

Health & Safety Department (Safety Section)

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Any modification to the document must be reviewed and approved
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1 Purpose

This technical guidance aims to:

1. Provide a safe work environment that maintains business continuity.
2. Protect workers from accidents related to unsafe storage, which can be fatal.
3. Protect the organization and neighboring organizations from fire accidents resulting from unsafe storage and overstocking material.
4. Save the effort and resources associated with accidents resulting from unsafe storage.
5. Maintain supply chains operating without interruption to meet accelerating market demands.

2 Scope

This guideline applies to storage sites related to general materials, whether they are warehouses or areas for storing raw materials and products in industrial facilities, in addition to loading and unloading areas. For storage requirements related to dangerous goods refer to the concerned authority's requirements. For Fire Safety refer to the concerned authority's requirements.

3 Definitions

Definition	Meaning
Pallet	Rigid horizontal platform of minimum height, compatible with handling by pallet trucks and/or forklift trucks and other appropriate handling equipment, used as a base for assembling, loading, storing, handling, stacking, transporting or displaying goods and loads.
Sprinkler Systems	A network of pipes containing pressurized water equipped automatics valves that release water or other compounds when a fire occurs.

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Definition	Meaning
pedestrian traffic	Congestion and disorganization in the paths used by pedestrians or equipment to move from one area to another.
Pathways	Clearly marked paths (often using yellow paint or tape) for separating pedestrians from machinery and equipment traffic
Dock boards	a portable or fixed device that spans a gap or compensates for a difference in elevation between a loading platform and a transport vehicle.
Aisle Space	Minimum dimension measured across the aisle at the floor and at any beam level between the stacking materials or rack structure.
Log cabin style	The system of stacking wood or tree trunks on top of each other in right angel position like small primitive wooden houses
Rigging Equipment	A set of tools used to hold and distribute heavy load in the loading and unloading process.
narrow aisle forklifts	Are machines for working in narrow aisle (of between 1500 – 1800 mm).

4 The Safe Storage Guideline

General Warehouse Requirements

Safe storage is one of the biggest challenges facing industrial and commercial facilities. To ensure safety in the field of storage, many measures must be taken to ensure safety from fire accidents, explosions, and injuries. To ensure this, the following measures must be taken:

- Ensure that the quantity of stored materials is proportional to the storage ability of the warehouse.
- Non-hazardous Materials: For general goods or non-hazardous materials, the minimum distance between storage lines is typically around 1- 1.2 meters to allow easy access and ensure safe operations.

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- With Heavy or Bulky Items: For larger or bulkier items, the distance may need to be greater, typically 1.5 – 1.8 meters or more, depending on the type of equipment used.
- Sprinkler Systems: If the warehouse is equipped with a sprinkler system stored material must not be closer than 45 centimeters to the walls, partitions, or sprinkler heads.
- Ventilation: In some cases, particularly for hazardous materials, proper ventilation must be supported, which could need more clearance from stored materials.
- Lighting: Ensure adequate lighting inside the warehouse and ensure that stored materials are not blocking the light from some parts of the warehouse. For walkways, aisles, and general indoor warehouse spaces maintain a minimum illumination level of 110 lux. For more specific tasks, optimal lighting intensity varies widely based on the exact operation.
- Fire Exits and Emergency Access: Ensure that storage rows do not obstruct fire exits, firefighting equipment or emergency access points.
- Housekeeping: Storage areas shall be kept free from accumulation of materials that form hazards such as tripping, fire, explosion, or hidden spaces that can lead to pest harborage.
- Preventing Slips, Trips, and Falls: Keep floors dry and clean. Clean up any spills immediately to prevent slip hazards, especially in areas where liquids or oils are handled.
- Anti-slip Floors: Use anti-slip mats/floor coatings in high-traffic areas or where spills are more likely to occur.
- Mark uneven surfaces: Clearly mark any raised or uneven areas on the floor to prevent tripping.
- How often your product is accessed dictates how your product should be stored. Frequently accessed products should be easily accessible to make their retrieval easier.
- The walls and beams are painted with stripes to indicate maximum stacking heights easily. Strict enforcement of height limitations should be seen to ensure safety and stability.
- You should also use floor tape around the edges of stacks to provide a visual reminder of where loads should be stored.
- Using signage throughout the facility to show areas with pedestrian traffic, vehicle traffic, and loading areas, PPE requirements, etc. to keep warehouses safe and running smoothly. For in-depth signage requirements refer to “Technical Guidelines for Safety Signs at Work: DM-HSD-GU99-SSW2”
- Dock boards (bridge plates):

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- Portable and powered dock boards shall be strong enough to carry the load imposed on them.
- Portable dock boards shall be secured in position, either by being anchored or equipped with devices which will prevent them from slipping.
- Handholds, or other effective means, shall be provided on portable dock boards to allow safe handling.
- Positive protection should be provided to prevent railroad cars from being moved while dock boards or bridge plates are in position.
- Powered and hydraulic dock boards must be tested periodically by a third-party testing company accredited by EIAC.

4.1 Stacking on Pallet

General requirements

When stacking materials on pallets, safety is paramount to prevent accidents and ensure stability. Here are some effective storage methods:

1. Weight distribution: place heavier items at the bottom and lighter items on top to keep a low center of gravity, reducing the risk of tipping.
2. Stable Pallet Base: use pallet in good condition without cracks or broken boards. Ensure the pallets are rated for the weight they will carry.
3. Uniform Stacking: stack material uniformly to create a stable load. Avoid overhang, as they can lead to instability.
4. Strapping and Wrapping: Use stretch film or shrink wrap to secure items on the pallet, preventing them from shifting during storage or transport. For heavier loads, consider using strapping.
5. Aisle Space: Ensure sufficient aisle space for easy access and minimize the risk of collisions with forklifts or other equipment.
6. Clear Signage: Use clear labels and markers to show load limits of each pallet.
7. Regular Inspections: Conduct routine checks on stacked pallets to ensure they are still stable and in good condition.

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Limits of allowed stacked Height:

The maximum height for safely stacking pallets depends on several factors, including the type of materials, the strength and stability of the pallets, the storage location, and the equipment used to manage the pallets. However, there are general guidelines that can be followed:

1. Pallet Material and Design:

- Wooden pallets: These can typically be stacked up to 1.5-1.8 meters for lighter loads, but it can vary depending on the quality of the wood.
- Plastic or metal pallets: These may be stackable to greater heights, often around 2.4-3 meters, depending on their construction.

2. Weight of the Load:

- The heavier the load, the more cautious you must be about the stacking height. Heavy items can cause the pallets below to crush or break if stacked too high. For very heavy loads, the stacking height is often limited to around 1.5 meters.
- If several pallets are stacked on top of each other the total weight of the stack shall not exceed maximum load capacity of the lower pallets.

3. Forklift or Pallet Jack Handling:

- The height should not exceed what can be safely handled by the equipment. If a forklift is used, ensure it can safely lift and place the stacked pallets without tipping or instability.

4. Pallet Racking Systems:

- If you're using pallet racking systems, there are generally no strict height limits if the racking is properly designed to support the weight and the goods. However, it's important to follow the manufacturer's guidelines for weight capacity and height.

4.2 Lumber

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General considerations:

- **Stack stability:** The Lumber should be stacked in a stable manner, using cross-layered stacking (like a log cabin style), which helps distribute the weight evenly and reduces the risk of shifting or collapsing.
- **Stack conditions:** Always store lumber on a flat, dry surface to prevent it from tipping, warping, or becoming unstable. If you're storing lumber on the floor, use pallets or skids to keep them off the ground and ensure airflow underneath.
- **Stack Lumber Horizontally:** Lumber should be stacked in horizontal layers to prevent it from becoming unstable. Each layer should be stacked evenly to reduce the risk of tipping. Ensure each stack is uniform and not top-heavy.
- **Keep Lumber Straight:** When stacking, arrange the lumber in a way that they don't bow or warp. Larger pieces should be placed on the bottom, with smaller ones stacked on top to maintain balance.
- **Secure Stacks with Strapping or Bands:** To further prevent instability, secure lumber stacks with banding, straps, or ropes. This helps keep the lumber in place, especially if the stacks are tall.
- **Keep Lumber Away from Extreme Heat or Cold:** Extreme temperatures can cause the wood to warp or crack. Store it in a temperature-controlled area, when possible, especially for sensitive materials or specific types of wood.
- **Use Stickers (Wood Spacers):** When stacking lumber, use wooden "stickers" (spacers) between each layer to keep the wood separated and allow for airflow. This helps prevent warping, rotting, or moisture buildup.
- **Store Lumber Away from Heat Sources:** Lumber is highly flammable, so ensure it is stored away from open flames, sparks, or heat sources. This includes avoiding storage near welding or cutting operations.
- **Keep Fire Extinguishers Nearby:** In areas where lumber is stored or processed, ensure fire extinguishers are readily available. Ensure staff are trained in how to use them and be aware of emergency procedures.
- **Prevent Combustible Dust Accumulation:** If storing in a processing area, ensure that sawdust and wood chips are regularly cleaned up and disposed of properly, as they can be highly combustible.

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- **Use Proper Lifting Techniques:** When moving or handling lumber, always use proper lifting techniques to avoid injury. If the lumber is heavy or bulky, use forklifts, cranes, or mechanical lifting equipment to move it.
- **Two-Person Handling:** For long or large lumber, always have two workers to move and lift the lumber to prevent accidents and reduce the risk of injury.
- **All lumber stacks must be level, supported with bracing, and free from nails.**
- **Height limit:** If you are stacking lumber manually, it must not be stacked more than 4.8 meters high. If the lumber is stacked with a forklift, the stack must not exceed 6 meters high, depending on the weight of the lumber. Higher stacks can become unstable and difficult to manage.
- **Maintain Clear Aisles and Walkways:** Ensure there are clear walkways around lumber storage areas to prevent tripping hazards. This allows for safe access to the materials without obstacles or risks of injury.
- **Inspect for Damage:** Regularly check lumber stacks for any signs of damage, such as broken boards, warping, or rotting. If damaged lumber is found, remove it immediately to prevent it from affecting the rest of the stack.
- **If using cantilever lumber racks for storage special attention must be given to the rack's safe working load limits, even weight distribution, and structural integrity to prevent collapse.**

4.3: Drums Storage

Storing drums containing non-hazardous materials still requires attention to ensure safety and prevent any potential issues. Here are some safe methods for storing drums with non-hazardous materials:

- **Ensure that each drum is clearly labeled with its contents, even if they are non-hazardous.** This helps identify the materials in case of an emergency or for inventory tracking.
- **Store drums in a designated, clean, and organized area.** This helps reduce the risk of accidents and ensures that they are easily accessible when needed.
- **Keep drums away from extreme heat or cold, as temperature fluctuations can cause the materials to expand, contract, or degrade over time.** Ideally, store them in a temperature-controlled environment.

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- Even for non-hazardous materials, it's good practice to store drums on spill containment pallets or trays. This will contain any accidental leaks or spills and prevent environmental contamination.
- If stacking drums, ensure they are properly secured to prevent them from rolling or falling. When stacking, drums should be placed with the larger drums on the bottom and the smaller ones on top to prevent instability. Consider using drum racks to store them safely.
- Store drums away from high-traffic areas to minimize the risk of physical damage (e.g., from forklifts or other machinery). Ensure that the drums are stored upright to prevent leakage or damage.
- If the drums contain materials that could release gases (even if non-hazardous), store them in a well-ventilated area to avoid the buildup of any potentially harmful gases or odors.
- Prolonged exposure to sunlight can degrade the material in the drums, even if it's not hazardous. Store them in shaded areas or under covers to avoid direct sunlight and UV exposure.
- Periodically inspect the drums for signs of damage, corrosion, or leakage, even if the materials inside are non-hazardous. Early detection can help prevent issues down the line.
- Stack Height: The drums should not be stacked higher than 3 drums when storing them in a warehouse or storage area. However, stacking drums beyond 2 high is generally avoided unless specific measures (like racks) are in place.
- Drum Size and Weight: Larger and heavier drums (e.g., 55-gallon drums) may have a lower stacking limit compared to smaller drums, as their increased weight can create more pressure on the lower drums, increasing the risk of instability. For example, stacking 55-gallon drums more than 2 high is generally not recommended without proper racking systems.
- Drum Condition: Ensure that the drums are in good condition (no dents, corrosion, or leaks) to prevent any structural failure under the weight.

4.4 Sacks Storage

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Storing sacks safely requires careful attention to avoid damage to the contents, ensure easy access, and maintain an organized storage environment. Whether the sacks are filled with food, chemicals, construction materials, or clothing, safe storage methods protect both the sacks and their contents and ensure safety for workers handling them. Below are safe storage methods for sacks:

- **Level Ground:** Store sacks on a solid, level surface to prevent shifting, tipping, or falling. If possible, use paved or concrete flooring to reduce instability.
- **Elevate Sacks Off the Ground:** If storing sacks in outdoor or damp environments, elevate them off the ground using pallets, racks, or shelves. This will help to prevent moisture exposure that can damage the sacks or their contents.
- **Use brick-style (cross stacking) or pyramid stacking** for better balance and prevent collapse.
- **Use slips resistant cardboard or fiberboard sheets** to prevent sliding between bag layers and distribute weight evenly.
- **Use Shelves or Racks for Easy Access:** For smaller sacks, or those requiring easy access, use shelves or racks. This helps keep the sacks organized, allows airflow around the sacks, and makes it easier to retrieve them.
- **Ensure Shelves Are Properly Rated:** Shelves should be strong enough to handle the weight of the sacks without sagging or collapsing. Use heavy-duty shelving for large or bulk sacks.
- **Separate Sacks by Type:** Organize sacks by size, material, or contents (e.g., food, chemicals, clothing) to reduce handling time and prevent contamination. Keep sacks containing hazardous or sensitive materials separate from other items.
- **Stack Sacks by Weight:** For sacks that need to be stacked, stack heavier sacks at the bottom and lighter sacks on top. This ensures stability and prevents crushing the lower sacks.
- **Avoid Over stacking:** Do not stack sacks higher than 1.5-1.8 meters 8 – 12 sacks to prevent the stack from becoming unstable. Over stacking can lead to falling sacks and injuries, this is why it should be used Rank or Shelves to store over stack sacks.
- **Stack Sacks in a Straight Line:** Always align the sacks neatly when stacking to prevent them from leaning, toppling, or falling. Use straight rows with no leaning to maintain stability.
- **Horizontal Storage:** If the sacks are large and heavy, storing them horizontally on pallets or shelves may be safer. This method distributes weight evenly and makes it easier to access.

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- **Vertical Storage:** For smaller sacks or sacks that don't contain liquids, you can store them vertically on shelving units or racks. If stored vertically, ensure that the sacks are secured and will not tip over easily.
- **Inspect Sacks Regularly:** Regularly check stored sacks for signs of damage, moisture, or pest activity. This will help catch any issues early before they escalate.
- **Maintain Storage Areas:** Keep storage areas clean and dry, and ensure that shelves, racks, or pallets are in good condition to safely hold the sacks.

Special requirements for super sacks (Large and oversized sacks):

- Super sacks are governed by ISO 21898 (Packaging — Flexible intermediate bulk containers (FIBCs) for non-dangerous goods), which sets standards for fabric and overall bag integrity.
- **Use Sacks Within Rated Capacity:** Never exceed the Safe Working Load (SWL).
- **Lift Using All Loops:** Always lift sacks using all designated lifting loops together. If using forklift to lift and move super sacks use approved forklift attachment/spreader bar with hooks that engage all four lift loops simultaneously to ensure stability.
- **Do Not Drag or Push Sacks:** Dragging may damage the fabric and stitching.
- **Store on Stable, Flat Surfaces:** Place sacks on pallets or even floors; avoid uneven or sloped surfaces.
- **Stacking:** Only stack if the bag is designed for stacking (cross-stacking or pyramid stacking). General rule: no more than 2 sacks high unless certified safe.
- **Keep Dry and Protected:** Store in a dry, covered area to prevent weakening of fabric due to moisture or UV.
- **Avoid Sharp Edges:** Protect sacks from nails, edges, or tools that may tear the material.
- **Label Clearly:** Include contents, handling instructions, and hazard info if needed.
- **Training Required:** Workers should be trained on proper lifting, storing, and disposal procedures.

4.5 Structural Steel, Poles, Pipes, Bar Stock, and Other Cylindrical Material

Structural steel, poles, pipe, bar stock, and other cylindrical materials, unless racked, shall be stacked and blocked to prevent damage, spreading or tilting.

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- **Level Ground:** Ensure the storage area has level, solid ground to prevent steel from tipping over or shifting. Uneven or soft surfaces, such as sand or gravel, should be avoided. Concrete or a paved surface is ideal.
- **Raised Storage:** If storing outdoors, elevate the steel off the ground using wooden beams, pallets, or blocks to prevent corrosion from water or moisture. The steel should not be in direct contact with the ground.
- **Steel Racks:** For smaller steel sections (e.g., angles, channels, or flat bars), use steel storage racks or frames to keep them organized and separated. Racks should be sturdy, with weight limits clearly marked, and should be securely anchored to the ground.
- **Vertical Storage:** If you need to store long structural steel sections (like beams or pipes), store them vertically or horizontally on specialized racks or frames, keeping them spaced out to avoid bending or warping.
- **Horizontal Stacking:** For larger, longer sections, stack them horizontally with wooden spacers between each layer. Ensure the stack is level to prevent instability. If storing long beams or plates, it's best to store them on racks or flat surfaces to avoid sagging.
- **Avoid Over stacking:** Stacking steel too high can lead to instability. Avoid stacking steel sections higher than 1.2-1.5 meters. For taller stacks, ensure the bottom layers are secure and the stack is properly supported.
- **Spacing Between Layers:** For horizontal stacking, allow enough spacing between each layer to prevent damage or distortion. Use wooden blocks or steel spacers to maintain a consistent gap.
- **Cover with Tarps or Plastic Sheeting:** If storing structural steel outdoors, use weatherproof tarps or plastic sheeting to protect the steel from rain, snow, and excessive moisture. Make sure the covering allows for ventilation to avoid trapped moisture, which can cause rust.
- **Ensure Proper Drainage:** When covering steel outdoors, ensure that rainwater can drain away to avoid pooling, which could cause rust. Elevating steel off the ground and keeping the surface sloped is helpful.
- **Tie Down Steel Sections:** If storing steel outdoors or in a high-wind area, use straps or chains to secure the steel sections. This prevents the steel from shifting or falling over, which could be hazardous.

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- **Fencing or Barriers:** Consider setting up safety barriers or fencing around large steel stacks to prevent accidental contact with workers or the public. This is especially important if storing steel near a construction zone or in a high-traffic area.
- **Clear Pathways:** Ensure there is enough space between stacked steel sections to allow for easy access and safe removal of individual pieces.
- **Use Proper Lifting Equipment:** Always use cranes, forklifts, or hoists to handle heavy structural steel sections. Never attempt to move large sections by hand. Ensure the proper rigging equipment is used to prevent injury.
- **Training for Workers:** Workers should be trained in proper storage and handling procedures, including the use of equipment and safety measures.
- **Protective Covers:** Steel sections often have sharp edges that can cause injuries. Use edge protectors or cover sharp edges with rubber or foam padding to reduce the risk of cuts and other injuries.
- **Warning Signs:** Place warning signs around storage areas indicating the presence of sharp steel edges.

4.6 Brick Stacks & Masonry Blocks

To store brick stacks safely, especially if you're working with large amounts of bricks or building materials, consider these steps to ensure safety and organization:

- **Level Ground:** Make sure the ground or surface is level to prevent bricks from tipping or sliding. If you're stacking on uneven ground, create a level base using wood, gravel, or concrete.
- **Pyramid or Zig-Zag Stacking:** When stacking, try to form a pyramid shape or zig-zag pattern. This provides stability and prevents the stack from falling over. If stacking in rows, make sure each layer is slightly smaller than the one below it.
- **Stable Layers:** Ensure each layer of bricks is stable and level. Don't place bricks loosely on top of one another.
- **Avoid Tall Stacks:** Brick stacks shall not be more than 2 meters in height. When a loose brick stack reaches a height of 1.2 meters, it shall be tapered back 5 centimeters) in every 30 centimeter of height above the 1.2 meters level.

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- **Cover with Tarps or Plastic Sheeting:** If storing bricks outside, cover them with weatherproof tarps or plastic sheeting to protect them from rain, moisture, and dirt. This will prevent the bricks from absorbing moisture, which could lead to damage.
- **Elevate Off the Ground:** Use wooden pallets, concrete blocks, or other materials to elevate the bricks off the ground. This prevents water absorption and allows airflow underneath the stack.
- **Strap or Secure the Stack:** If storing bricks in a high-risk area (like near a construction zone or where strong winds may occur), use tie-downs or straps to secure the stack and prevent bricks from shifting or falling.
- **Safety Barriers:** If stacking bricks in a high-traffic area, consider using safety barriers around the stack to prevent people from accidentally knocking over.
- **Clear Pathways:** Make sure there's clear access to the stack for easy removal of bricks without disturbing the rest of the stack.
- **Label or Organize:** If you're working with different types of bricks (e.g., sizes, colors), organize and label them to avoid confusion and improve efficiency.

4.7 Boxes Storage

Storing boxes safely is crucial for preventing damage, ensuring easy access, and maintaining a safe working environment. Proper storage techniques help protect the contents of the boxes, reduce the risk of accidents, and improve organization. Whether you're dealing with small packages, large cartons, or bulk items, here are the key safe storage methods for boxes:

- **Level Ground:** Always store boxes on solid, level surfaces to prevent shifting or falling. Uneven or soft ground (like dirt or gravel) can cause instability. Use a concrete or paved surface for maximum stability.
- **Elevate Off the Ground:** If storing boxes in a damp environment or outdoors, elevate boxes (minimum 150 mm) using pallets, racks, or shelving. This prevents water from seeping into the bottom of the boxes, which could lead to damage (e.g., water damage, warping, or rust).
- **Stack Boxes by Size and Weight:** Store heavier boxes at the bottom and lighter boxes on top. This ensures that the weight is evenly distributed and prevents crushing or damage to the boxes at the bottom.

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- **Avoid Over stacking:** To prevent instability, avoid stacking boxes too high. A general rule of thumb is to stack boxes no higher than 1.5-1.8 meters, depending on the size and weight of the boxes. Over stacking increases the risk of boxes falling or collapsing.
- **Ensure Boxes Are Aligned:** Stack boxes straight and aligned, with no leaning. This minimizes the risk of the stack toppling over. Use a pallet jack or forklift if necessary to move and align large stacks.
- **Use Spacers for Stability:** For large stacks, consider using spacers or intermediate layers (such as wooden boards or cardboard) between layers to prevent shifting.
- **Use Shelves or Racks for Small Boxes:** If you have smaller boxes, consider using shelves or shelving units for better organization and access. This prevents boxes from being stacked on the floor, which could lead to moisture or dirt damage.
- **Ensure Shelves Are Stable:** Make sure that shelves or racks are properly secured and rated to hold the weight of the boxes. Heavy-duty shelving is necessary for storing large or bulk boxes.
- **Avoid Overloading Shelves:** Do not overload shelves, as this could cause them to bend or collapse, resulting in damage to the boxes or injury.
- **Cover Boxes:** If storing boxes outdoors or in an exposed area, cover them with weatherproof tarps or plastic sheeting. This will protect the boxes from rain, snow, and sunlight, which could weaken the cardboard or other materials.
- **Store in Dry Areas:** Avoid storing boxes in damp areas, as moisture can cause cardboard to weaken, cause mold growth, or lead to corrosion on metal contents. If possible, store boxes in a climate-controlled environment to maintain their integrity.
- **Use Pallets for Elevation:** Storing boxes on pallets or racks keeps them elevated from the ground, which reduces the risk of moisture damage, contamination, and pests.
- **Clear Labeling:** Label each box clearly with its contents, weight, and handling instructions (e.g., "fragile," "this side up"). This will help with organization and ensure that the boxes are handled appropriately.
- **Use Color-Coding or Markers:** If storing many boxes, use color-coded labels, tags, or markers to easily identify the contents, priority, or location of the boxes.

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- **Group Boxes by Type or Destination:** Store boxes in designated areas based on their contents, size, or destination. This reduces the time spent searching for specific boxes and improves workflow.
- **Inspect Stacks Regularly:** Regularly inspect the stacks of boxes for signs of instability or damage. If you notice that a stack is leaning or some boxes are becoming crushed, rearrange the stack to maintain stability.
- **Create Clear Pathways:** Always maintain clear aisles and pathways between stacks of boxes to allow easy access for moving or retrieving boxes. This reduces the risk of accidents and ensures that workers can quickly access items when needed.
- **Avoid Blocking Emergency Exits:** Ensure that emergency exits and fire lanes are not blocked by stacks of boxes or storage racks. Clear pathways are essential for safety in case of an emergency.

4.8 Safe Storage on Racks (Shelving System)

Storing materials on racks involves many risks such as falling materials, collapsing racks and injuries resulting from collisions with racks. All precautions must be taken to avoid these accidents. For storage on racks to be safe, the instructions below must be followed.

- **Choose Racks Based on Load Requirements:** Ensure that the rack system you choose is rated to handle the weight and size of the items you intend to store. Always refer to the manufacturer's specifications for load capacities.
- **Select the Appropriate Material:** Choose racks made from durable materials (e.g., steel, heavy-duty plastic) to ensure they can bear the expected weight. Racks should be able to resist corrosion, wear, and impact depending on the environment.
- **Distribute Weight Properly:** Place heavier items at the bottom of the racks and lighter items on the top to prevent top-heavy racks, which are more likely to tip over. Ensure that the total weight does not exceed the specified load capacity of the rack.
- **Center the Weight:** Always store items in a way that distributes the weight evenly across the rack's surface. Items should be stored as centrally as possible to prevent leaning or unbalanced loads.

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- **Avoid Overloading:** Never exceed the load capacity specified for each shelf or rack level. Overloading can lead to structural failure and cause the rack to collapse. Safe working load of the rack must be displayed on both ends of each rack.
- **Use Rack Guards:** If your racks are in high-traffic areas, consider installing rack guards or bumpers to protect the racks from being hit by forklifts or other equipment. This prevents damage to the structure and maintains stability.
- **Install Safety Bars or Mesh:** For tall or open racks, consider adding safety bars or mesh panels to prevent items from falling off, especially in busy areas where people or vehicles may be operating nearby.
- **Secure Loose Items:** Ensure that items stored on the rack are secured to prevent them from shifting or falling during movement or handling. Use straps or securing tools for irregularly shaped or unstable items.
- **Conduct Regular Inspections:** After installation, regularly inspect the racks for safe working load (SWL) and any signs of wear or instability. Look for bent bars, broken bolts, or signs of corrosion. Pay particular attention to the anchoring system to ensure that no components are loosening.
- **Re-tighten Fasteners:** Over time, fasteners and bolts may loosen due to vibration or weight shifts. Periodically re-tighten these components to ensure the rack remains secure.
- **Ensure Proper Load Distribution:** Continuously monitor the storage and avoid overloading or improperly distributing weight as it may compromise the structural integrity of the rack.
- **Employee Awareness:** Ensure that employees are trained in how to load and unload racks safely. They should understand the importance of even weight distribution and the correct techniques for handling items on the racks.
- **Warn of Potential Hazards:** Workers should be aware of the risks associated with rack systems, such as the possibility of items falling off or the rack tipping over and follow safe practices when operating around the racks.
- **Forklift or Equipment Access:** 1 to 1.2 meters for narrow aisle forklifts, and 1.8 to 2.4 meters for standard forklifts.
- **Personnel Access:** 1 meter minimum for walking aisles; consider 1.2 to 1.5 meters if workers need to use carts or trolleys.
- **Headroom Clearance:** 45 cm minimum clearance from the top of the racks to the ceiling.

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- Pallets and Shelving Units: For pallets, ensure at least 7.5 cm between racks and pallets; for shelves, consider 45 to 60 cm between units.
- Preventing Overloading: Spacing between shelves should also consider the weight capacity of each shelf and the total load it will support. Overloading can cause sagging or collapse. Ensure the shelves are spaced to distribute the load evenly and avoid excess weight on any single shelf.

4.9 Sheet Material Storage

Brittle sheet materials such as glass, marble, granite and other materials can shatter or crack if not handled properly therefore it is crucial to provide proper storage to protect the workers from falling or broken materials, by ensuring proper handling and storage businesses can reduce financial losses due to cost of injuries and fatalities and wasted inventory and delays in production. Follow these steps to minimize such risks:

- Store Vertically at an Angle: Lean material sheets at a 5–7° angle from vertical to reduce tipping risk.
- Use A-Frame Racks or Stillages: Designed to hold sheet materials securely and prevent shifting or falling.
- Ensure racks are rated for the material weight.
- Secure with Restraints: Use straps, clamps, or rubber blocks to prevent movement during storage or handling.
- Protect Edges and Corners: Use edge protectors or rubber padding to avoid chipping and injury.
- Maintain Clear Aisles: Ensure space around storage racks for safe handling and emergency access.
- Weight Distribution: Do not overload racks; follow manufacturer load limits.
- Label Material Types Clearly: Indicate thickness, type (tempered, laminated), and handling precautions.
- Avoid Stacking Sheets Flat: Never lay sheets flat on the floor or on top of each other, it increases breakage risk.
- Inspect Regularly: Check for cracks, loose restraints, or unstable stacking.
- PPE for Workers: Use cut resistant gloves and long sleeve arm protection, safety glasses and steel-toe boots while handling brittle sheet materials.

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4.10 Considerations for Safe Stacking

Safe stacking height depends on several factors such as weight, pallet characteristics, distribution of the weight and compression strength of the materials as well as at what height existing mechanical equipment such as forklift can reach and operate safely. Following is some general industry guidelines to help businesses determine maximum stack height safely.

1. weight considerations:

- Lightweight Items (e.g., boxes of paper, lightweight consumer goods):
- Maximum Height: Up to 6 meters or more.
- Reason: Light items exert less pressure on the lower layers, and there's less risk of crushing or destabilizing the load. Pallet stability is still important, but the risks are lower with lighter goods.
- Moderately Weighted Items (e.g., electronics, packaged food):
- Maximum Height: Around 3.6 to 4.5 meters.
- Reason: These items still exert moderate weight on the pallets below. At this height, the stack should be stable, but the material handling equipment must be able to reach higher levels, and care must be taken to ensure that the load is distributed evenly and not top-heavy.
- Heavy Items (e.g., industrial parts, tools, machinery):
- Maximum Height: Around 1.8 to 2.4 meters.
- Reason: Heavy items put significant pressure on the pallets below, which can lead to crushing, breaking of pallets, or instability. As the weight increases, the height of the stack should decrease to maintain safety and prevent accidents.

2. Factors Influencing Safe Stacking Based on Weight

Pallet Type and Strength:

- Standard Pallets: Typically hold up to 450 to 900 kg. For these, stacking heights may need to be kept lower if heavy items are involved.

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- Heavy Duty Pallets: These can handle up to 1,360 kg or more, and can be stacked higher, depending on the weight and nature of the load.
- Pallets with Weak Spots: If pallets are damaged, aged, or of low quality, their ability to support weight will be compromised, so lower stacking heights are necessary.

Distribution of Weight:

- If the weight is evenly distributed across the pallet, the risk of collapse is reduced, and higher stacking may be acceptable.
- Uneven weight distribution can cause instability, which is especially dangerous for heavier items.

Compression Strength of Materials:

- Different products have different levels of resistance to pressure. For example, electronics may be stacked higher, but fragile or crushable items (like sacks of flour or produce) should not be stacked too high, regardless of their weight.

3. Calculation for Safe Stacking Height

The safe stacking height is typically determined by considering the compression strength of the items being stacked. Here are some general guidelines:

- Heavier Loads (e.g., 450 kg per pallet):
- Lower stacking height (typically 1.8 to 2.4 meters) to prevent excessive pressure on lower pallets.
- This prevents crushing or damaging the items at the bottom of the stack, which may not be designed to withstand heavy pressure for extended periods.
- Medium Loads (e.g., 225 – 450 kg per pallet):
- Moderate stacking height (approximately 2.4 to 3.6 meters).
- Depending on the weight, the load may still be safe at this height, provided the weight is properly distributed.

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- Light Loads (e.g., 45 to 225 kg per pallet):
- Higher stacking height (up to 6 meters or more).
- Lighter loads have a lower risk of crushing or destabilizing the pallet stack, so they can be stacked higher.

4. Stability and Load Distribution

For stacking, load distribution is key to maintaining pallet stack stability. Even with light loads, stacking too high without ensuring proper balance can cause a collapse. A few tips include:

- Stacking Pattern: Ensure boxes on pallets are stacked in the below suggested patterns for better load distribution:
 - **Brick Stacking:** boxes or crates in each layer are offset (like bricks in a wall) to interlock the load. Best for uniform, rectangular boxes to prevent shifting.
 - **Pinwheel Stacking:** Cartons are rotated 90 degrees around a central point in each layer, leaving a hollow "chimney" in the middle. Excellent for uneven loads or different-sized boxes.
 - **Column (Block) Stacking:** Boxes are aligned perfectly on top of each other, corner to corner. Best for extremely heavy, crush-resistant items, but requires banding or stretch wrap to prevent lateral swaying.
- Strapping and Wrapping: If necessary, secure the pallets using shrink wrap or strapping to prevent them from shifting under pressure.
- Pallet Arrangement: In multi-layer stacks, make sure that the bottom layers are not overloaded beyond their rated weight capacity. Ensure that upper layers do not exceed the weight tolerance of the bottom ones.

5. Additional Considerations for Heavy Loads

- Pallet Integrity: Always inspect pallets before stacking. Broken or damaged pallets should be replaced immediately, especially when dealing with heavy loads.

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- **Forklift Access:** The higher the stack, the more difficult it is for equipment like forklifts or pallet jacks to handle. Make sure to stack the pallets at heights that are manageable by the equipment available.
- **Load Compressibility:** Some loads, like those with soft packaging, can compress materials under, increasing the risk of damaging materials at the bottom. Consider these properties when determining stack height.

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5 Suggestions, Comments & Complaints

For (suggestions, comments, and complaints)	For further information
- Unified interactive platform that connects Dubai Government and its customers: The 04 Platform https://04.gov.ae/) Dubai Municipality - Call Center: 800900	* Safety@dm.gov.ae) Dubai Municipality - Call Center: 800900

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6 References

- Occupational Health and Safety Administration (OSHA)
- National Fire Protection Association (NFPA)
- UAE Fire and Life Safety Code of practice.
- Plastic Drums Institute (PDI)
- Code of Construction Safety Practices.
- Ports Customs & Free Zone Corporation.
- American National Standard Institute (ANSI)
- National Safety Council (NSC).
- HSE Manual Handling (UK).

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