



Department of Commerce,  
Ministry of Commerce and Industry  
Government of India



REFERENCE DOCUMENT FOR STANDARDISATION OF

# Warehousing and Related Assets

VERSION 1



# Authors and Acknowledgments

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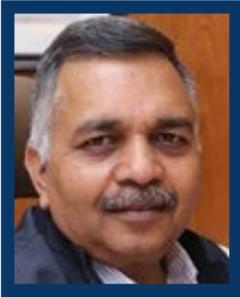
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# Foreword



**Shri Pawan Kumar Agarwal, IAS**  
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Warehousing and related assets are an important segment of the overall logistics sector in the country. In the warehousing value chains, “standardisation” is becoming essential for reducing costs, improving efficiency, and ensuring global compatibility as well as competitiveness.

The Logistics Division, Ministry of Commerce and Industry, Government of India has consulted various organisations, reviewed the existing standards pertaining to warehousing and related physical assets of the logistics ecosystem, and has brought out the present reference document. This reference document includes the existing standards that are issued by the standards agencies such as the Bureau of Indian Standards (BIS) and the Warehousing Development and Regulatory Authority (WDRA), and wherever there are gaps those have been identified and suggestions have been made therefore

Although there are innumerable standards existing with the country, knowing about these standards itself poses a challenge before they are even applied. The standards exist for general application and to cull out the relevant standards for the logistics sectors, in particular for the warehousing sector is in itself a challenge. As a first attempt, a team of experts from industry and the Logistics Division had put together the available standards within the country and some of these that are available elsewhere. The present Reference Document is to be considered as a first attempt (version 1) and with time,, we hope to bring out further versions that are more user-friendly for the application of standards..

The Reference Document envisages to act as an enabling and guiding document for facility developers and regulatory agencies to identify and implement facility and sector specific standards. This will facilitate in improved performance of the logistics ecosystem and pave way for global competence of the Indian Warehousing and Logistics sector.

# Introduction

Warehousing and related assets are an important segment of the overall logistics sector in the country. In the warehousing value chains, “standardisation” is becoming essential for reducing costs, improving efficiency, and ensuring global compatibility as well as competitiveness.

Currently, there are numerous standards for warehousing and related assets. In view of the growing logistic sector, technology advancements and globalisation, the Logistics Division in the Department of Commerce of the Ministry of Commerce and Industry, Government of India took up the task of assessing the adequacy of these existing standards and to fill the gaps with additional standards and guidelines. In consultation with experts and various stakeholders, including industry, users, interest groups, standards organisations and governments, the present draft guidelines for standardisation of warehousing and related assets for seamless and efficient logistics are issued.

These proposed guidelines include the existing standards that are issued by standards agencies such as the Bureau of Indian Standards (BIS) and the Warehousing Development and Regulatory Authority (WDRA), and wherever there are gaps, additional standards are proposed.

The Logistics Division, Ministry of Commerce and Industry, Government of India has consulted various organisations, reviewed the existing standards pertaining to warehousing and related physical assets of the logistics ecosystem, and has brought out the present reference document.

## SCOPE OF THE REFERENCE DOCUMENT

This Reference Document includes the existing standards that are issued by the standards agencies such as the Bureau of Indian Standards (BIS) and the Warehousing Development and Regulatory Authority (WDRA), and wherever there are gaps those have been identified and suggestions are made further based on standards in use by the industry and international standards.

This Reference Document intends to help the users to gain quick overview of the standards they should refer to. The potential users of this document include the manufacturing industry; commerce and e-commerce agencies, traders and businesses; logistics industry, logistics service providers, developers, landlords; manufacturers of racking systems, material handling equipment, trucks, pallets, packaging systems and solutions; and standards setting agencies.

## OVERVIEW OF THE CHAPTERS

The Reference Document covers the following aspects:

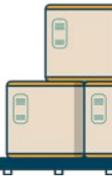
- Chapter 1: Standards for Warehousing
- Chapter 2: Standards for Palletisation
- Chapter 3: Standards for Racking
- Chapter 4: Standards for Material handling Equipment
- Chapter 5: Standards for Transportation
- Chapter 6: Product Specific Standards

Brief overview of the chapters is given below.

### CH01 Standards for Warehousing

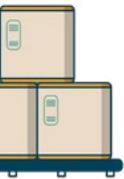
The present warehouse standards prescribed are primarily governing the physical infrastructure of the warehouses. Additional standards are proposed for ensuring reduction in warehousing costs as well as achieving improved efficiency and effectiveness covering the following areas of warehousing:

1. Warehousing structure standards that include design and construction standards, flooring standards, roofing standards.
2. Maintenance Standards including fire safety standards, security standards, occupational safety, health and sustainability standards and illumination standards.
3. Warehouse Machinery standards
4. Standards for Warehouse Management Systems including regulatory compliance, labour management systems, digital management systems, and Industry 4.0. Details are given at Chapter 1.



### CH02 Standards for Palletisation

Palletisation plays an important role in achieving efficiencies not only in warehousing but also in the whole cycle of logistics. Standardisation of pallet sizes will allow standardisation of palletizers, racking, material handling equipment, trucks, and warehouse design. This will result in economy of space and facilitate automation, thereby eliminating manual transfer of goods and improves the overall productivity and work efficiency, as well as reduces losses and the wastage of pallets.



In addition to the existing standards, additional standards are now proposed for standardized pallet dimensions/sizes for unitized loads for various industry segments, viz. chemicals/ petrochemicals, food & beverages, retailers, pharma, textiles, electronics, automotive etc. The proposed standards include the following:

1. Standards for pallet dimensions,
2. Standards for tolerance and load capacity,
3. Standards for pallet material specification,
4. Packaging,
5. Pallet stacking,
6. Manufacturing material of pallets; and
7. Number of entry points.

Details are given at Chapter 2.

### CH03 Standards for Racking

A good warehouse should provide safe and efficient storage for various products. A warehouse facility providing maximum space utilisation for storage creates higher profit margins for the operator.

Currently, there are no Indian Standards for racking. Application of standards for racking is essential to ensure efficient storage within warehouse premises. The proposed standards for racking cover the following:

1. Racking dimensions,
2. Load factors; and
3. Material strength factors.

Details are given at Chapter 3.



### CH04 Standards for Material Handling Equipment

Warehouses use various types of material handling equipment for ease of operations. The most common equipment used are forklift trucks and cranes, conveyors and other dock levelling equipment. Details of the recommended standards for material handling equipment are given at Chapter 4.



### CH05 Standards of Transportation

The standards for road transportation primarily include existing guidelines for dimensions of containers and other storage and transit equipment used at various warehousing and transportation facilities. Key changes will be required in truck body standards to make trucks ready for palletized cargo to improve throughput, besides truly synchronizing with international norms. The truck body width must match the pallet sizes as also flooring of trucks should follow standards to facilitate use of mechanized material handling equipment. From environmental considerations, it is important to have optimal vehicular routing, to use electric vehicles and to and ensure efficiency and maintenance of service vehicles. The proposed standards cover the following areas:

1. Dimensions and truck design; and
2. Network optimisation.

Further details are given at Chapter 5.



### CH06 Product Specific Standards

Products stored in warehouses may be classified as agricultural and non-agricultural items. These products are required to be stored in warehouses capable of protecting the quality. The standards for agricultural products and commodities are specified by WDRA, BIS and other product specific agencies. For the non-agricultural commodities, the standards are specified by various nodal regulatory agencies such as BIS as well as international agencies. The product specific standards cover the following:

1. Assaying/grading standards.
2. Testing standards; and
3. Weighment standards.

Details are given at Chapter 6.



## TARGETED USERS

The Targeted Users of the Reference Document on Standardisation of Warehousing & Related Assets		
1.	Manufacturing Industry	For establishing or planning and availing logistics services.
2.	Commerce and e-commerce agencies, traders and businesses	For establishing or planning and availing logistics services.
3.	Logistics industry, logistics service providers, developers, landlords	For establishing logistics services as per standards and ensuring operational efficiency, occupational safety to workers and cost effectiveness.
4.	Manufacturers of racking systems, material handling equipment, trucks, pallets, packaging systems and solutions	
5.	Standards setting agencies	For setting new or additional logistics standards.
6.	Government and regulatory agencies	For ensuring adequacies of logistics installations/facilities.

## ANTICIPATED BENEFITS

Numerous benefits are foreseen from the application of this reference document on standardisation of warehousing and related assets. Some of these include:

- Standardisation leads to **unitisation of shipments**. This is the most crucial element in measuring and organizing the logistics of the shipment in a seamless way. For example, the truck internal width standard needs immediate attention as this can lead to significant efficiencies in loading cargo of standard pallets.
- Unitisation helps in ensuring **safety of the shipment** while **reducing the cost of damages** and pilferages.
- The benefits expected from implementation of standards include reduced costs, efficient asset utilisation, material handling, productivity and operational efficiency, enabling inter modal transport and integration of country's logistics with global supply chains and achieving **transparency and inter-operability**.
- Standardisation helps in **network optimisation**, reducing lead times and inventory levels.
- Standardisation ensures **adoption of standardized costs/tariffs, real time tracking and real time decision making through robust data analytics and use of artificial intelligence**.
- The implementation of **logistics standardisation** in areas such as automation and infrastructure upgradation can result in significant improvements in efficiency.
- The standardisation is expected to help in **improved occupational health and safety of employees**, and in enabling **implementation of green and environmentally sustainable technologies**.

## LIMITATIONS OF THE REFERENCE DOCUMENT

There are innumerable standards existing within the country relevant to warehousing and related assets. For the users, knowing about the availability of all these standards itself is a challenge. Moreover, many of the standards are applicable for various situations and not exclusively for warehousing and related physical assets. Hence, as a first attempt, this document only provides a list of such standards and does not go into details to enable the users to identify the standards available, refer to them and apply suitably.

This Reference Document is not a comprehensive document that covers all standards existing or required to be considered. The present Reference Document is to be considered as a first attempt (version 1) and eventually further versions would be brought out that are more user-friendly for application of standards.

This Reference Document is only to be treated as a reference document and not a legally or statutorily binding document unless any standard mentioned in this document is a statutorily binding requirement as may have been specified in the relevant laws/rules or by the relevant authorities/agencies.

The Reference Document envisages to act as an enabling and guiding document for facility developers and regulatory agencies to identify and implement the relevant standards and benefit from improved performance of the logistics ecosystem in the country and pave way for global competitiveness of the Indian warehousing and logistics sector.



CHAPTER 01

# Standards for Warehousing



The standards for warehousing cover the following:

- A. Warehousing structure standards that includes design and construction standards, flooring standards, roofing standards.
- B. Maintenance Standards including fire safety standards, security standards, occupational safety, health and sustainability standards and illumination standards.
- C. Warehouse Machinery standards
- D. Standards for Warehouse Management Systems including regulatory compliance, labour management systems, digital management systems, the future, and Industry 4.0.

### A. Warehousing Structure Standards

#### A.1 Warehousing Construction Standards

Warehouses can be classified into different types based on the physical structure, viz. Conventional buildings (Brick and Mortar), Pre-Engineered Buildings (PEB, Cover and Plinth (CAP) Storages, Silos, Open Yards or Depot, Storage Tanks and Underground Storages.

#### Existing Standards

There are certain mandatory standards that have to be adhered to by any structure being constructed and used for warehousing purposes. These have been specified by the respective nodal regulatory agencies like the Bureau of Indian Standards (BIS), Warehousing Development and Regulatory Authority (WDRA) etc. as detailed below.

1. National Building Code of India (NBC) provisions for Group H: Storage and Warehousing Occupancy Guidelines including its Part 6 ‘Structural Design’ and other parts.
2. Construction standards based on provisions laid down under the Warehousing (Development and Regulation) Act, 2007 and subsequent rules and regulations framed there under by the Warehousing Development and Regulatory Authority including Warehousing (Development and Regulation) Registration of Warehouses Rules and Warehousing and Regulatory Authority (Electronic Negotiable Warehouse Receipts) Regulations, 2017;
3. Grading of warehouses into Grade A and Grade B are based on the criteria given below.

S. No.	General Warehouse Building Specification	Grade A Warehouse Structure	Grade B Warehouse Structure
1.	Plot Area Layout	With 50% to 60% max ground coverage with all around setbacks as per norms	70-80% ground coverage with limited setbacks
2.	Building Height at Eaves (Clear) in M	Varies from 9M to 13.5M	6M to 9M
3.	Insulation	Wall and Roof- Super Polynum bubble wrap- R value of 3.7 m2 K/W min/Polynum sheets or glass wool creating temp. difference of 5 to 7 degrees	No insulation
4.	Translucent Lighting Panels in Roofs	4-5% of area- Polycarbonate sheet with underdeck mesh, Waterproofed design	<4-5%
5.	Rainwater/Storm Water Management	Mandatory	May or may not be provided

6.	Fire Fighting	Ceiling sprinkler system with IS Std/ FM Global standards	Not provided
7.	Fire Alarm and detection system with PAS	IS Std/FM Global Standards	Not provided
8.	Flooring Type	FM2 laser guided floor with high point load	VDF/trimix
9.	Floor Loading Capacity	6-10 Tons/sqm	4-8 Tons/sqm
10.	Structure	PEB Structure	Steel Structure or PEB Structure
11.	Roof Type	Seamless and Screwless with leakproof guarantee	With screws
12.	Roof Slope	10-20-degree upward slope	Undefined specs
13.	Equipment	Mechanized loading, dock levelers, conveyors	Loading platform, forklifts, dock levelers
14.	Docks and Docks Type	Electric powered and hydraulic actuation/ 1.2 m above ground level, Docking platform	Less than 1.2 m plinth height
15.	Air Circulation	5-6 Air changes with ridge type ventilation	Turbo ventilation or others
16.	Infrastructure	STP, D.G, Drainage system, Concrete roads and setbacks, BMS, Access control security, landscaping	Limited Infrastructure
17.	Amenities	Common toilets, canteen facilities, Driver rooms, Parking, Ambulance etc.	Limited Infrastructure



4. The standards specific to design/construction and maintenance of structures is as follows:

Standard / Guidelines	Issuing Authority
Guidelines for Group H: Storage and Warehousing Occupancy Guidelines in National Building Code of India 2016 (NBC 2016) including Part 6 'Structural Design'	Bureau of Indian Standards
Fire safety standards as prescribed by the Bureau of Indian Standards	Bureau of Indian Standards
Water drainage mechanism, methods for rainwater harvesting as per Bureau of Indian Standards	Bureau of Indian Standards
Standards for Effluent Discharge as per NBC 2016 (Part 9)	Bureau of Indian Standards

## REFERENCE DOCUMENT FOR STANDARDISATION OF WAREHOUSING & RELATED ASSETS

Standards for Solid Waste Management as per Bureau of Indian Standards	Bureau of Indian Standards
Fire safety of Industrial Buildings (IS 3594)	Bureau of Indian Standards
Code for practice for interior illumination (IS 3646 Part 1)	Bureau of Indian Standards
Code of Practice for Plain & Reinforced Concrete (IS 456)	Bureau of Indian Standards
General Construction in Steel-Code of Practice (IS 800)	Bureau of Indian Standards
Code of Practice for Composite Construction in Structural Steel and Concrete (IS 11384)	Bureau of Indian Standards
Code of Practice for use of cold-Formed light gauge steel structural members in general building construction (IS 801)	Bureau of Indian Standards
Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks (IS 803)	Bureau of Indian Standards
Silos for grain storage (IS 5503 Part 1 and 2)	Bureau of Indian Standards
Criteria for design of reinforced concrete bins for the storage of granular and powdery materials (IS 4995 Part 1 and Part 2)	Bureau of Indian Standards
Criteria for Design of Steel Bins for Storage of Bulk Materials - Part 1 : General Requirements and Assessment of Loads ; Part 2 : Design Criteria; Part 3 : Bins Designed for Mass Flow and Funnel Flow (IS 9178 (Part 1 to 3)	Bureau of Indian Standards
Design, fabrication, testing and installation of underground storage/tank storages (IS 10987)	Bureau of Indian Standards
BIS Guidelines for Improvement of existing structures used or intended to be used for food grain storage (IS 609), Dunnage pallet warehousing (IS 13714)	Bureau of Indian Standards
Foodgrain storage godowns - Code of Practice (IS 16144)	Bureau of Indian Standards
Portable Fire Extinguishers (IS 15683)	Bureau of Indian Standards
Selection, Installation and Maintenance of First Aid Fire Extinguishers (IS 2190)	Bureau of Indian Standards
Installation of Surveillance equipment conforming to BIS 13252 (Information Technology Equipment-Safety)	Bureau of Indian Standards
Guidelines for improving cyclonic resistance of low-rise houses and other structures (IS 15498)	Bureau of Indian Standards
Landslide control Guidelines for structures in Hilly regions (IS 14680)	Bureau of Indian Standards
Criteria for earthquake resistant design of structures [IS 1893 (Part 1) and IS 1893 (Part 4)]	Bureau of Indian Standards
Code of practice for design loads (Other Than Earthquake) for buildings and structures: Part 1 dead loads - Unit weights of building materials and stored materials [IS 875 (Part 1)]	Bureau of Indian Standards
Code of practice for design loads (Other Than Earthquake) for buildings and structures: Part 2 imposed loads [IS 875 (Part 2)]	Bureau of Indian Standards

Design Loads (Other than Earthquake) for Buildings and Structures - Code of Practice Part 3 Wind Loads [IS 875 (Part 3)]	Bureau of Indian Standards
Code of practice for design loads (Other Than Earthquake) for buildings and structures: Part 4 snow loads [IS 875 (Part 4)]	Bureau of Indian Standards
Code of practice for design loads (Other Than Earthquake) for buildings and structures: Part 5 special loads and load combinations [IS 875 (Part 5)]	Bureau of Indian Standards
Building Design and Erection Using Prefabricated Concrete - Code of Practice (IS 15916)	Bureau of Indian Standards
NBC 2016: Part 8/Sec 1 'Lighting and Natural Ventilation'	Bureau of Indian Standards
NBC 2016 : Part 6 'Structural design' Sec1 to 8)	Bureau of Indian Standards
NBC 2016 (Part 12) Asset and facility management	Bureau of Indian Standards
Thermal insulation of cold storage - Code of practice (IS 661)	Bureau of Indian Standards
The Air (Prevention and Control of Pollution) Act, 1981	Central Pollution Control Board
The Water (Prevention and Control of Pollution) Act, 1974	Central Pollution Control Board
Noise Pollution (Regulation and Control) Rules, 2000	Central Pollution Control Board
The Environment (Protection) Act, 1986	Central Pollution Control Board
Guidelines issued by CWC	CWC
Guidelines issued by FCI	FCI
Guidelines under Food Safety Management System by FSSAI	FSSAI
Standards by National Centre for Cold Chain Development	National Centre for Cold Chain Development
WDRA Warehouse Registration Rules, 2017 (Rule 20 for Infrastructure requirements of Warehouses)	Warehousing Development and Regulatory Authority
Petroleum, petrochemical and natural gas industries – Internal coating and lining of steel storage tanks (ISO 16961)	ISO
ISO 22311:2012 Standards for Societal Security- Video Surveillance system	ISO
Design Codes for Built-up section and HR sections	American Institute of Steel Construction
Design Codes for Cold rolled section for roofing	American Iron and Steel Institute
RP 1604 (Closure of Underground petroleum storage tanks)	American Petroleum Institute (API)
RP 1615 (Installation of Underground Petroleum storage tanks),	American Petroleum Institute (API)
RP 1631(Interior lining and periodic inspection)	American Petroleum Institute (API)

RP 1632 (Cathodic protection of underground tanks)	American Petroleum Institute (API)
EN BS 8204-2:2002 and ASTM C779 and ASTM C944 for abrasion resistance	European Standards
Guidelines under International Tanker Container Organisation	International Tanker Container Organisation
Loading codes under MBMA	Metal Building Manufacturers Association
Guidelines under National Leak Prevention Association Standards for Entry, Cleaning, Repair of Underground Storage Tanks (NLPA Std 631)	National Leak Prevention Association, USA
Construction standards based on provisions laid down under the Warehousing (Development and Regulation) Act, 2007 and subsequent rules and regulations framed there under by the Warehousing Development and Regulatory Authority including Warehousing (Development and Regulation) Registration of Warehouses Rules and Warehousing and Regulatory Authority (Electronic Negotiable Warehouse Receipts) Regulations, 2017	Warehousing Development and Regulatory Authority

**Proposed Additional Standards**

Apart from the above-mentioned mandatory standards for construction, the following national and international standards are suggested for construction of warehouses:

1. National Standards:
  - Standards by the National Centre for Cold Chain Development.
  - CAP Storages: BIS Guidelines for Improvement of Existing Structures Used or Intended to be Used for food grain storage (IS 609:2020), Dunnage pallet warehousing (IS 13714:1993), Guidelines issued by FCI, CWC, Grain Marketing Corporation.
2. Standards for temperature controlled storage and transportation
  - IS 6028 : 2002/ISO 931:1980 Green bananas - Guide to storage and transport (Second Revision)
  - IS 6669 : 2001/ISO 1212:1995 Apples - Guide to cold storage (First Revision)
  - IS 6670 : 2018 Storage of potatoes - Guidelines (First Revision)



- IS 7191 : 2001/ISO 5524:1991 Tomatoes - Guide to cold storage and refrigerated transport (First Revision)
  - IS 7192 : 1974 Guide for storage of citrus fruits
  - IS 7252 : 2013/ISO 2169 : 1981 Fruits and vegetables - Physical conditions in cold stores - Definitions and measurement (First Revision)
  - IS 7730 : 1975 Guide for storage of pears
  - IS 7731 : 1975 Guide for storage of peaches
  - IS 9303 : 1979 Guide for cold storage of table grapes
  - IS 9304 : 1979 Guide for storage of mangoes
  - IS 9311 : 2001/ISO 1673:1991 Onions - Guide to storage (First Revision)
  - IS 11966 : 1997/ISO 6663:1995 Garlic - Cold storage (First Revision)
  - IS 16118 : 2013/ISO 6665 : 1983 Strawberries - Guide to cold storage
  - IS 16119 : 2013 ISO 7562 : 1990 Potatoes - Guidelines for storage in artificially ventilated stores
  - IS 16120 : 2013/ISO 5525 : 1986 Potatoes - Storage in the open (In Clamps)
3. International Standards:
- Underground Storages: Guidelines specified by the American Petroleum Institute (API), RP 1604 (Closure of Underground petroleum storage tanks), RP 1615 (Installation of Underground Petroleum storage tanks), RP 1631 (Interior lining and periodic inspection) and RP 1632 (Cathodic protection of underground tanks), Guidelines under National Leak Prevention Association Standards for Entry, Cleaning, Repair of Underground Storage Tanks (NLPA Std 631), Steel tank standards for liquid storage and underground tanks (STI R892, STI SPO31, STI R942).
  - Storage Tanks: Guidelines under International Tanker Container Organisation, American Petroleum Institute (API), American National Standards Institute, ISO standards for corrosion protection (IS 16961:2015).

## A.2 Warehousing Flooring Standards

Flooring can be considered as soul of the warehouse. Good flooring not only plays a very important role as installation of racking and movement of MHE is critical to the project, but it is also a very important factor for HSEQ aspects of the total warehousing activities. Good flooring provides many benefits in day to day operations and upkeep of the warehouse and ensures minimal maintenance costs of MHE's/machines.

Floor slabs in Warehouses and Distribution Centres are integral to the efficient operation of the facility. They are the table-top on which an operator runs his business. On the surface they appear to be one of the simplest parts of a structure to construct. However, this simplicity often leads to an underestimation of the design and construction requirements. A well designed and constructed floor will increase productivity, reduce maintenance of the building and increase the life of the equipment using the floor.

Need for Flooring Guidelines:

- Travel speeds (currently 12 km/h) and lift heights (currently above 17m) have almost doubled since last few years.
- Excitation due to floor variation and lift height result in forced resonance vibrations and oscillation of structure and truck components.

Classification categories by which the floor can be defined:

1. Unguided are defined as an area where "MHE can travel randomly in any direction".
2. Guided are defined as an area where "vehicles use fixed paths".

Details of the existing standards and the suggested standards for warehouse flooring are given below.

### Existing Standards

The flooring techniques currently used in domestic construction practices are majorly adopted from standards specified by the international agencies such as ISO and the American Society for Testing and Materials (ASTM). The current standards for ensuring adequate flooring techniques are as follows:

1. IS 4971 Recommendations for selection of industrial floor finishes
2. BS EN 8204-2:2003+A2:2011 for flooring techniques
3. ASTM C779 and ASTM C944 for abrasion resistance
4. TR34 guidelines under FM2 norms for flooring

### Proposed Additional Standards

#### 1. Load Bearing Capacity:

The load bearing capacity of the floor should be 5-6 ton per sq.m. for a G+4 or lesser levels of racking, or where higher racks are used for low weight FMCG goods. This should be adequate for majority of applications. For heavy industrial flooring having G+9 or G+10 levels of industrial racking, load bearing capacities required are to the tune of 9-10 ton per sq.m. Given the international trend towards greater use of vertical space, it is recommended that the new Grade A warehouses have provision for higher stacking.

#### 2. Maintenance of Flooring:

To ensure that the flooring doesn't lose its strength over time, it is essential to follow certain maintenance procedures periodically. It is recommended that these procedures are mandatorily followed for upkeep of warehouse floors:

- Flatness and levelness achieved by flooring applicator should be measured within 48 hours of finishing and checked against the prescribed flatness/ levelness specifications of the floor.
- Cracks on the floor of sizes larger than 0.8 mm width and 20 mm depth for a length of greater than 300 mm should be immediately treated.
- Net shrinkage at the joint should not be more than 0.06% of the panel size after 1 year from the handover of the constructed unit.
- Maintenance and Serviceability routine

and checklists for the flooring should be detailed out at the design stage itself. These will help regular maintenance and at the time of lease deal, it will help even a technically unqualified user to understand.

#### 3. Others:

- Other relevant standards:
  - i. *DIN 18202: Basic warehouse floor design Tolerance levels "for areas outside the very narrow aisle travel lanes".*
  - ii. *DIN 15185 T1 (1991): Defines tolerance levels in very narrow aisles Transversely and in parallel to the travel tracks.*
  - iii. *EN 15620 (2008): "Steel Static Storage Systems -Tolerances, Deformations and Clearances" "Iron, Sheet and Metal Goods" Standard Committee.*
  - iv. *VDMA: Floors for use with VNA Trucks*

The floor should have an appropriate flatness in order to provide a suitable surface for the operation of materials handling equipment, and an appropriate levelness to ensure that the building as a whole, with all its static equipment and MHE, can function satisfactorily.

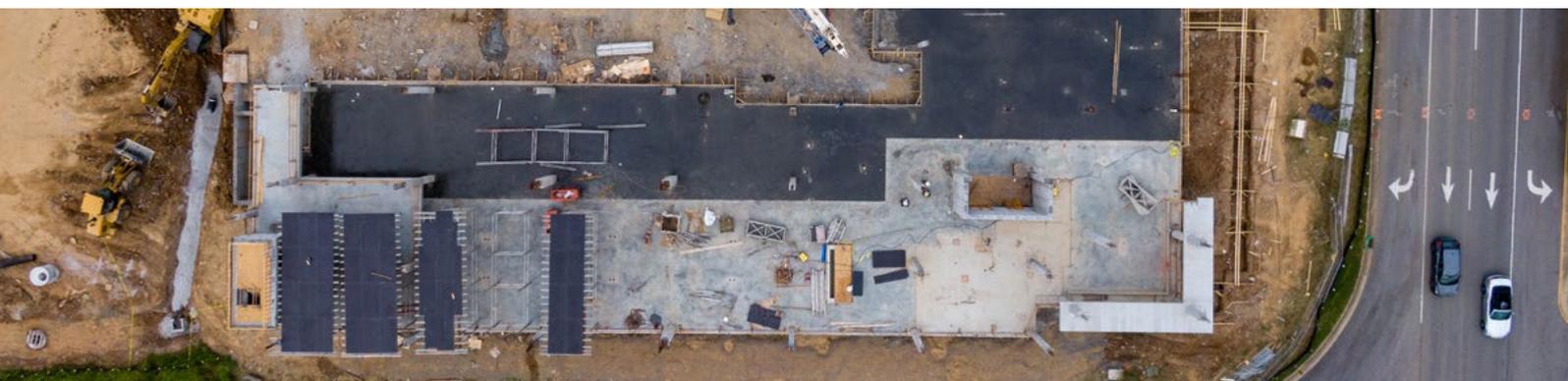
The Concrete Society's TR34 (table 3.1) recommends that 2 basic properties of the floor's surface regularity should be surveyed:

- i. *Flatness - Property F, the change in elevational difference between two consecutive measurements of elevational difference each measured over 300mm.*
- ii. *Levelness - Property E, as the difference in elevation between two opposing points 3.0 metres apart, set out on a 3.0 x 3.0 metre grid.*
- iii. *In addition, the deviation in height of the surface of all new floor construction should be within +/-15mm of a fixed datum plane.*

#### • Machinery:

- i. *Diesel & Electric Forklift: Forklifts are used in severe road condition as well as on concrete floor since they are equipped with Super Elastic Tyres and*

- higher ground clearance.*
- ii. *Junior Trucks: Junior trucks like Battery Operated Stacker and Battery-Operated Pallet truck which are less in weight are suitable for Trimix Flooring operation.*
  - iii. *Reach Truck: Reach Truck are basically used for stacking and de-stacking of pallets on racking system with average weight of maximum 1000kg @ lift height of 13mtr which in turn results in higher service weight of the truck, Trimix flooring suits for this application.*
  - iv. *Very Narrow Aisle Trucks: Very Narrow Aisle Trucks operate with guidance system in narrow aisle with lift height up to 17.5mtr. Even the Service weight of the truck is high which is concentrated to specific path, flooring plays very important role for such kind of semi-automatic trucks. Super flat flooring is recommended for operation of Very Narrow Aisle Truck.*
- *Points to be considered during flooring preparation*
    - i. *Guided or Unguided MHE: Guided or Unguided application of the MHE plays very important as deciding factor for strength and flatness of the floor*
    - i. *Self-weight of the truck: Self weight of the truck along with the load carrying capacity is helpful in calculating the total point load acting on each wheel of the truck. Load axle width of the truck also helps in defining the flooring strength requirement in warehouse.*
    - ii. *Dynamic Load bearing Capacity: Since MHE is usually carries load, it should be always considered dynamic load which in turns take care of the safety factor requirement of the truck.*
    - iii. *No. of Wheels: Since MHE can be 3-wheel or 4-wheel driven equipment, load wheelbase dimension should be considered.*
    - iv. *Type of Wheel: Polyurethane, Voulkallan, Pneumatic tyres, etc. are the wheel types of MHE.*
    - v. *Ground Clearance of the trucks: Ground clearance of MHE ranges from 30mm to 80mm which should be considered in order to avoid any major floor waviness or ramp movement.*
    - vi. *Strength: Tensile strength requirement of Warehouse Equipment varies from 50kg/cm<sup>2</sup> to 1000kg/cm<sup>2</sup> depending upon type of equipment to be used.*
    - vii. *Thickness: Minimum thickness of concrete for any MHE requirement is 150mm.*
    - viii. *Metal Reinforcement: Metal bars are always used for strengthening of the flooring which should be laid 50mm below the flooring level in order to avoid any static current effect on the truck*
    - ix. *Joint Layout: Joints are the most critical parts of the flooring which are affected most during MHE operation as wheels create impact during movement.*
    - x. *Surface irregularity: Since Warehouse equipment are 3-wheel and 4-wheel truck the waviness of the floor matters a lot.*
    - xi. *Flatness and levelness: Flatness of the flooring plays very important role for MHE like VNA trucks which works in guided path.*



### A.3 Warehousing Roofing Standards

Details of the existing standards and the suggested standards for warehouse roofing are given below.

#### Existing Standards

The existing roofing standards are mostly aligned with the American Iron and Steel Institute (AISI) and ISO. The existing roofing standards that are used for Indian construction practices are:

1. Indian Standards
  - IS 875 – Part I: Dead Load
  - IS 875 – Part II: Imposed Loads
  - IS 875 – Part III: Wind Load
  - IS 875 – Part V: Special loads and Load Combinations
  - IS 800 – Steel Design Code
  - IS 801: Design Code for Light gauge cold rolled/formed section
2. American Institute of Steel Construction (AISC) Design Codes for Built up sections and Hot Rolled Sections
3. Metal Building Manufacturers Association (MBMA) 2012 Standards:
  - Cold Formed Steel Design Manual 2017

#### Proposed Additional Standards

Apart from the above standards, it is recommended to adopt the following guidelines:

1. Roof Design and Construction:
  - Use roofing material having a high solar reflective index.
  - The heat gain in the warehouse through roof should be minimal apart from meeting its functional requirements. For ensuring the lower heat gain, the roof assembly has to meet the Energy Conservation Building Codes (ECBC), i.e. the U value should not be more than 0.33 W / m<sup>2</sup> K.
  - For reducing heat gain in the building, the roof top should be coated by high SRI paints or in case of metal roofing, roofing sheets with SRI values of more than 70 can be used. Make use of GreenPro certified roofing sheets that meet the above requirements for roofing.

- Use vegetation cover of at least 50% of the exposed area of the roof of warehouse as well as open areas including all covered parking spaces.
- Roof has to be designed with standing seams or screw bolt sandwich panels in a way that there is no leakage. Roof insulation and side cladding must be present in order to create at least a 6-7 degrees centigrade lower temperature inside as compared to outside.
- Run-off coefficients for rainwater to be defined as per roof surface and take up rainwater harvesting.
- The floor to roof height should be at least 12 m on the edges and up to 18 m in the centre to account for future vertical expansions.
- Solar panels on the rooftop are desirable for tapping renewable energy.
- Mandatory sprinklers and hydrants (FM compliant) to be installed in the roof (for all heights).

2. Roof Ventilation:

Louver ventilation system should be used in Grade A warehouses in order to ensure that the building ventilates at least six air changes every hour. Screw bolt with ridge and Turbo ventilation systems should be used in Grade B warehouses.

3. Roof Illumination:

- For sufficient daylight, 50 % of the regularly occupied spaces with daylight illuminance levels for a minimum of 110 Lux (and a maximum of 1,100 Lux) in a clear sky condition at 12 noon at working plane (through simulation or measurement approach).
- It is recommended that there should be enough skylight so as to not require additional lighting during a normal day. Indian Green Building Council (IGBC) standards recommend at least 5% of roof area should have skylights; this can be increased as needed.

## B. Maintenance Standards

Details of the existing standards and the suggested standards for warehouse maintenance are given below.

### B.1 Fire Safety Standards

#### Existing Standards

The following fire safety standards are prescribed by BIS and are mandatorily to be adhered to by all the warehousing structures irrespective of the type of warehousing structure or the products stored:

1. Adherence to Fire safety standards as prescribed by the National Building Code of India (Part 4).

2. Adequate infrastructure to be installed following BIS Code for Practice for Fire Safety of Industrial Buildings- General Storage and Warehousing including Cold Storages (IS 3594) and Specification for Portable Fire Extinguishers (IS 15683)

#### Proposed Additional Standards

No additional standards are proposed. The above existing standards are considered adequate for fire safety. The implementation of these standards is essential and must be monitored regularly to avoid any fire accidents within warehouse premises.



### B.2 Security Standards

A key feature of warehousing is to provide safe and secure storage for goods.

#### Existing Standards

The following standard is prescribed by BIS for adequate safety at warehouse premises:

1. NBC of India 2016: Part 4 Fire and Life safety and Part 12 Asset and Facility Management.
2. IS 16910 Video Surveillance System for use in Security applications

#### Proposed Standards

1. Adhere to global security standards specified by the Transport Asset Protection Association (TAPA).
2. Install warehouse surveillance systems using CCTV cameras and monitors.
3. Deploy well defined Standard Operating Procedures (SOPS) for security personnel for dealing with events like theft, unlawful entry, damage to goods, disasters etc. Conduct mock drills regularly.
4. Use BIS compliant surveillance equipment.

### B.3 Occupational Safety, Health and Sustainability

#### Proposed Standards (Occupational Safety and Health):

1. Occupational Safety and Health Administration (OSHA)
2. IS/ISO 45001 (Occupational Health and Safety Management System)

#### Proposed Standards (Sustainability):

The following quality management systems, environmental management systems, energy management systems should be followed:

1. IS/ISO 9001: Quality Management Systems
2. IS/ISO 14001: Environment Management Systems
3. IS/ISO 50001: Energy Management System
4. Adherence to Standards laid down under Leadership Energy and Environmental Design (LEED)/IGBC



### B.4 Illumination Standards

Adequate illumination of warehouse premises is a significant factor in ensuring safe working conditions and risk-free handling of goods. The selection and installation of lighting equipment

is essential to achieve optimum illumination level within the warehouse premises while keeping operational and maintenance costs under control.

#### Existing Standards

Part 8 of National Building Code of India enlisting standards for Building services (Illumination) are the set of standards required to be implemented across all warehousing structures.

#### Proposed Standards

Additionally, the following standards, specified by international agencies, are recommended for adoption in domestic for implementation to achieve higher efficiency of operations:

1. IS 3646 (Part 1): Code for Practice for Interior Illumination
2. Adequate lighting measures within premises as

specified by OSHA (1915.82) (Operational Safety and Health Administration, USA) is essential to achieve optimum illumination level within the warehouse premises while keeping operational and maintenance costs under control.



### C. Warehouse Machinery Standards

In view of the technological advancements in machinery and handling equipment such as cube containers, robotic handling equipment and drone-based equipment, warehouse machinery standards are suggested. Most modern and traditional warehouses use equipment and machinery for handling of material stored. The machinery is largely grouped into Docking equipment (including dock levellers, Dock seals and shelters etc.), Storage equipment (pallet racks, hand operated pallet trucks etc.), Lifting equipment (stacker cranes, forklifts

etc.) and conveyors. Apart from this equipment, warehouses also use lighting equipment, safety signages and other safety equipment like rails, ramps, loading/unloading bay areas etc. Standards to be followed are:

1. The standards for specifications, dimensions, testing and stability tests for handling equipment like forklifts, trailers and other transport handling equipment are prescribed by the following Bureau of Indian Standards:

IS 10517	IS 13971-2	IS 15640
IS 10312	IS 14770	IS 4357
IS 11683	IS 15487	IS 6876
IS 11757	IS 15488	IS 7309
IS 12726	IS 15611-1	IS 7525
IS 13302	IS 15611-2	IS 7570
IS 13971-1	IS 15634	IS 7617
IS 8790-2		

2. IS 11592: Selection and design of belt conveyors, IS 14188: Conveyor systems - Maintenance facilities - Design parameters are some standards specified by the Bureau of Indian Standards for conveyor systems used in large warehouses.
3. Illumination standards specified under IS 3646 (Part 1) Code of Practice for Interior Illumination and standards specified under international agencies like Occupational Safety and Health Administration (OSHA), are also in practice in most modern warehouses.



## D. Standards for Warehouse Management Systems

Due to globalisation, dynamic market and consumer behaviour, the warehouse management systems (WMS) should be integrated with the external systems for accurate and timely data communication and effective business collaboration. Managing these systems integration becomes complex and tedious when the business runs on different industry verticals and on different platforms. Hence, it becomes very important and necessary for the logistics service providers to

standardize the systems with integrated solutions when it comes to WMS implementation. Different aspects of WMS are: Training & deployment, Project management, Business requirements, Configuration, Integration and Testing.

It is recommended to follow standard guidelines to ensure adequate implementation of warehouse management systems and labour management systems.



### Existing Standards

There are no existing standards.

### Proposed Standards

#### 1. Warehouse Management Systems:

The warehouse management systems should cover all of the following:

- Delivery of services to the customers
- Registration of depositors
- Process of receipt of goods
- Sampling, inspection & grading
- Inventory management and its visibility to clients
- Storage and delivery of goods
- Inspection & verification of stocks
- Insurance and insurance policy management

Advantages of effective Warehouse Management Systems are:

- Increase in reduction of errors.
- Increase in optimum accuracy.
- Effective implementation of cost control measures.
- Effective utilisation of resources such land, capital, and labour.
- Reduction in lead time.
- Increase in data and information accuracy.
- Optimum inventory management.
- Easy identification and tracking etc.

#### 2. Regulatory Compliance:

For ensure compliance of the warehouse facility with the regulatory authorities, the following should be ensured:

- Accreditation of warehouse with an accreditation agency
- Warehouse registration
- Control of documents and records
- Correction action processes
- Internal audit, performance review
- Disputes settlement

#### 3. Labour Management Systems:

For effective labour management, the following are suggested:

- Maintenance of records of manpower deployed in the warehouse.
- Ensure compliance with applicable labour regulations.
- Create awareness amongst workers about their roles and responsibilities to protect the integrity of the products.
- Undertake training and sustained skill development programmes for the workers to enhance knowledge and skills with respect to good warehousing practices.
- Ensure periodic assessment of workers performance, including assessing effectiveness of the training and skills development undertaken.

- Establish worker safety management systems in the premises and provide necessary training as well as resources to the workers to develop and ensure safety culture.

#### 4. Digitalisation/Digital Management Systems:

Implementation of digital management systems for facilities creates scope for ensuring robust processes and methods to ensure data collection and verification at any stage. This sort of full-chain standardisation enables seamless integration in a way that can enhance transparency in operations, centralize communication and increase collaboration potential. All in all, it leads to enhanced visibility of the full supply chain. This means that the flow of material movement can be tracked end-to-end.

The application of IT Logistics Systems helps in efficient warehouse management systems and the supply chain management. Due to globalisation, dynamic market and consumer behaviour, WMS has been integrated with the external systems for accurate and timely data communication and effective business collaboration.

#### 5. The Future of Warehouse Management Systems:

- Digital Twins in Warehousing  
*A digital twin lets companies design, simulate, and test new warehouse operations and product movements virtually, before starting up new sites or making changes within existing sites.*
- Technology  
*As technology drives innovation, the warehouse of today will transform into an increasingly digital environment in future. WMS enables deliveries of consistent with high service at a low cost. Change will be driven with real-time transaction processing, optimized storage, and selection strategies, directed task management, and integrated labour standards.*
- Real time visibility for real time decision making  
*Operational and strategic teams need to be able to make accurate decisions about*

*ongoing situations. Real-time visibility provides with actionable information that can help swiftly adapt plans, improve processes, minimize threats and maximize opportunities. These insights involve data integrated with material flow in real time. Real-time decision is also facilitated as access to accurate and comprehensive data can help plan for transit delays – dwell times and journey times, monitor weather and material conditions during movement, plan for re-routing based on road and traffic conditions, rework supply during fluctuating demand, and resultantly, mitigate risks.*

- i. For manufacturers, real-time visibility can give manufacturing companies excellent insights about production volumes, manufacturing inefficiencies, and raw material sourcing or procurement.*
- ii. For suppliers, key information and real-time updates about order backlogs can help them strategize or tweak their inventory management processes.*
- iii. For logistics vendors, visibility means real-time information about cargo batches, consignments, and delivery status. This can let them manage day-to-day operations and track the movement of goods more efficiently.*
- iv. For the end consumer, it keeps them in the loop about the entire cycle, helping them stay updated about the dispatch and delivery status.*

- Industry 4.0  
*With the advent of Industry 4.0, technology has aided visibility and real-time decisions. From RFID tags, IoT sensors and cloud-based management systems, the real-time supply chain allows has enabled greater agility and flexibility via machine learning and predictive data analysis. The advantages conferred by supply chain visibility may be individually small, but they can be applied to every movement, operation and transaction in a supply chain, thereby saving time and creating efficiencies that add up to significant savings.*

Example of Technical Specification for a Warehousing Park		
A	Building Civil Works	Specification
1.	Building Clear Height	12 m at eaves
2.	External Bay Dimension	8.2m to 8.8m
3.	Internal Bay Dimension	17 m x 22 to 25 m
4.	Wall Panel/ Perimeter Wall	Concrete Waffle Crete Wall upto 3.6m height
5.	Building Floor / Loading Dock Height	1.2m (above truck court elevation at the dock wall)
6.	Floor Type	FM 2 Floor
7.	Floor Load	5 T /m2 UDL and 7T Point Load
8.	Densification on Floor	Provided
9.	Glazing	Glass Façade without windows
10.	Dock Pits	Only pit provision
11.	Truck Apron Area	16.5mtr wide with Concrete finish
12.	Toilet	Fully functional Toilet as per NBC
13.	DG	Only Foundation
<b>PEB Works</b>		
1.	Structure	Pre-engineered building,
2.	Mezzanine Structure	2.5% of total Plinth Area, Dead load of floor - 4.0 KN/ Sqm, Live load - 3.5 KN/Sqm
3.	Dead Load	0.15 KN/Sqm as per IS 875 (Part 1):1987
4.	Collateral Load	0.3 KN/Sqm
5.	Live Load	0.57 KN / Sqm as per IS 875 (Part 2):1987
6.	Wind Speed	As per code requirement
7.	Design Codes	IS 456:2000 for Plain and Reinforced concrete AISC 2010 & AISI 2007 for Design load IS 1893 Part 1 for Earthquake resistance AISC MBMA for load combination IS 13920-2016: Ductile design and detailing of RCC subjected to seismic forces
8.	Steel spec for primary members	AISC - 2010 ASD 345 MPa
9.	Steel spec for secondary members	AISI - 2007
10.	Wind load application	Wind load application as per MBMA 2012
11.	Seismic code	Seismic IS 1893 - 2016 Part 1
12.	Roof	Standing seam roof with bare galvalume sheet 1:20 slope
13.	Louvers	Louvers with bird mesh
14.	Building Ventilation	3 - 6 air changes/hour
15.	Canopy	4.5m from dock wall and 5.2m height from FGL
16.	Sky Light	3-5% of roof area
17.	Insulation	Glass wool insulation 16 Kg / cum density with 50mm thickness on roof and wall

<b>Dock Equipment</b>		
1.	Dock Doors Numbers & Shutter Type	1 in 10,000 to 12,500 sq.ft. electrically operated MS rolling shutter with a manual override option
2.	Dock Door Width x Height	2.4 m x 3.0 m
3.	Drive-in door number & Shutter Type	Electrically operated MS rolling shutter
4.	Drive in Width x Height	1 No. of 4 m x 5 m, electrically operated MS rolling shutter
5.	Fire Escape Doors with Panic Bar and Alarm	Available as per local code without fire rating
6.	Dock Guards/Bumpers	02 nos. per dock
7.	Dock Levelers	Provided as per client requirement under TI
<b>Fire Fighting Works</b>		
1.	Sprinklers	K115 type roof sprinkler
2.	Fire Alarm and Detection System	Provided as per local norms
3.	Internal Hydrant Systems	Available. Designed as per NBC and local norms
4.	Hose Reel & Fire Extinguisher	Available as per local code
<b>Electrical Works</b>		
1.	Lighting Arrestor	Equipotential Bonding of PEB/ building structure & solid grounding of the same
2.	Internal Lighting	Provided
<b>B</b>	<b>Common Infrastructure Civil Works</b>	<b>Specification</b>
1.	Boundary Wall	1.8m precast / UCR wall + 0.6m concertina
2.	Internal Road	Bitumen Finish
3.	Parking	Common parking area shall be with paver finish.
4.	Storm Water Drainage	Combination of hume pipe and open trench
5.	Fresh Water supply	Provision of 15 Lit per person per day
6.	Flushing water supply (treated STP water)	Provision of 30 Lit per person per day
7.	Water Tank	Modular water tank
8.	STP	Based on 45 lit per day/person for population as per 1:1000
9.	Total Population	Total population accordance with standard specification ratio 1: 1000 sq. ft. building space per day including all shifts
10.	Utility Space	Well graded & levelled open space
11.	Security Cabins	Provided
12.	Entry and Exit Gates	At park Level Only
13.	Drivers Rest Room	Common at park level
14.	Admin / Facility Office	Provided, In container type
15.	Rainwater Harvesting	As per statutory requirement

	<b>Electrical Works</b>	
1.	Power	Power connection up to building as per standard ratio of 1.25 kVA per 1,000 sq.ft. building space – 90 kVA maximum demand
2.	Electrical Works	Power at building level. Complex lighting 15 Lux for road area and 5 Lux for park perimeter
3.	CCTV Surveillance	Provided
	<b>Fire Fighting Works</b>	
1.	External Fire hydrant line	Available. Designed as per NBC and local norms
2.	Pump Room	Provided, as per local norms and IS Code
	<b>Other Works</b>	
1.	Landscaping	As per statutory requirement
2.	Signages	Provided



CHAPTER 02

# Palletisation Standards



Palletisation plays an important role in achieving efficiencies not only in warehousing but also in the whole cycle of logistics. Standardisation of pallet sizes will allow standardisation of palletizers, racking, material handling equipment, trucks and warehouse design. This will result in economy of space and facilitate automation, thereby eliminating manual transfer of goods and improves the overall productivity and work efficiency, as well as reduces losses and the wastage of pallets. Hence, palletisation standards are proposed.

A pallet is a support or platform for boards to stack the load. They are rigid frames on which the goods

are placed, distributed in a homogeneous way at height and on the pallet surface. The pallets, and consequently the load, will be transported from one place to another place.

Pallets are so common yet they're practically invisible without them, global commerce would not run as well as a car without tires. Pallets are the primary interface of any unit load. They protect the product, absorb the stresses, hold the weight, encounter fork truck impacts, and safeguard goods traveling through the supply chain. Pallets have a tremendous amount of influence on the outcome of a logistics operation.

### A. Pallet Standards

Rather than choosing a pallet based solely on the lowest price, industries and logistics service providers should select a pallet that meets the need for high stiffness, proper strength and size, durability, cleanliness and low weight. In the past, a lot of efforts have been made in the field of standardisation of pallets, but a lot still remains to be done.

Standardisation of pallets eliminates the manual transfer of goods to another pallet and removes

the need for sorting pallets thereby improving productivity and work efficiency. By limiting manual handling, product losses and the wastage are minimized. Further, standardisation of pallet sizes will allow standardisation of packaging, palletizers, racking, material handling equipment, trucks and warehouse design. This will result in economy of space, faster availability, faster delivery and facilitate automation. The current standards governing palletisation are specified by the BIS in India.



### B. Pallet Sizes Impact on Plant and Warehouse Operations

In the construction and design of any warehouse, accommodating standardized pallet dimensions is a very important factor. This allows for optimisation of workflow, to allow for efficient movement of inventory in and out of the plant or warehouses. Designing a warehouse to accommodate the correct pallet size for industry represents huge financial savings. Warehouse space is valuable and procuring the most suitable racking systems to accommodate

inventory is a good financial investment. It is especially important to know the pallet sizes will be working with in instances where goods shipped from overseas. Incorporating the standard pallet dimensions for industry and warehouse design will ensure efficient use of resources, time and prevent blockages of inventory flow. Details of the existing standards and the suggested standards for palletisation are given below.

## Existing Standards

The current standards governing palletisation are specified by BIS in India. The below mentioned standards are mandatory for warehouse facilities using pallets for storage:

1. Palletisation standards specified under TED 24 of Transport Engineering Department under the Bureau of Indian Standards (BIS).
2. Palletisation Standards such as IS 509 (dimensions of hand pallet trucks), IS 13609 (Guidelines for quality of timber in pallets), IS 7631 (Methods of stability testing for pallet stackers and high lift platform trucks) etc.
3. Crates Standards such as IS 8726 (Standards of wire bound wooden crates), IS 15532 (Standards for plastic crates for fruits and vegetables), IS10324 (Standards for Wooden crates for bottled drinks) etc.
4. Export Standards for Pallets such as IS 7073 (Glossaries of terms related to air cargo pallets & containers), IS 13823 (Guidelines for palletisation – general cargo) etc.
5. IS 16058: Dunnage pallets made from recycled plastic wastes for warehousing application – Specification
6. IS 17427: Wooden (Timber) Pallets for Packaging, Storage and Transportation - Specification

Some of ISO Standards formulated on pallets are as follows:

- ISO 445: Pallets for materials handling – Vocabulary
- ISO 6780: Flat pallets for intercontinental materials handling -- Principal dimensions and tolerances

The Transport Engineering Department of Bureau of Indian Standards, the national standards body of India is also actively involved in formulation of Indian Standards on Pallets.

1. IS 3971: Pallets for materials handling - Vocabulary (second revision)
2. IS 4300: Box pallets for through transit of goods - specification (first revision)
3. IS 5325: Box pallets for through transit of goods - Methods of test (first revision)
4. IS 6219: Methods of test for general purpose flat pallets for through transit of goods (second revision)
5. IS 6865: Specification for pallets for use in ISO series1 freight containers

6. IS 7276: Non-expendable general purpose, flat pallets for through transit of goods - Specification (second revision)
7. IS 7804: Guide for palletisation of tea chests (first revision)
8. IS 8005: Classification of unit loads
9. IS 8006: Recommendations for handling of timber pallets (first revision)
10. IS 9208: Guide for palletisation of mica for export
11. IS 9340: Expendable pallets - Specification (first revision)
12. IS 11076: Guide for palletisation of cashew kernels for export
13. IS 11982: Design rating and safe working load for general-purpose flat pallet for through transit of goods
14. IS 11983: Guidelines for marking of general purpose flat pallets for through transit of goods
15. IS 13546: General purpose flat pallets for through transit of goods - Performance requirements.
16. IS 13714: Dunnage pallets - Ware housing
17. IS 13664: Polly pallets for bag storage godowns
18. IS 11496: General and performance test requirements of pallet truck and stillage truck.
19. IS 7631/ ISO 22915 - Industrial trucks - Pallet stackers, double stackers and order - Picking trucks with operator position elevating up to and including 1200 mm lift height - Verification of stability (Second Revision)
20. IS 6219: Methods of Test for General Purpose Flat Pallets for Through Transit of Goods
21. IS 5325: Box Pallets for Through Transit of Goods - Methods of Test
22. IS 8726: Wire bound wooden crates
23. IS 7698: Returnable wooden crates for vegetables
24. IS 5247: Part 2 - Converted timber (coniferous): Part 2 - Packing cases and crates
25. IS 3071: Wooden crates
26. IS 15532: Plastics Crates for Fruits and Vegetables
27. IS 13289: Polypropylene/impact Copolymer (PPCP) Crates for Milk Sachets
28. IS 11584: High Density Polyethylene (HDPE) Crates for Milk Sachets
29. IS 3971/ ISO 445: Pallets for materials handling - Vocabulary
30. IS 13823: Guidelines for palletisation - General cargo

**Proposed Additional Standards**

In addition to the mandatory standards specified for palletisation, it is recommended to include the following in the standards:

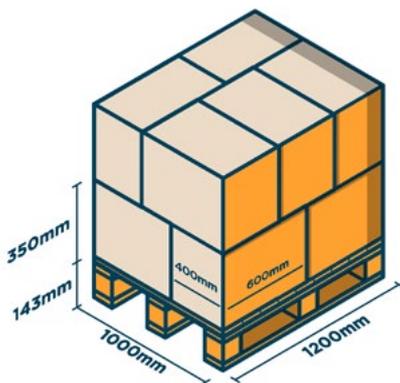
1. More Pallet Dimensions
  2. Tolerance and Load Capacity
  3. Pallet Material Specifications
  4. Packaging
  5. Recommendation for Pallet Stacking
- Details are given below.



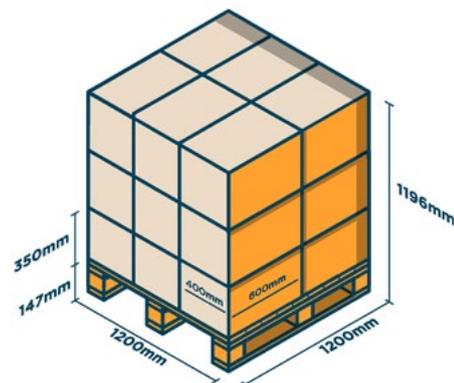
**1. Recommended Pallet Dimensions**

Pallet Dimensions	Applicability in Industrial Segments
1200 mm x 1200 mm	Chemicals/ Petrochemicals
1200 mm x 1000 mm	Food & Beverages, Fast Moving Consumer Goods, Fast Moving Electrical Goods, Retail, Pharma (ambient temperature), Consumer Durables, Textiles, Electronics, Hi-Tech, Industrial and Engineering, Automotive / Auto Components
1200 mm x 800 mm	Automotive/Auto Components
1140 mm x 1140 mm	International shipping purposes in ISO containers as prescribed by the Chemical Association

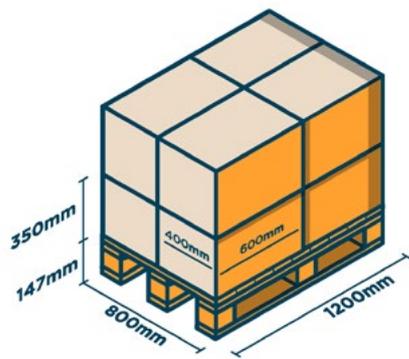
- Square pallets for specific usage (e.g. carriage of drums) e.g. 1200mm x 1200mm
- Full perimeter-block pallet with 4-way entry for structural stability and ease of handling.



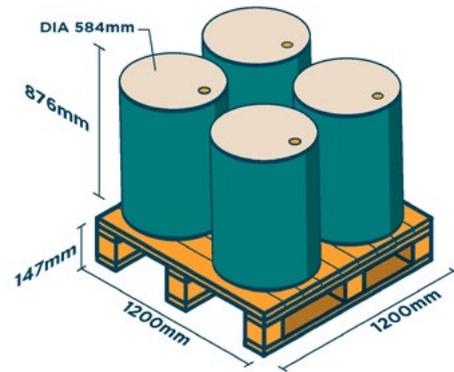
**1200 x 1000 MM**  
2 layers - 10 boxes, 3 layers - 15 boxes



**1200 x 1200 MM**  
2 layers - 12 boxes, 3 layers - 18 boxes



**1200 x 800 MM**  
2 layers - 8 boxes, 3 layers - 12 boxes



**1200 x 1200 MM**

## 2. Tolerance and Load Capacity

- Dimensional tolerance ( $\leq 1\%$  by length and width) to ensure compatibility with Automation and the Automated Storage and Retrieval Systems where needed.
- Automatic Stock Retrieval System and Pallet Conveyor Lines; BIS standards for conveyors in vogue.
- Minimum load capacity of 1 Ton for dynamic goods movement and 4 Ton for storage.

## 3. Pallet Material Specifications

- Made of certified and/or legally compliant timber source (e.g. Indian Forestry Act, 1927 for local lumber, ISPM 15 compliant for imported lumber).
- Pallets / Timber should not be treated with toxic chemicals especially for Food and

Beverage sector, as per Indian Food and Safety Act 2008. Reduce, reuse and recycle approach should be adopted for packaging materials be it wood or composite wood, or plastic or metal or paper.

- Apart from these above-mentioned recommendations, various international standards specified by International Organisation for Standards (ISO), American Society for testing and Materials (ASTM) and National Wooden Pallet and Container Association (NWPCA) are specified.

## 4. Packaging

- The suggested sizes for small load carriers are:

Nominal (mm)	Actual (mm)	Internal (mm)
300x200	297x198	243x162
400x300	396x297	346x265
600x400	594x396	544x364
800x600	800x600	752x552

- Intermediate Bulk Container (IBC) would have an average base dimension of 45 inch x 45 inch (1,143 mm x 1,143 mm).

- Drums with outer dimension of a 200 litre capacity would have the following dimension:

Diameter		Height
Top / Bottom Rim	Chinese (ridges around drum)	243x162
584 mm	597 mm	876 mm

**5. Pallet Stacking**

- Rectangular stacks of dimensions of 1200 mm X 1000 mm can take 10 boxes in 2 layers or 15 boxes in 3 layers.
- Rectangular stacks of dimensions of 1200 mm X 1200 mm can take 12 boxes in 2 layers and 18 boxes in 3 layers.
- Rectangular stacks of dimensions of 1200 mm X 800 mm can take 8 boxes in 2 layers and 12 boxes in 3 layers.
- Rectangular stacks of dimensions of 1200 mm X 1200 mm can take 4 drums of standard size.
- Apart from the above-mentioned recommendations, various international standards specified by International Organisation for Standards (ISO), American Society for testing and Materials (ASTM) and National Wooden Pallet and Container Association (NWPCA) are suggested to be referred to.

**6. Manufacturing material of pallets**

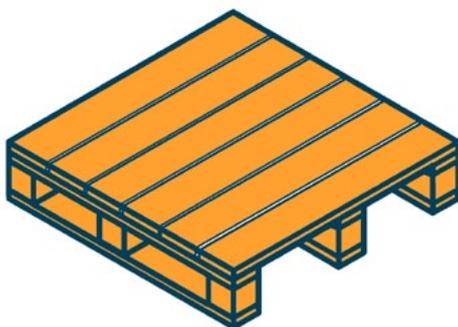
- **Wooden:** The majority of pallets are made of timber because it's strong and can be repaired. Wooden pallets having a market share of around 90% or 95%. Fumigation of wooden packing material should be carried out with methyl bromide at the dosage of 48 grams per meter cube. In this process the wooden packing crates are placed

inside the fumigation covers which is kept on a smooth flooring and it is covered with gas tight sheets to make it an airtight enclosure.

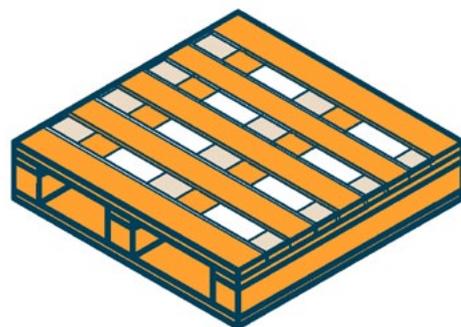
- **Plastic:** This durable option, often used for food and pharmaceutical products, is most cost effective in closed-loop shipping situations. Easier to clean and disinfect than wooden pallets. They are lighter because they weigh less and are even more durable than wooden ones because any knocks cause less impact to the pallet. They are also 100% recyclable. Plastic pallets having a market share of around 2%.
- **Steel reinforced pallets** are also now days commonly used specially in automated warehouse.

**7. Pallets according to the number of entry points:**

- **Entry points** refer to the number of sides where the forklift introduces the fork to be able to move the load.
- **4 entry points:** the forklift or mechanical equipment to transport the pallet can access the pallet on any side along either the length or width.
- **2 entry points:** the pallet can only be accessed on 2 sides opposite to each other. These pallets have less mobility than those with the 4 entry points because they are less accessible.



**4 ENTRADAS - 4 WAY ENTRY**



**2 ENTRADAS - 2 WAY ENTRY**

## 8. Pallets according to their dimensions:

- Industrial pallet: The dimensions of the Industrial pallet are 1200x1000 mm also called as ISO pallet widely used in Asia and America.
- Euro pallet: It is a support whose measurements are 1200x800 mm. It is currently the most widespread in Europe. This type of pallet is regulated by EPAL (European Pallet Association) and as its website indicates, “around 500 million are currently in circulation”.
- In addition, it is one of the types of pallets standardized by ISO (International Organisation for Standardisation). European industry and logistics therefore use the euro pallet as the main support to facilitate the flow of goods and their grouping in the transport and storage process.
- The measurements of the euro pallet are determined by the width of the truck wagons, containers and trailers, which are usually 2400 mm, which allows them to be placed in a way that takes full advantage of the load space.
- Flat board pallet: Flat board or Square pallets for specific usage (e.g., carriage of drums) e.g., 1200mm x 1200mm.

## 9. Others

- Access areas for entry/exit to the warehouses to be well maintained with paved roads and easy manoeuvrability to load /unload shipments.
- For international cargo, unitised handling is suggested with Euro pallets with standard dimensions to ease handling at airport/ seaport.
- Put in place standard operating procedures for truck/trailer drivers with log sheets for maximum permitted driving per day and strict adherence to traffic rules. The same needs to be monitored for adherence and driver's performance assessment. Driver's experience and license validity can be included in the e-way bill to enable authorities and customers to verify the same.
- Manual loading/unloading to be avoided as high risks are associated to the loaders. The loaders should be trained to handle pallets with forklifts and pallet jacks.





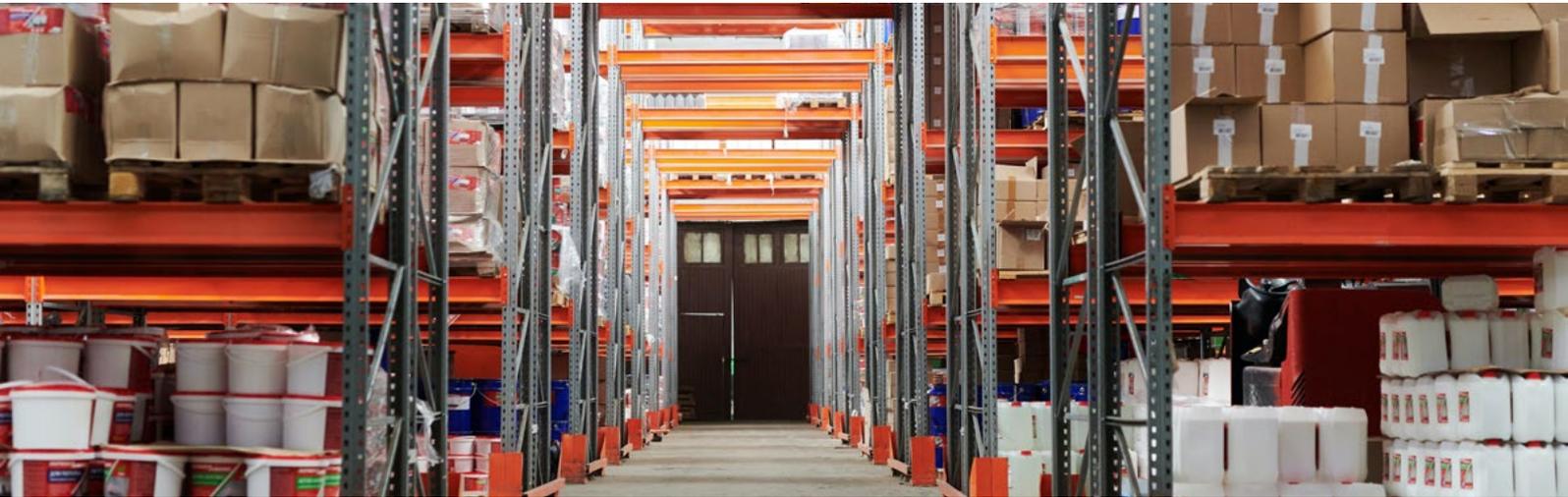
CHAPTER 03

# Racking Standards



A good warehouse should provide safe and efficient storage for various products. A warehouse facility providing maximum space utilisation for storage creates higher profit margins for the operator. Currently, there are no Indian Standards for racking.

Application of standards for racking is essential to ensure efficient storage within warehouse premises. The following recommendations are made to ensure development of standards for racking operations across warehouses.



### Existing Standards

There are no existing standards.

### Proposed Standards

#### 1. Racking Dimensions

Based on palletized load weight and number of pallets, a load beam length should be designed, covering internal and centre to centre dimensions, metal gauge thickness, and heights. If the rack beam length is not matching with pallet width, there could be loss of racking space. Besides the size aspect, the other important aspects to be considered in racking are load factors, material strength factors, material to be used for racks and the green/environment considerations.

- Suggested standard sizes:
  - i. 1200 mm (W) x 1200 mm (D) x 1200 mm (H)
  - ii. 800 mm (W) x 1200 mm (D) x 1200 mm (H)
  - iii. 1140 mm (W) x 1140 mm (D) x 1200 mm (H)
  - iv. 1000 mm (W) x 1200 mm (D) x 1200 mm (H)
  - v. To match the pallet size of 1200 X 1200 mm, rack beam length of 2650 to 2800 mm would be ideal. (2700 mm is commonly used).

- vi. For 3 pallets stacking on 800mm width, 2700mm width is to be used.
- vii. For 1000mm pallet, design shall be modified / adopted as per the pallet dimension.
- viii. Vertical clearance space of 75mm - 175mm depending upon the storage rack class.
- ix. Horizontal clearance space of 75mm - 100mm depending upon the storage rack class.

#### 2. Load Factors

At the limit state of strength or stability, the relevant load factors for Dead Load, Pallet Load, Imposed Load and Accidental loads are to be adhered as per EN 15512 (Steel Static Storage Systems- Adjustable pallet racking systems- Principles for Structural Design).

#### 3. Material Strength Factors

Beam end connections at the ultimate limit state: ultimate limit ( $M = 1.25$ ), All other cases: ( $M = 1.00$ ), Beam deflection shall be limited to  $\text{Span} / 200$  (span in mm), Deck Panels are to be decided based on a collapse criteria as well as deflection, with a limitation of deflection to  $\text{span}/200$ .

## **Farukh Nagar Warehouse design study with different base size of pallet. Height is constant for all cases.**

### **Scenario 1: Rack beam length is constant for all cases 2700mm**

1. 1200W x 1200D x 1200H (all Dimensions are in mm) pallet stored 29280 Nos. means 50,595.84 cu.m.
2. 800W x 1200D x 1200H (all Dimensions are in mm) pallet can be store 43920 Nos. means 50,595.84 cu.m.
3. 1140W x 1140D x 1200H (all Dimensions are in mm) pallet can be store 29280 Nos. Nos. means 45,662.75 cu.m.
4. 1000W x 1200D x 1200H (all Dimensions are in mm) pallet can be store 29280 Nos. means 42,163.2 cu.m.

### **Scenario 2: Rack beam length is constant for cases 1, 2 and 3 is 2700mm.**

#### **In Case 4 beam length considered 2300mm & 3300mm**

1. 1200W x 1200D x 1200H (all Dimensions are in mm) pallet stored 29280 Nos. means 50,595.84 cu.m.
2. 800W x 1200D x 1200H (all Dimensions are in mm) pallet can be store 43920 Nos. means 50,595.84 cu.m.
3. 1140W x 1140D x 1200H (all Dimensions are in mm) pallet can be store 29280 Nos. Nos. means 45,662.75 cu.m.
4. 1000W x 1200D x 1200H (all Dimensions are in mm) pallet can be store 33456 Nos. means 48,176.64 cu.m.

### **Scenario 3: Rack beam length is constant for all cases and beam length considered 2300mm and 3300mm**

1. 1200W x 1200D x 1200H (all Dimensions are in mm) pallet stored 16952 Nos. means 29,293.06 cu.m.
2. 800W x 1200D x 1200H (all Dimensions are in mm) pallet can be store 33456 Nos. means 38541.31 cu.m.
3. 1140W x 1140D x 1200H (all Dimensions are in mm) pallet can be store 16952 Nos. Nos. means 26436.98 cu.m.
4. 1000W x 1200D x 1200H (all Dimensions are in mm) pallet can be store 33456 Nos. means 48,176.64 cu.m.



CHAPTER 04

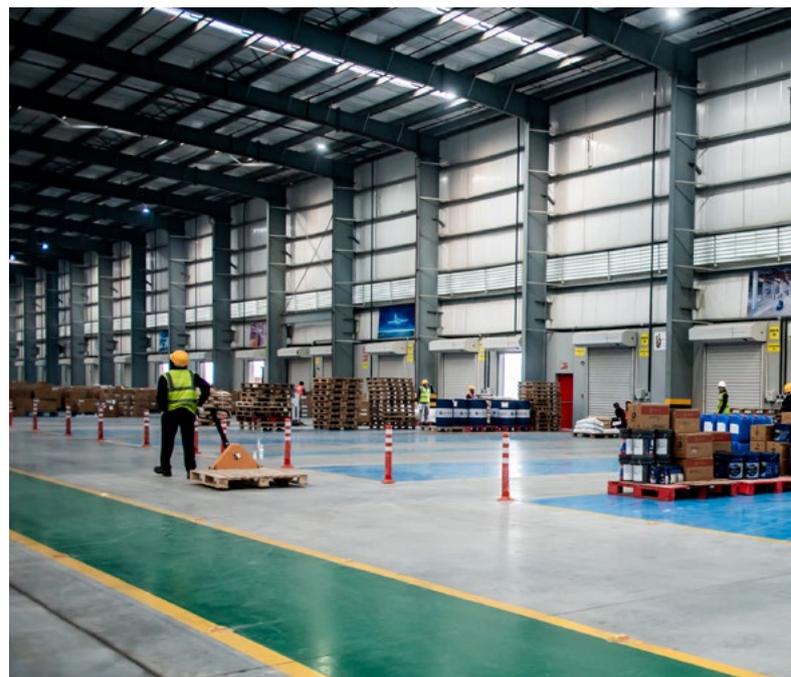
# Standards for Material Handling Equipment



Warehouses use various types of material handling equipment for ease of operations. The most common equipment used are forklift trucks and cranes, conveyors and other dock levelling equipment. The Material Handling Equipment (MHE) plays a very important role for performing end to end operation of customer starting from receipt of raw material and dispatching of Finished Goods as Final Product.

Whether it's vendor, supplier or end customer all of them needs to handle their material in and out of warehouse and factory to increase the efficiency from supply chain management point of view.

Details of the existing standards and the proposed standards for material handling equipment are given below.



**Existing Standards**

The standards regulating this equipment are prescribed by BIS in India which are mandatory and are to be adhered for use of such equipment. The standards regulating material handling equipment are:

BIS standards for classification and use of forklift equipment such as IS 10517 (Acceptance criteria for Forklift Trucks), IS 11757 (General requirements and acceptance criteria for forklift trucks with capacity from 10000 kg to 50000 kg), IS 4660 (Powered Industrial Trucks) etc.

Document Number	Standard / Guidelines
IS 10517	Acceptance Criteria for Forklift Trucks
IS 11757	General requirements and acceptance criteria for forklift trucks with capacity from 10000 kg to 50000 kg
IS 4660	Powered Industrial Trucks - Terminology
IS 8005	Classification of unit loads
IS 6765	Powered industrial trucks parameters for designation of rated capacity and capacity
ISO 13564-1	Powered industrial trucks - test methods for verification of visibility
IS 6305-1	Safety code for powered industrial trucks - Part 1 - Application, Operation and Maintenance
IS 6305 2	Safety Code for powered industrial trucks - Part 2
IS 7862	Glossary of terms relating to safety aspects concerning operating areas of industrial trucks

IS 7496	Direction of Travel-controls for Industrial Tractors and Powered Industrial Trucks
SAEJ 898	Control locations for off-road work machines
IS 7553	Control symbols for powered industrial trucks
IS/ISO 6405-1, 2	Common and specific symbols for operator controls and other displays
IS/ISO 9244	Compliance of machine safety labels
IS 15488	Powered Industrial Trucks - Safety Signs and Hazard Pictorials - General Principles
IS 8790-2	General requirements of powered industrial trucks working in hazardous areas, Part 2 Electric battery powered industrial trucks
IS 6876	Fork - Lift trucks - Fork arms - Technical characteristics and testing (Second Revision)
IS 7621	High lift rider trucks - overhead guards - Specification and testing
IS 4357	Industrial trucks - Counter balanced trucks with mast - Verification of stability
IS 7309	Industrial trucks - Verification of stability reach and straddle trucks
IS 7631	Industrial trucks - Pallet stackers, double stackers and order - Picking trucks with operator position elevating up to and including 1200 mm lift height - Verification of stability
IS 9075	Stability tests for side loader trucks
IS 14770	Industrial trucks - repairs and maintenance of fork arms in service on forklift trucks
IS 7570	Glossary of terms relating to fork arms and attachments of forklift trucks
IS 7525	Fork - Lift trucks - Hook - On type fork arms and fork arm carriages - Mounting dimensions
ISO 2328	Hook on type Fork Arms and Carriage
IS 15634	Forks-arm extensions and telescopic fork-arm - Technical characteristics and strength requirements
ISO 1585	Road vehicles - Engine test code - Net power
ISO 9249	Earthmoving machinery - Engine test code - Net power
ISO 8178	Exhaust emission measurement for non-road engine applications
DIN 72551-6	Low tension cables for off-road vehicles
DIN 72551	Compliance for electrical wiring
IS 15487	Industrial Trucks - Indicator Lights for container handling and Grappler Arm operations
ISO 6055	Specification and testing standards for overhead guards
ISO 13849	Safety of machinery - safety related parts of control systems

## REFERENCE DOCUMENT FOR STANDARDISATION OF WAREHOUSING & RELATED ASSETS

ISO 20898	Electrical requirements of industrial trucks
ISO 3691-3	Additional requirement of trucks with elevated operator position and specifically designed to travel with elevated loads
IS 10311	General requirements of powered platform trucks and their acceptance criteria
IS 8049	Specification for platform trucks
IS 10312	Safety code for powered tow trucks
IS 6839-2	Glossary of terms relating to non-powered materials handling equipment, Part 2 Hand trucks and trolleys
IS 11496	General and performance test requirements of pallet truck and stillage truck
IS 10517	Acceptance criteria for forklift trucks
IS 10312	Safety code for powered tow trucks
IS 11757	General requirements and acceptance criteria for forklift trucks with capacity from 10000 kg to 50000 kg
IS 12726	Industrial trucks - Order - Picking trucks with operator position elevating above 1200 mm - Verification of stability
IS 14770	Industrial Trucks- Inspection and Repair of Fork-arms in Service on Forklift trucks
IS 15487	Industrial Trucks- Indicator Lights for container handling and Grappler Arm operations
IS 15488	Powered Industrial Trucks- Safety Signs and Hazard Pictorials - General Principles
IS 15611-1	Single side loading Forklift trucks, Part 1: Stability tests
IS 15611-2	Single side loading Forklift trucks, Part 2: Additional Stability tests for trucks handling freight containers of 6m length and above
IS 15634	Forklift Trucks- Fork arm extensions and telescopic fork arm- Technical characteristics and strength requirements
IS 15640	BI-Directional Multi directional forklift trucks- Stability tests
IS 4357	Industrial trucks - Counter balanced trucks with mast - Verification of stability
IS 6876	Fork - Lift trucks - Fork arms - Technical characteristics and testing
IS 7309	Industrial trucks - Verification of stability reach and straddle
IS 7525	Fork - Lift trucks - Hook - On type fork arms and fork arm carriages - Mounting dimensions
IS 7570	Glossary of terms relating to fork arms and attachments of forklift trucks
IS 8790-1	General requirements of powered industrial trucks working in hazardous areas: Part 1 internal combustion engine powered trucks
IS 8790-2	General requirements of powered industrial trucks working in hazardous areas, Part 2 Electric battery powered industrial trucks

## Proposed Standards

### 1. Material Handling Equipment to be used:

Worldwide, the application of material handling equipment is same and that needs to be harmonised. Right material handling equipment (MHE) for right application will help in efficient way of handling warehouses in the country. Various defined applications within warehouses are:

- **Throughput:** Electric Forklift and Pallet Truck can be used for this application depending on load and whether load has to carry from floor or ramp.
- **Transporting:** depending upon distance, Pallet Truck should be used based on the operator's comfort as Manual & Battery operated. Whether it should be walk behind or seating arrangement it should be very dependent on distance, which should be covered.
- **Storage/Stacking:** Material Handling Equipment like Stacker, Reach Truck, Forklift and Very Narrow Aisle Truck for Storage/Stacking should be decided based on No of Pallet Storage, Stacking height, Aisle width availability and frequency of operation.
- **Order Picking:** Order Picker should be used as standard Equipment for all the picking operation within warehouse whether it is low-level picker or vertical picking
- **Towing:** Towing operation within the warehouse should be done with the help of tow truck considering ground clearance within the warehouses.

The following material handling equipment (MHE) should be considered in warehouses:

Application	Operation	MHE	Basic Capacity	Class
Throughput	From the floor	Electric/ Diesel Forklift	1t to 10t	Class 1/4
	Over Ramp	Pallet Truck	1t to 3t	Class 3
Transporting	Short Distance	Hand/Walk Behind Pallet Truck	1t to 3t	Class 3
	Medium Distance	Walk Behind Pallet Truck	1t to 3t	Class 3
	Long Distance	Stand-on/Seat-on Pallet Truck	1t to 5t	Class 3
Storage/ Stacking	Lift height up to 6200mm	Electric Stacker	1t to 2t	Class 3
	Lift height up to 7500mm	Electric Forklift/Man-down VNA	1t to 5t	Class 1/2
	Lift height up to 13000mm	Reach Truck/ Man-up VNA	1 TO 2.5t	Class 2
	Lift height up to 17500mm	Man-up VNA	1t to 1.6t	Class 2
Order Picking	Picking height up to 2nd level	Low Level Order Picker	0.2t to 3.6t	Class 2
	Picking height up to 14345mm	Vertical Order Picker	0.8t to 1.2t	Class 2
	Picking height up to 16530mm	Man-up VNA	1t to 1.6t	Class 2
Towing	Towing Capacity up to 28000kg	Tow Tractor	1t to 28t	Class 6

MHE to be utilized for different racking types:

Racking Types	MHE	Basic Capacity
Conventional Heavy Duty Racking	Stacker/Reach Truck	1t to 2.5t
Double Deep Racking	Pantograph Reach Truck with mechanically fixed mast	1.6t
Very Narrow Aisle Racking	Very Narrow Aisle Truck	1t to 1.6t
Mobile Racking	Stacker/Reach Truck/Forklift	1t to 5t
Drive-in Racking	Stacker/Forklift/Reach Truck	1t to 5t
Shelving Racking (parts)	Order Picker	0.25t to 1.2t
Shuttle Racking	Reach Truck	1t to 2.5t
Cantilever Racking	Multi-Directional Reach truck	2t to 2.5t

- Apart from meeting the specified BIS standards, the complete Forklift Truck should be certified by agencies such as the Automotive Research Association of India (ARAI) in order to meet the requirements of the Central Motor Vehicle Rules (CMVR) pertaining to Construction Equipment Vehicles (CEV).
- All Internal Combustion (IC) engine powered Forklift Trucks, whether manufactured in India or imported, as fully built or semi-knocked down or completely knocked-down condition and assembled in India, must all adhere to prevalent emission norms under BS-CEV.
- All imported Forklift Trucks, whether IC engine powered or electric battery powered, must meet the existing MHE standards listed above in Existing Standards for use in India. This must apply to newly manufactured as well as to used Forklift Trucks.
- All Forklift Trucks used in India must be re-certified as “Fit-for-purpose” every year, either by a relevant government agency or by the OEMs themselves.
- ISO standards, as specified for imported forklift trucks, must be adhered to for safe and efficient material handling operations.

The key component of the material handling system in any warehouse, distribution centre, factory stores or yard storage facility is the Forklift Truck. The forklift trucks are used to carry, lift and stack unitized loads and as such they are one of the most important components of intra logistics. Forklifts carry heavy loads ranging from few hundred kg

up to 2 tonnes in a typical warehouse. In factories and in open yards, Forklift Trucks can be used to carry loads as heavy as 32 tonnes and have to lift the load they carry up to heights of 17 meters. All Forklift Trucks are driven by human operators and hence safety aspects play an important role. Also, the Forklift Trucks often handle goods like food products, water and beverages, pharmaceuticals, all of which are directly consumed by consumers, and at times are required to handle hazardous goods like inflammable chemicals, paints etc.

**Important considerations:**

- Operation: No movement of load from one place to other in lifted condition except for Very Narrow Aisle Truck.
- Recommended to use Electric Forklift for handling pallets while loading and unloading of container instead of Diesel Forklift to avoid any health problem to operator due to emission of fuel.
- When the Warehouse length is more than 25mtr, it is recommended to use either Stand-on or Seat-on Material Handling Equipment to achieve efficiency of the operation with operator’s comfort.
- In line with standardisation of Pallet Size, we can fix up the width of fork size of either 540mm or 670mm based on entry size of 1000mm & 1200mm for all the junior trucks.
- A standard aisle width can be defined for Stackers, avriable reach trucks and Very Narrow Aisle operations.
- Overhang of pallet on racking should be

restricted to 100mm for safe handling of Pallet by Material Handling Equipment.

- Minimum safety clearance required between load and Very Narrow Aisle truck is 100m on each side within the guidance system. This safety clearance should not be more than 125mm for safe traverse operation for truck used in Very Narrow Aisle.
- Assistance Equipment like camera is a must for Reach Truck for load handling at a height more than 7mtr in any warehouses.
- Travelling speed of all the Material Handling Equipment should be defined in each and every warehouse depending upon their internal safety requirement.
- Standard clear height of the warehouse after fitment of lights and duct should be defined for MHE standardisation.
- Door height for Material Handling entry and exit should be standard as per Warehouse height.
- Stabilize power supply for charging of battery at sites.
- Standard Ramp specification to be defined for movement of Forklift with load.
- Proper lighting facility within warehouse for safe operation and proper visibility.
- Class 2 warehouse trucks are not meant for ramp application due to less ground clearance and traction.
- Chequered floor is not suitable for Battery Operated pallet truck as wheel get worn off.

**Permissible Limits on Properties dZ, dX, d<sup>2</sup>Z, d<sup>2</sup>X in defined movement areas**

Floor Classification	Racking Top Beam Height	Property Z <sub>SLOPE</sub>	Property dZ	Property d <sup>2</sup> Z	Property dX	Property d <sup>2</sup> X
Calculation	-	mm per m	Z x Z <sub>SLOPE</sub>	dZ x 0.75	Fixed value 2 x Z <sub>SLOPE</sub> x 1.1	Fixed value
DM1	Over 13m	1.3	Z x 1.3	Z x 1.0	2.9	1.5
DM2	8 - 13m	2.0	Z x 2.0	Z x 1.5	4.4	2.0
DM3	Upto 8m	2.5	Z x 2.5	Z x 1.9	5.5	2.5

**Properties measured**

The following properties are defined in the figures as follows:

**Property Z:** The transverse dimension between the centres of the truck front wheels, in m.

**Property X:** The longitudinal dimension between the centre of the front and rear truck axles. This is taken to be a fixed 2m.

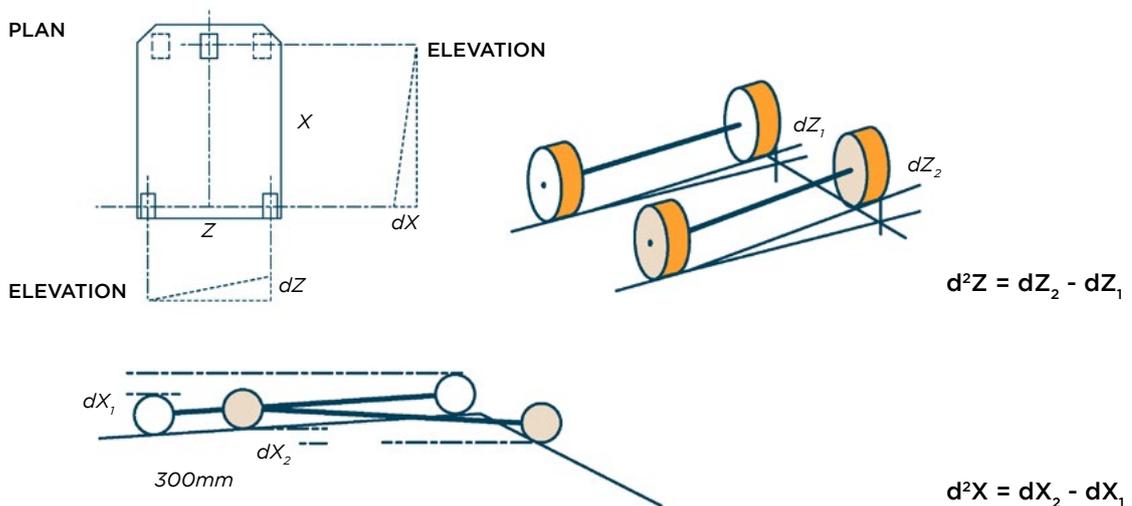
**Property Z<sub>SLOPE</sub>:** The cross-aisle slope between the centres of the truck front wheels in mm/m

**Property dZ:** The elevational difference in mm between the centres of the truck front wheels

**Property dX:** The elevational difference in mm between the centre of the front axle and the centre of the rear axle

**Property d<sup>2</sup>Z:** The change in dZ in mm over a forward movement of 300mm along the wheel tracks

**Property d<sup>2</sup>X:** The change in dX in mm over a forward movement of 300mm along the wheel tracks





CHAPTER 05

# Standards for Transportation



The current standards governing road transportation infrastructure in the country are governed under various rules prescribed by nodal agencies. These standards are mandatory, and adherence is required by all users of any transportation infrastructure. However, this section covers transport sector aspects related to the warehousing assets. The proposed standards cover the following areas:

1. Dimensions and Truck Design
2. Network Optimisation

Details of the existing and proposed standards for the transportation sector of the warehousing are as follows.

**Existing Standards**

The standards specified for the transportation infrastructure can be found at:

1. Rules and regulations prescribed under the Central Motor Vehicles Rules (CMVR).
2. Code of Practice for Construction and Approval of Truck Cabs, Truck Bodies and Trailers (MoRTH).
3. The European trailer standard dimensions are as below.

Type	Internal Dimensions	Max. Carrying Weight	Cubic Volume Capacity cu.m.	Pallet Capacity (without stacking)
Box Trailer	13.60 x 2.46 x 2.71 m	23,000 kg	90	33
Curtain Sider Trailer	13.60 x 2.50 x 2.65 m	24,500 kg	90	33
Mega Trailer	13.60 x 2.47 x 3.00 m	24,000 kg	100	33

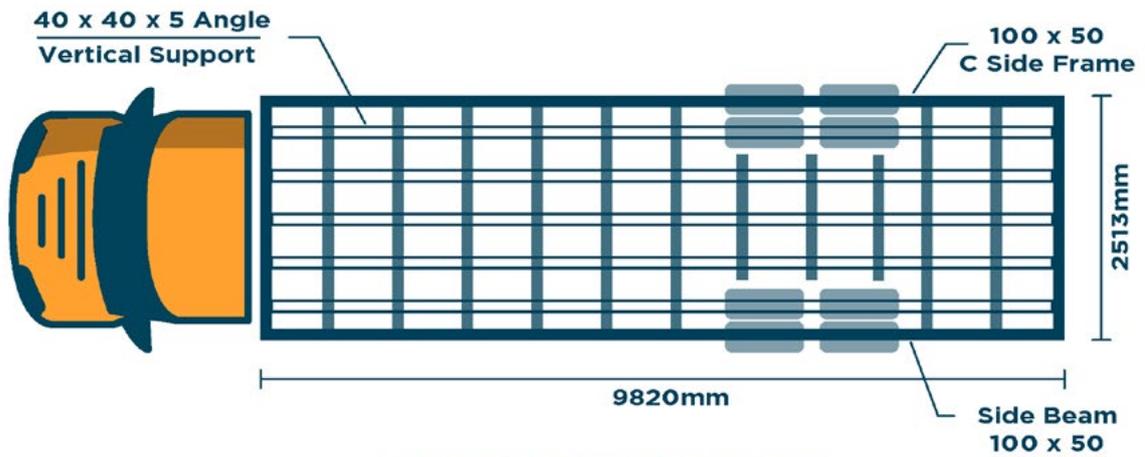
4. The European standard load plan basis Curtain Sider Trailer 13.20 x 2.50 x 2.65 m:

Pallet Size	No. of Pallets Single Stack	No. of Pallets Double Stack
1200mm x 1200mm	22	44
1200mm x 1000mm	26	52
1200mm x 800mm	33	66

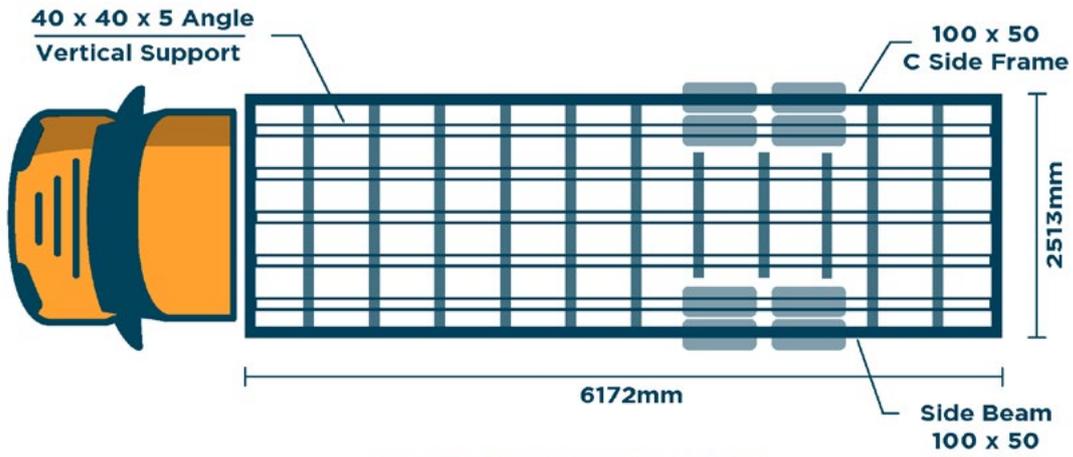
**Proposed Additional Standards**

**1. Dimensions and Truck Design**

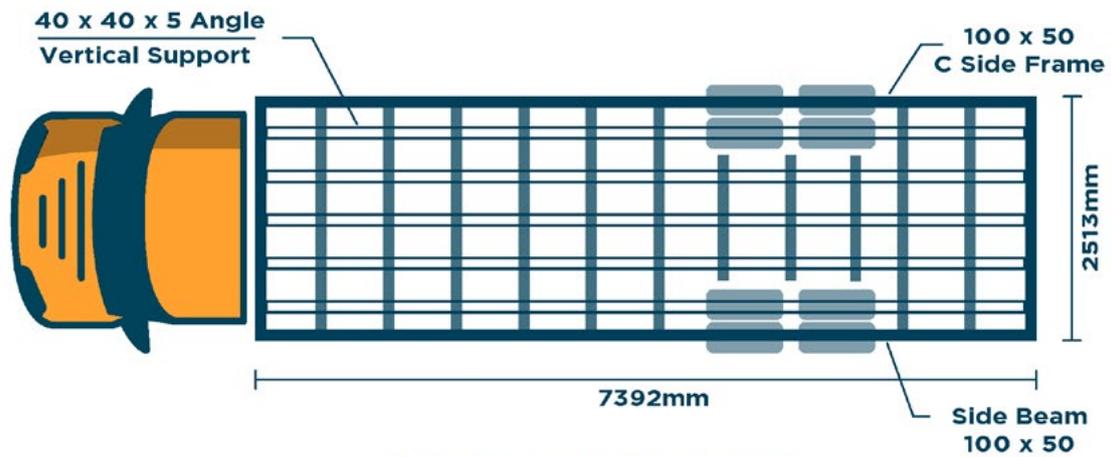
- Ideal truck body should have clear internal width should be 2450 mm for maximum efficiency considering the pallet standards of 1200 mm X 1200 mm, 1200 mm X 1000 mm and 1200 mm X 800 mm and 1140 mm x 1140 mm and taking a clearance of 50 mm on either side.
- At least one side should have a collapsible flap to facilitate loading of pallets from side using forklifts, especially in plants having no ramp/dock-levelers.
- Flooring of truck should be smooth and of adequate strength to facilitate smooth movement of Battery-Operated Pallet Terminals (BOPT) and Forklifts inside the trucks for single or two high stacking of palletized loads.



TOP VIEW WITH BASE



TOP VIEW WITH BASE

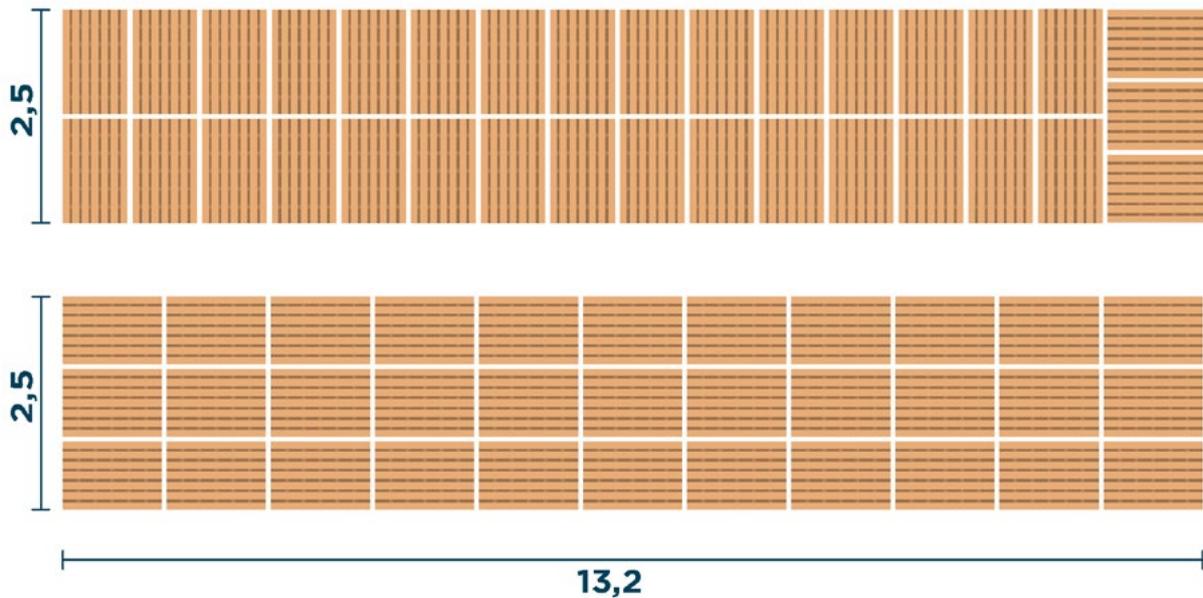


TOP VIEW WITH BASE

**Note:** Internal width of Indian trucks - minimum 2450 mm.



Side view / Simulation of Curtain Sider Trailer



**1200 x 800**  
**1 Layer - 33 pallets, 2 layers - 66 pallets**

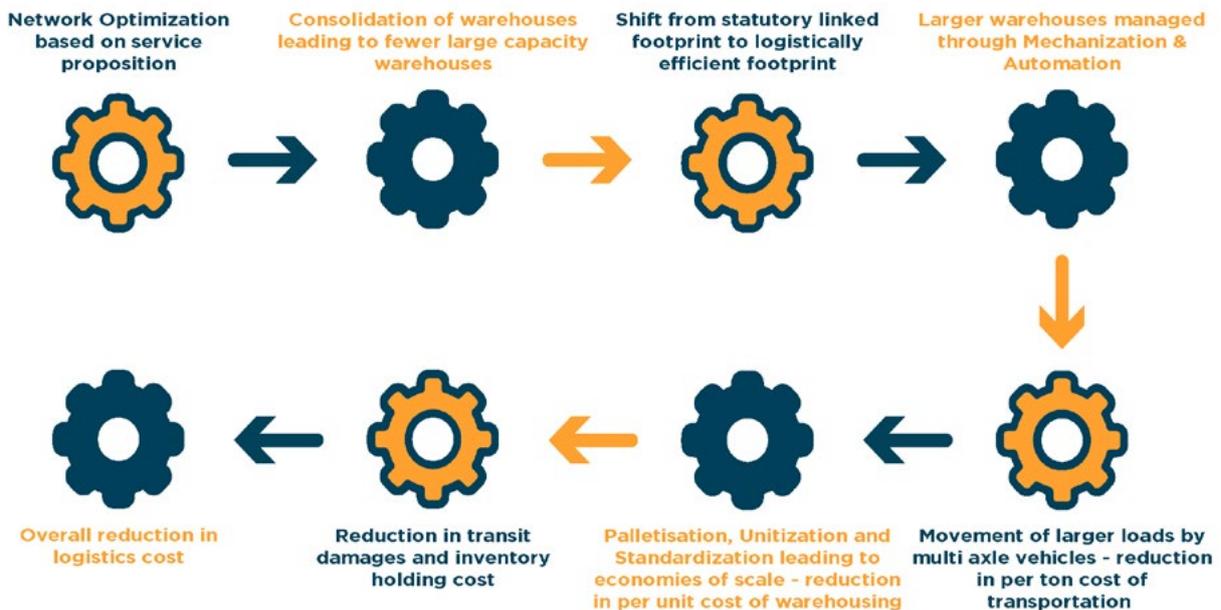
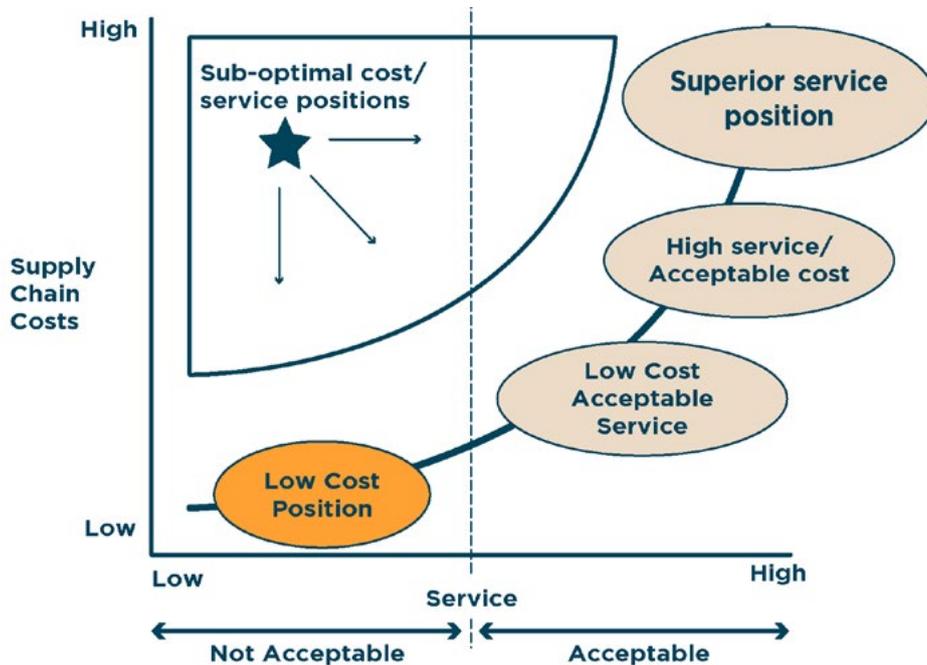
**2. Network Optimisation**

It is recommended to incorporate network optimisation practices across supply chain networks to obtain maximum cost efficiency.

- For warehouse network optimisation, standardisation of various aspects of the logistics industry must be undertaken.

- All the key elements of the logistics costs, namely Inventory Carrying Cost, Inbound Transportation Cost, Warehousing Cost and Outbound Transportation Cost, need to be evaluated based on delivery lead times.

- It is suggested to create and adopt appropriate network design models based on delivery lead time constraints, which may range from immediate deliveries that are unconstrained to up to 72 hours, and all variations plotted on a single graph to determine the optimum cost. Accordingly, an optimized network can be determined.
- Outsourcing of logistics services to professional players may be considered to help in leveraging shared cost options for the overall cost reduction.
- Collaborative logistics initiatives are suggested in which competitors can work together to service a common customer, or a customer can bundle competing suppliers. For example, trucking companies can bundle freight into one truck load to maximize utilisation of the truck capacity as well as to have committed return loads. This will lead to better utilisation of assets and reducing turnaround times, thereby enabling efficient and cost-effective logistics environment.





CHAPTER 06

# Product Specific Standards



Products stored in warehouses may be classified as agricultural and non-agricultural items. These products are required to be stored in warehouses capable of providing infrastructure to ensure consistent quality. In this regard, it is essential to identify and implement standards for grading, sampling and testing and weighing of products. The guidelines for agricultural products and commodities are specified by the Warehouse Development and Regulatory Authority (WDRA),

BIS and other product specific agencies whereas those for non-agricultural commodities are specified by various nodal regulatory agencies like the BIS and other international agencies. The food specific standards cover the following areas:

- A. Assaying/Grading Standards
- B. Sampling and Testing Standards
- C. Weighment Standards

Details are given below.

### A. Assaying/Grading Standards

The standards specified for grading of commodities stored within warehouses registered with the WDRA are aimed at achieving optimum quality standards for the products. The standards of grading for agricultural products are deemed mandatory and need to be implemented by all warehouses registered with the WDRA as authorized storage units for products and commodities.

#### Existing Standards

The standards for assaying are as follows:

1. AGMARK standards for most agricultural commodities with grades prescribed based on their intrinsic quality, cleanliness, extraneous matter, active components etc.
2. Commodity specific standards for specific items issued by concerned regulatory authority (Tea Board, Rubber Board etc.)

3. The detailed list of standards corresponding to specific products has been listed under the detailed report (Attached herewith)

#### Proposed Additional Standards

The assaying standards for non-agricultural commodities are specified by various domestic and international agencies. The standards recommended for non-agricultural commodities are:

1. Assaying standards prescribed by BIS (for Metals like Brass, Copper, Lead etc.)
2. Global assaying standards prescribed by international agencies like London Metal Exchange (LME), London Bullion Market Association (LBMA), Chicago Mercantile Exchange (CME).



## B. Sampling and Testing Standards

The standards for testing are mandatory for WDRAs registered warehouses, facilitating adherence to specified quality for the products.

### Existing Standards

The mandatory standards specified by BIS primarily govern the following aspects of testing:

1. IS 2860: Sampling and testing of processed fruits and vegetables
2. IS 4333 has 5 parts, all these may be referred.
3. IS 4333: Part 1: Methods of analysis for foodgrains Part 1 Refractions (Third Revision)
4. IS 4333: Part 2: ISO 712: Methods of analysis for foodgrains Part 2 Determination of moisture content (Second Revision)
5. IS 4333: Part 3: ISO 7971-3: Methods of analysis for foodgrains Part 3 determination of bulk density called mass per hectoliter (Second Revision)
6. IS 4333: Part 4: ISO 520: Methods of analysis for foodgrains Part 4 determination of the mass of 1000 grains (Second Revision)
7. IS 4333: Part 5: Methods of analysis for foodgrains Part 5 Determination of uric acid
8. IS 6261: Analysis of insects and rodent contamination in grains
9. IS 8077: 'Procedure for checking temperature of quick - Frozen foods'
10. IS 8184: Determination of ergot in food grains
11. IS 10768: Test of quality characteristics of pulses
12. IS 11396: Test for determination of storability of food grains
13. IS 12529: Methods for estimation of storage losses by insects
14. IS 12700: ISO 3093: 'Wheat, rye and their flours, durum wheat and durum wheat semolina - Determination of the falling number according to hagberg - Perten (Second Revision)
15. IS 16516: Bajra - Specification
16. IS 16518: Maize - Specification
17. IS 16519: Jowar - Specification
18. IS 16520: Barley - Specification
19. IS 16682: Ragi - Specification
20. IS 16892: Sattu - Specification
21. IS 3581: Green Coffee - Specification (Third Revision)
22. IS 3633: Black tea - Specification (Second Revision)
23. IS 15344: Green tea - Specification

### Sampling of Agricultural commodities

1. IS 4115: Methods of sampling of oilseeds
2. IS 4905: ISO 24153: Random sampling and randomisation procedures (First Revision)
3. IS 14818: ISO 24333: Cereal and cereal products - Sampling (First Revision)
4. IS 5404: Methods for drawing and handling of food samples for microbiological analysis (First Revision)

### Proposed Additional Standards

In addition to the mandatory testing standards issued for agricultural commodities, it is recommended to create and implement similar testing standards for non-agricultural commodities as well. These standards may be regulated by nodal regulatory agencies like BIS or other product specific regulatory authorities.



### C. Weighment Standards

While grading and testing standards primarily govern the quality of the products stored in warehouses, the standards specified for weighment are aimed to ensure the quantity of products. The existing standards are mandatory and must be adhered to agnostic of warehouse structure.

#### Existing Standards

The mandatory guidelines issued by BIS are as follows:

1. BIS Standards for Weigh bridge specifications (IS 1436)
2. BIS Standards for General Requirements for Weighing Instruments (IS 1432)

#### Proposed Additional Standards

While the above-mentioned standards regulate the specifications for weighment instruments, it is recommended to include weighbridge construction as a part of warehouse design, wherever applicable. This will ensure adherence to weighment of cargo (inbound as well as outbound) across various nodes of the supply network.





# About Us



सत्यमेव जयते

Department of Commerce,  
Ministry of Commerce and Industry  
Government of India



## Department of Commerce, Ministry of Commerce and Industry

The Department of Commerce under Ministry of Commerce and Industries aims to make India a major player in the world trade by 2020 and assume a role of leadership in the international trade organisations commensurate with India's growing importance. The medium-term vision is to double India's exports of goods and services by 2017-18 over the level of 2008-09 with a long-term objective of doubling India's share in Global trade.

## Logistics Division, Department of Commerce, Ministry of Commerce and Industry

The Logistics Division was set up on 7 July, 2017 as a consequence of the Government of India (GoI) Rules, 1961 in the Department of Commerce, Ministry of Commerce and Industry. The division is headed by a Special Secretary to GoI and aims to develop an Action Plan for the integrated development of the logistics section in the nation, by introducing various policy changes, advances in existing procedures, finding of bottlenecks and gaps and introduction of technology in this sector.



