मानकः पथप्रदर्शकः

COMPENDIUM OF INDIAN STANDARDS ON

WEIGHING INSTRUMENTS

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Foreword

This compendium gives a consolidated list all the Indian Standards published on Weighing Instruments in a single document. These standards are the collective expertise of scientists, engineers, industry stakeholders, and regulatory authorities who have collaborated under the aegis of BIS to establish comprehensive guidelines for weighing instruments. It encompasses a wide range of measuring technologies, including gravimetric, load-cells, weighing in motion, spring balances and mechanical mass comparators. Similar Compendiums for Indian Standards on Length Measurement and Flow meters are also available.

Introduction to Weighing Instruments

Weight measurement in India has a rich history rooted in ancient systems, as detailed in the *SP 4: Handbook on Metric System* published by the Bureau of Indian Standards (BIS). India employed diverse regional weight units such as the maund, seer, and tola, which varied across kingdoms and communities, often based on natural standards like grains or stones. The adoption of the metric system, formalized with the Standards of Weights and Measures Act, 1956, marked a transformative shift. The metric system introduced standardized units like kilogram, ensuring precision, uniformity, and alignment with global trade standards. This transition, supported by BIS through standards like IS 1056 for commercial weights, streamlined commerce, scientific research, and industrial processes.

Modern weighing instruments are governed by standards of **accuracy**, **repeatability**, and **compliance** with legal metrology. With advancements in digital technology, traditional mechanical scales have evolved into complex machines with **automatic** and **non-automatic** functionalities, suited to different operational needs.

Classification of Weighing Instruments

Weighing instruments can be broadly classified into two main categories based on the **requirement of human intervention** during the weighing process:

1. Non-Automatic Weighing Instruments (NAWIs): Weighing instruments that **require operator involvement** to perform the weighing process—specifically in placing the load, initiating the weighing, and recording the result**.** Examples:

Type	Description / Application
Mechanical Balance	Beam balances used in labs or traditional markets
Platform Scale	Weighing goods in warehouses or industries
Analytical Balance	High-precision lab scales
Retail Scale	Grocery shops for weight-based billing

2. Automatic Weighing Instruments (AWIs)

Instruments that **perform the weighing operation without operator involvement**, including placing, weighing, processing, and recording the load. Suitable for **high-speed**, **continuous**, or **in-motion** weighing applications. Examples:

Type of AWI	Description / Application
Check Weighers	Automatically verify if a product is within a weight range
Weighing Price Labellers	Print labels after weighing packaged goods
Gravimetric Filling Machines	Fill containers based on predefined weight
Belt Weighers	Measure the mass flow on a conveyor belt
Catch Weighers	Measure weight of random pre-packed goods
Weighing in Motion (WIM)	**Weigh vehicles or axles while in motion** on roads or bridges

Standards Covered under Non-Automatic Weighing Instruments (NAWIs)

Non-Automatic Weighing Instruments (NAWIs) are those that require **human involvement** in the weighing process — such as placing the load and reading the result. The following Indian Standards (IS) have been developed to regulate various technical, metrological, and structural aspects of NAWIs, ensuring uniformity, precision, and legal compliance.

IS 1056 : 2004 [Commercial Weights - Specification]

Scope:

Covers specifications for solid and sheet metal weights used in commercial transactions:

- Iron weights: 50 kg to 50 g
- Brass/Bronze weights: 10 kg to 1 g
- Sheet metal weights: 500 mg to 1 mg
  Does not include proportional weights used in weighing machines.

Key Aspects:

- **Materials:** Cast iron, forged mild steel, brass, bronze, stainless steel, aluminium, and nickel-silver.
- **Shapes:** Hexagonal (iron), cylindrical or flat (brass/bronze), geometric (sheet metal).
- **Permissible Errors:** Defined per denomination; bullion weights have tighter limits.
- **Marking:** Indelible denominations and manufacturer's mark; international Indian numerals.
- **Adjustment:** Via loading holes with lead or by grinding (for solid weights).
- **Finish:** Smooth surface, painted/coated for durability.

IS 1057 : 2004 [Commercial Carat Weights - Specification]

Scope:

This standard specifies the requirements for **commercial carat weights** used in the **weighing of pearls, diamonds, and other precious stones.**

Key Aspects:

- Types: Knob weights (5–500 carat) and sheet weights (0.005–2 carat)
- Materials: Brass, bronze, nickel silver, stainless steel; aluminium for very small weights
- Shape: Knob (cylindrical), Sheet (square with raised corner)
- Tolerance: Strict permissible errors, only on excess side
- Marking: Denomination and manufacturer's name stamped (above 50 carat)
- Packing: Velvet-lined box with forceps and transparent cover for small weights

IS 1433 : 1990 (Reaffirmed in 2022) [Beam Scales - Specification]

Scope

Covers the requirements for **commercial beam scales** in four classes (A, B, C, D), used for precise to general-purpose weighing.

Key Aspects:

- **Classes & Uses:**
  - Class A – Assay & precision weighing
  - Class B – Precious materials (jewels, bullion, chemicals)
  - Class C – Costlier commodities (cotton, spices, dry fruits)
  - Class D – Cheaper goods (charcoal, scrap, vegetables)
- **Materials:**
  Stainless steel, brass, bronze, mild steel, aluminium; Class A uses non-magnetic materials.
- **Design:**
  Knife-edges, indicators, suspension pans; specific configurations like agate-box, swan-neck, Dutch-end beams.
- **Accuracy:**
  Defined sensitivity & permissible errors per class; Class A most precise.
- **Construction & Dimensions:**
  Standardized dimensions per class; optional glass case for Class A.
- **Testing & Marking:**
  Sensitivity, arm inequality, shift tests; requires clear marking of class, capacity, and manufacturer's name

IS 1434 : 1959 (Reaffirmed in 2022) [Specification for Counter Machines]

Scope:

Applies to **counter machines**, which are equal-arm weighing instruments with pans placed above the beam, for loads up to **50 kg.**

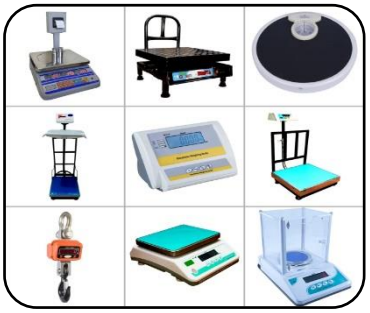
Key Aspects:

- **Capacities:** 500 g, 1 kg, 2 kg, 5 kg, 10 kg, 15 kg, 20 kg, 25 kg, 50 kg
- **Construction:**
  - Two-sided beams connected with cross-bars
  - Hard steel or agate knife-edges and bearings
  - Rigid pan supports; balance box for fine adjustment allowed
- **Materials:**
  Pans may be made of mild/stainless steel, brass, bronze, etc., and may be flat, scoop-shaped, or oblong
- **Performance:**
  - Machines must pass sensitivity and error tests at full load
  - Must maintain accuracy even if the load is unevenly placed in the pan

- Prescribed minimum fall for different capacities (e.g., 6 mm for 1 kg, 13 mm for 50 kg)

- **Sealing:**
  Provided with a soft metal plug/stud for official verification seals

IS 9281 (Part 1 to 4) : 1983 (Reaffirmed in 2023) [Specification for Electronic Weighing Systems]



The IS 9281 series sets standards for Electronic Weighing Systems, covering key definitions, testing methods, performance criteria, and installation practices. It ensures consistent design, accurate calibration, and reliable operation of electronic weighing devices, mainly for static use, helping manufacturers and regulators maintain quality and legal compliance.

Scope & Key Aspects of IS 9281 (Part 1 to 4)

Part No	Scope	Key Aspects
Part 1	Defines terms and definitions related to electronic weighing systems; forms the basis for further parts covering measurement, requirements, and installation.	- Focus on Load Cells: load types (axial, angular, eccentric), output behavior (creep, hysteresis, drift), calibration - System Components: load receptors, measuring devices, indicators, printers - Performance Parameters: accuracy, repeatability, resolution, sensitivity, response time, permissible errors - Environmental Influence: temperature, excitation, impedance, insulation - Digital Terms: graduation value, rounding error, tare systems, zero-setting
Part 2	Specifies test conditions and measurement methods to evaluate load sensing devices and electronics performance.	- Performance Tests: accuracy, non-linearity, hysteresis, sensitivity, overload, creep, repeatability, resolution, response time - Environmental Test Conditions: temp 15–35°C, humidity 45–75%, pressure 86–106 kPa - Test Methods: calibration, fatigue, insulation resistance, cross-sensitivity, drift due to time/temp/humidity - Influencing Factors: levelling, temperature variations, power fluctuations, magnetic/vibration effects (Appendix A)
Part 3	Sets performance and construction requirements for electrical load cells and complete electronic weighing systems; excludes industrial process measurement systems.	- Electrical Load Cells: accuracy, non-linearity, creep, hysteresis, repeatability, temperature effects, output voltage, drift, side load, insulation resistance (Class 1 to 3) - System Performance: accuracy, drift, tare, response, display, calibration - Operational Parameters: temperature range,

Part No	Scope	Key Aspects
		warm-up, voltage tolerance - Marking: model, serial no., rated load, non-linearity, resolution, manufacturer - Testing: type and routine tests
Part 4	Provides a code of practice for use and installation of electronic weighing systems for static weighments.	- System Description: schematic layouts - Load Cells: sensing types (strain gauge, piezoelectric), construction types, marking - Accessories: saddles, spacers, heat shields - Installation & Calibration: installation drawings, in-situ calibration - Environmental Conditions: temperature, humidity, tilt, electromagnetic fields - Compliance: IS 9281 (Part 3) and metrology laws - Sealing & Packing: tamper-proof sealing, proper packing

IS 9865 : 1981 (Reaffirmed in 2022) [Specification for Laboratory Weights]

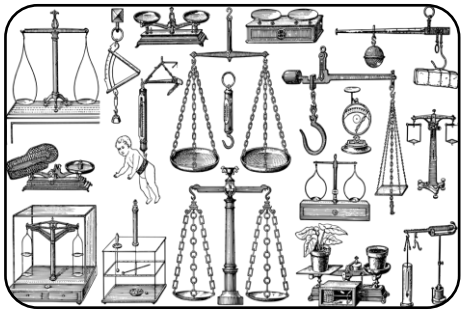
Scope:

- Covers laboratory weights from 1 mg to 200 g used in educational labs.
- Classifies weights into Grade A (high precision), Grade B (medium accuracy), and Grade C (ordinary work).

Key Aspects:

- Materials: Brass, stainless steel, platinum (for high grades), etc.
- Design: Compact, easy to handle, with forceps included. Fractional weights are shaped for easy ID.
- Tolerances: Strict accuracy limits based on grade and weight size.
- Testing: Visual, desiccation (for plated weights), and accuracy tests against national standards.
- Marking: Weights stamped with denomination; boxes marked with grade, manufacturer, and year; optional ISI mark.

IS 16514 (Part 1 & 2) : 2019 [Non-Automatic Weighing Instruments]



IS 16514 covers standards for Non-Automatic Weighing Instruments (NAWIs) that require operator intervention. Part 1 defines the terminology and key concepts, while Part 2 specifies the metrological and technical requirements. Together, they ensure accurate, reliable, and consistent performance of various types of weighing instruments used in commercial and industrial settings.

Scope & Key Aspects of IS 16514 (Part 1 & 2)

Part No	Scope	Key Aspects
Part 1	Covers terminology and definitions used for non-automatic weighing instruments requiring operator intervention during weighing.	- **Instrument Types:** Graduated, non-graduated, self-indicating, semi-self-indicating, electronic, price-computing types - **Components:** Load receptor, load-transmitting & measuring devices, display (analogue/digital), tare devices, zero-setting mechanisms - **Metrological Characteristics:** Max/min capacity, scale intervals (d, e), repeatability, discrimination, span stability, permissible errors - **Readings & Errors:** Gross, net, tare readings, rounding errors, influence of external conditions - **Supplementary Functions:** Levelling, locking, interpolation, stabilization, auxiliary verification devices
Part 2	Specifies metrological and technical requirements for non-automatic weighing instruments requiring human operation. Excludes non-graduated beam scales and counter machines.	- **Accuracy Classes:** I (special) to IV (ordinary) - Permissible Errors defined for each class - **Functions:** Tare, zero-setting, calibration, discrimination - **Environmental Tests:** Temperature, tilt, humidity, voltage - **Marking:** Max, Min, e, accuracy class - Covers: Electronic/mechanical types, price-computing, multi-range instruments

Standards Covered under Automatic Weighing Instruments (AWIs)

Automatic Weighing Instruments (AWIs) are devices that perform the entire weighing process—including **load placement, measurement, and result recording—without operator involvement**. They are widely used in high-speed, high-volume, and automated environments such as conveyor lines, packaging units, and highway weigh stations.

The following Indian Standards (IS) govern the **design, metrological performance, construction, testing, and application** of various types of AWIs.

IS 11547 (Part 1, 2, 3 Sec 1 & 3 Sec 2) : 1985 (Reaffirmed in 2020) [Specification for Electronic Weighing-in-Motion Systems]

The IS 11547 series specifies standards for **Electronic Weighing-in-Motion (WIM) Systems** designed to weigh trains and wagons while in motion. This comprehensive standard covers the terminology, design rules, performance requirements, and detailed test methods for such systems. It ensures accurate, reliable, and tamper-resistant weighing under dynamic conditions, supporting railway operators and manufacturers in maintaining safety, compliance, and operational efficiency. The series addresses laboratory simulation tests as well as site testing procedures, establishing stringent accuracy and performance criteria for both individual wagons and entire trains.

Scope & Key Aspects of IS 11547 Series

Part No	Scope	Key Aspects
Part 1	Defines terminology and design rules for electronic weighing-in-motion systems used for weighing trains in motion.	- **Terminology:** axle weigher, bogie weigher, dynamic calibration, dynamic error - **Design Rules:** weigh each wagon or entire train, accuracy independent of operating principle/display, static error limits per IS 9281 (Part 3), added dynamic error limits - **Calibration & Testing:** dynamic errors via moving test wagons, total train error averaged across wagons
Part 2	Specifies performance and construction requirements for electronic WIM systems, including static and dynamic tests.	- **Accuracy:** ±0.2% for total train mass, ±1.0% for wagon mass (dynamic) - **Testing:** static every 2 years, dynamic every 4 years, minimum 5 test runs - **Construction:** tamper-proof, fraud-resistant, reliable under speed and direction changes - **Display & Print:** gross, tare, net weights with vehicle IDs - **Zero & Tare:** zeroing ±0.25e, taring ±0.5e - **Markings:** capacity, accuracy class, speed range
Part 3 Section 1	Specifies simulated lab tests for components of electronic WIM systems	- **Submission:** load cells (min 4), indicator, printer, track switches for lab testing - **Test Procedures:** load cells tested per IS 9281 (Part 2), system compliance with IS 11547 (Part 2)

Part No	Scope	Key Aspects
	as part of pattern approval.	- **Testing Framework:** simulation (static lab loads), static (on-site verified masses), dynamic (on-site test trains)
Part 3 Section 2	Describes site testing methods to evaluate WIM system performance under real-world conditions.	- **Tests:** static (verified masses/test trolleys), dynamic (actual trains with known wagons) - **Error Limits:** ±0.1% for wagon group mean, ±0.2% total train mass repeatability, ±1.0% individual wagons - **Setup:** minimum 5 known-mass wagons, verified weighbridge, mimic actual operating conditions - **Checks:** overspeed protection, rollback prevention, tare-to-net verification

IS 17008 : 2019 [Weigh-in-Motion System for Road Vehicles – Specification]

Scope:

Applies to fixed and portable WIM systems used on roads and bridges for weighing moving vehicles (low and high speed). Excludes on-board vehicle systems.

Key Aspects:

- **Uses**: Traffic data, road design, overload screening, legal enforcement
- **Types**: Five WIM types based on application (e.g., tolls, enforcement)
- **Accuracy**: Defines tolerance levels for vehicle mass and axle loads
- **Components**: Load sensors, vehicle detectors, ID systems, data loggers
- **Testing**: Lab simulation, on-site static/dynamic tests
- **Data**: Must record weight, speed, axle data, and ensure secure storage

IS 17080 (Part 1 & 2) : 2020 [Automatic Gravimetric Filling Instruments]

The IS 17080 series specifies standards for **Automatic Gravimetric Filling Instruments** that automatically fill containers with a predetermined mass of product from bulk materials without operator intervention. Part 1 defines the terminology and fundamental concepts related to these instruments, while Part 2 outlines the metrological and technical requirements ensuring accuracy, reliability, and environmental robustness. These standards help manufacturers and users maintain consistent performance, legal compliance, and quality control in automatic filling operations.

Scope & Key Aspects of IS 17080 (Part 1 & 2)

Part No	Scope	Key Aspects
Part 1	Defines terminology and basic concepts for automatic gravimetric filling instruments that fill containers automatically with set masses.	- **Instrument Types:** Associative, Cumulative, Subtractive weighers - **Components:** Load receptors, feeding devices, control units, electronic parts - **Metrological Terms:** Scale interval, preset value, weighing cycle, min/max capacity, fill time - **Indication & Errors:** Digital/analogue methods, intrinsic/fault/span stability errors - **Tests:** Material, simulation, performance, span stability tests
Part 2	Covers metrological and technical requirements for automatic gravimetric filling instruments applicable to all capacities; excludes non-automatic operations.	- **Accuracy Classes:** Classified based on product type, fill value, speed - **Limits of Error:** For fills, preset values, influence factors (temperature, voltage) - **Technical Requirements:** Robust construction, tamper-proof, secure marking, tare & zero-setting - **Electronic Systems:** Must perform reliably under humidity, tilt, power fluctuations - **Display & Marking:** Fill weight, preset, accuracy class, manufacturer info - **Verification & Testing:** Pattern approval, initial/in-service verification, static weighing, material and span stability tests, environmental stress tests (Annex A)