A. Usable Stacking Volume (m$^3$)

The total (or “gross”) volume of a warehouse is calculated by multiplying the width of the structure by its length and height. However, all of that volume cannot be utilized to stack commodities. 

- At least 1 meter of free space should surround every stack. This facilitates loading and unloading, inspecting, fumigating, and counting. (If possible, allow for a 2-meter passage between stacks, and, in a large warehouse, allow for a central “gangway” of 4–6 meters.) 

- Leave at least 1 meter of free space between the top of the stack and the roof.

The difference between the gross dimensions of a warehouse and the usable volume for storage must be taken into consideration. The following illustrations show gross dimensions of warehouses and usable volume when stacks of food are stored.

**Small warehouse:** 5 meters wide, 10 meters long, 3 meters high

Total (Gross) Volume: $(5 \text{ m}) \times (10 \text{ m}) \times (3 \text{ m}) = 150 \text{ m}^3$

<table>
<thead>
<tr>
<th>One stack</th>
<th>Two stacks</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="small_warehouse.png" alt="Diagram" /></td>
<td><img src="small_warehouse_two_stacks.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Usable stacking volume:

- One stack: $(3 \text{ m}) \times (8 \text{ m}) \times (2 \text{ m high}) = 48 \text{ m}^3$
- Two stacks: $(3 \text{ m}) \times (3.5 \text{ m}) \times (2 \text{ m high}) \times (2 \text{ stacks}) = 42 \text{ m}^3$

**Large warehouse:** 15 meters wide, 40 meters long, 5 meters high

Total (Gross) Volume: $15 \text{ m} \times 40 \text{ m} \times 5 \text{ m} = 3,000 \text{ m}^3$

Eight stacks with 4-meter central gangway

![Diagram](large_warehouse.png)

Usable stacking volume:

$= (6 \text{ m}) \times (8 \text{ m}) \times (4 \text{ m high}) \times (8\text{ stacks})$

$= 1,536 \text{ m}^3$
B. Storage Capacity

It is good practice to develop a commodity layout plan to ensure adequate warehouse space. While “general guidelines” state that at least 1 meter of air space should be left between the stack top and the warehouse roof, in practice, maximum stack height depends on the commodity. Guidelines for common commodities are presented in the table below.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Packaging</th>
<th>Maximum Stack Height</th>
<th>Volume (m³/MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains, beans</td>
<td>50-kg sacks</td>
<td>4 meters (20-40 sacks)</td>
<td>1.5</td>
</tr>
<tr>
<td>Flour, meal, blended foods</td>
<td>25-kg bags</td>
<td>3.5 meters (20-30 bags)</td>
<td>2</td>
</tr>
<tr>
<td>DSM in bags</td>
<td>25-kg bags</td>
<td>2.5 meters (20-30 bags)</td>
<td>2.4</td>
</tr>
<tr>
<td>DSM in tins</td>
<td>20-kg/carton (4 tins each)</td>
<td>8 cartons if stacked individually, 20 if palletized</td>
<td>4</td>
</tr>
<tr>
<td>Edible oil in cans</td>
<td>25 kg/carton (6 cans each)</td>
<td>8 cartons if stacked individually, 20 if palletized</td>
<td>2</td>
</tr>
</tbody>
</table>

Storage capacity for a specific commodity is calculated in the same way as usable stacking volume, but the figure for height is the Maximum Stack Height for that commodity. In the example on Page 1, the large warehouse has a usable stacking volume of 1,536 m³, but only 960 m³ of DSM in 25-kg bags can safely be stored there.

Large warehouse: 15 meters wide, 40 meters long, 5 meters high

Total (Gross) Volume = 15 m x 40 m x 5 m = 3,000 m³

Usable Stacking Volume = (6 m) x (8 m) x (4 m high) x (8 stacks) = 1,536 m³

Storage Capacity for DSM in 25-kg bags = (6 m) x (8 m) x (2.5 m high) x (8 stacks) = 960 m³

Storage capacity in metric tons (MT) is calculated by dividing storage capacity for a specific commodity by the volume (m³ per MT) for that commodity.

Large Warehouse: 15 meters wide, 40 meters long, 5 meters high

Total (Gross) Volume = 15 m x 40 m x 5 m = 3,000 m³

Usable Stacking Volume = (6 m) x (8 m) x (4 m high) x (8 stacks) = 1,536 m³

Storage Capacity for DSM in 25-kg bags = (6 m) x (8 m) x (2.5 m high) x (8 stacks) = 960 m³

Storage capacity (in MT) for DSM in 25-kg bags = 960 m³ / 2.4 = 400 MT

1. Always check specific recommendations from the suppliers (and sometimes printed on cartons).
2. Polypropylene bags from local millers may be irregular in size / shape, reducing the maximum safe height.