleum, Chemical and Gas Service Industries — Centrifugal Compressors (IS 15661:2006)

Scope: It covers design, materials, fabrication, inspection, testing and preparation for shipment of centrifugal compressors for use in the petroleum, chemical and gas service industries. It is not applicable to machines that develop less than 35 kPa above atmospheric pressure, nor is it applicable to packaged, integrally geared centrifugal air compressors.

Basic Design: The basic design should contain castings, interstage diaphragms and inlet guide vanes, casing connections, external forces and moments, rotating elements, bearings and bearing housings, shaft seals, dynamics, lube oil and seal oil systems.

Accessories: The accessories may include drivers, couplings and guards, mounting plates, controls and instrumentation, piping and appurtenances and special tools.

Inspection: Its inspection may include material inspection, radiographic inspection, ultrasonic inspection, magnetic particle inspection and liquid penetrant inspection.

Testing: The quality tests for the compressor are hydrostatic test, impeller overspeed test, mechanical running test as assembled compressor gas leakage test