

SECTION III

Storage/Shelf Life Specifications

I STORAGE SPECIFICATIONS

Storage space requirements should be given careful attention. The amount of space necessary in a warehouse depends upon the total volume of food to be stored and on the number of different commodities. Each commodity should be stacked separately. Separate stacks require more usable volume than one large stack (i.e., a warehouse large enough to hold 50 MT of wheat will hold less than 50 MT of wheat and sorghum stacked separately).

The difference between gross dimensions of a warehouse and 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.

Space Utilization - Usable Stacking Volume in Cubic Meters

Figure 1: Warehouse with one stack of grain.

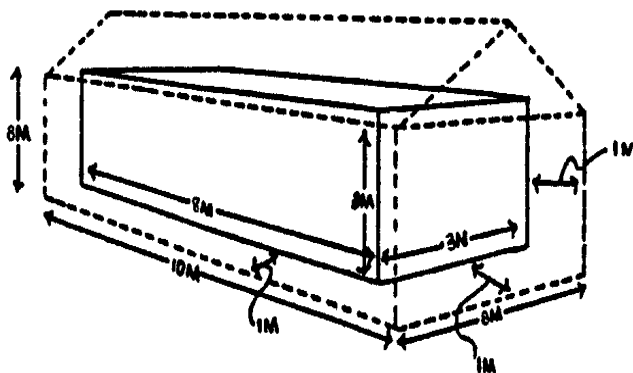
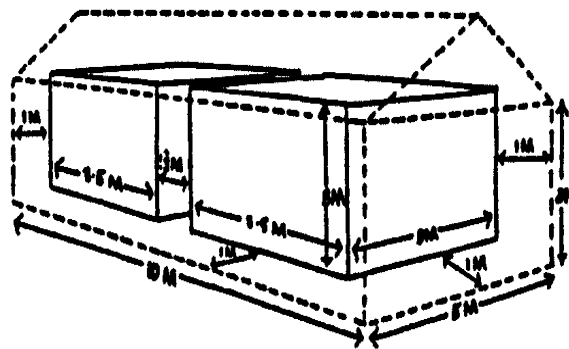


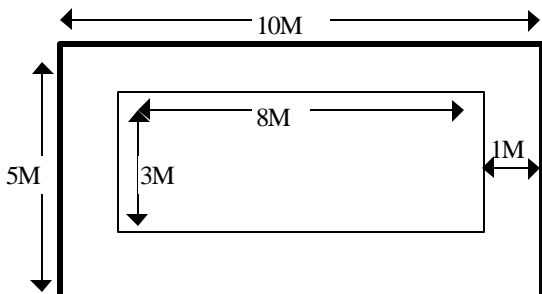
Figure 2: Warehouse with two stacks of grain.



(Source: CARE Food Resource Manual, November 1995).

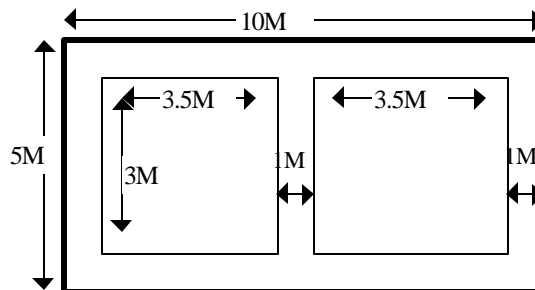
Small Warehouse (Height = 3M)

One stack



Gross Volume
 = 10M x 5M = 50M² x 3M = **150M³**
Usable Volume
 = 8M x 3M = 24M² x 2M = **48M³**
Storage Capacity (50 kg bags)
 = 48 M³ / 2 = 24 MT (480 bags)

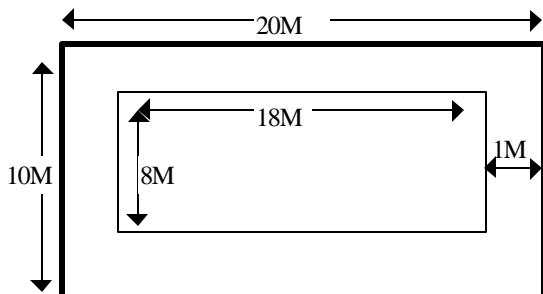
Two stacks



Gross volume
 = 10M x 5M = 50M² x 3M = **150M³**
Usable volume
 = (10M - 3M) x (5M - 2M)
 = 7M x 3M = 21M² x 2M = **42M³**
Storage Capacity (50 kg bags)
 = 42 M³ / 2 = 21 MT (420 bags)

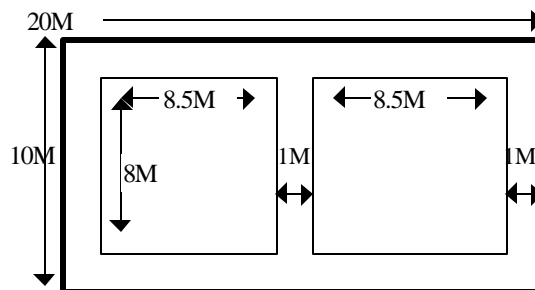
Medium Warehouse (Height = 4M)

One stack



Gross Volume
 = 10M x 20M = 200M² x 4M = **800M³**
Usable Volume
 = 18M x 8M = 144M² x 3M = **432M³**
Storage Capacity (50 kg bags)
 = 432 M³ / 2 = 216MT (4320 bags)

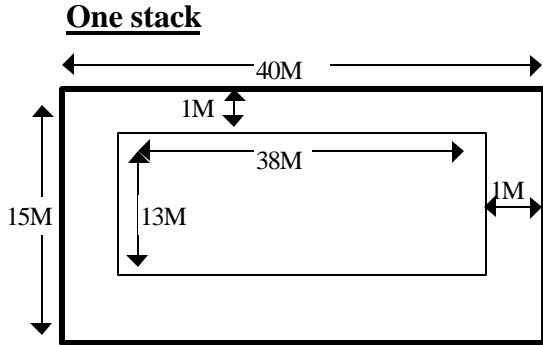
Two stacks



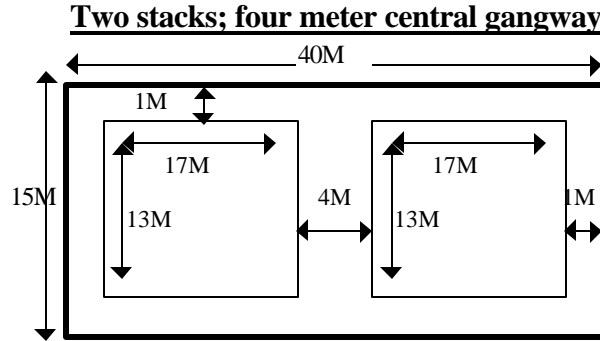
Gross volume
 = 10M x 20M
 = 200M² x 4M = **800M³**
Usable volume
 = (20M - 3M) x (10M - 2M)
 = 17M x 8M = 136M² x 3M = **408M³**
Storage Capacity (50 kg bags)
 = 408M³ / 2 = 204 MT (4080 bags)

(Source: CARE Food Resource Manual, November 1995).

Large Warehouse (Height = 5M)

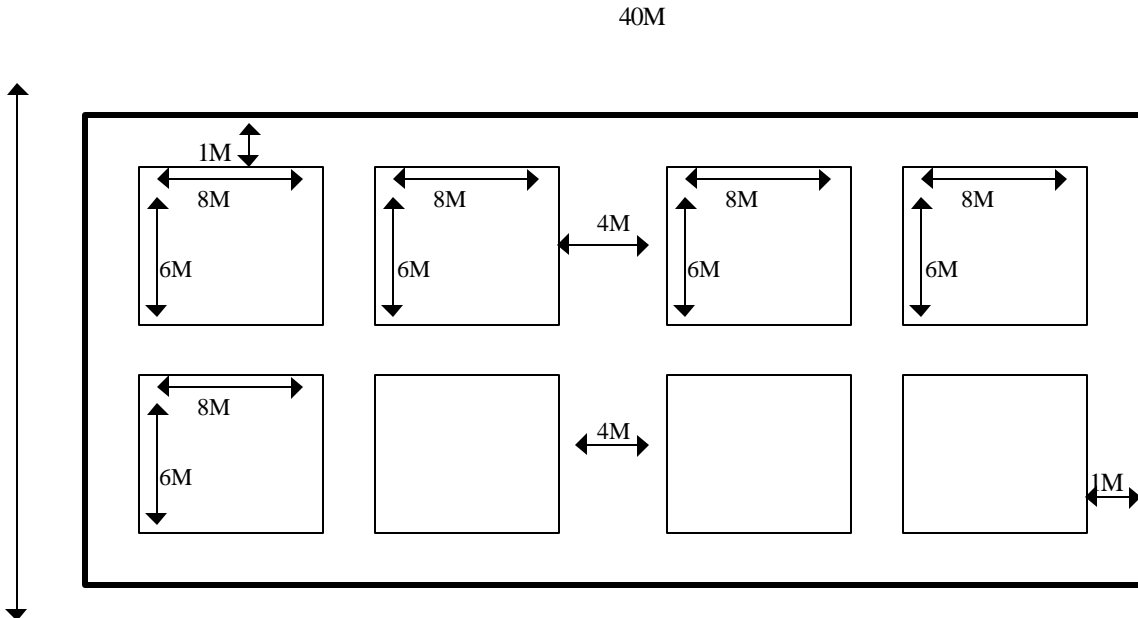


Gross Volume
 = 40M x 15M = 600M² x 5M = **3,000M³**
Usable Volume
 = 38M x 13M
 = 494M² x 4M = ,1976M³
Storage Capacity
 = 1,976M³ / 2 = **988M³ (19,760 bags)**



Gross volume
 = 40M x 15M = 600M² x 5M = **3,000M³**
Usable volume
 = (40M - 4M - 2M) x (15M - 2M)
 = 34M x 13M = 442M² x 4M = **1,768M³**
Storage Capacity
 = 1,768M³ / 2 = **884M³ (17,680 bags)**

Eight stacks; four meter central gangway



Gross volume = 40M x 15M = 600M² x 5M = **3,000M³**
Usable volume = (40M - 4M - 4M) x (15M - 3M)
 = 32M x 12M = 442M² x 4M = **1,768M³**
Storage Capacity = 1,768M³ / 2 = **884M³ (17,680 bags)**

(Source: *CARE Food Resource Manual*, November 1995).

In estimating how much usable space is needed per commodity, the following rules of thumb may help. (These are **estimated** figures)

- One MT of a bagged commodity (50 lb. bags) requires approximately 2 cubic meters of usable storage space.
- One MT of edible Vegoil in tins requires approximately 1.4 cubic meters of usable storage space.
- In using the stacking suggestions below, do not stack fiberboard cases of oil tins higher than 8 layers. Do not stack flour and meals higher than 20 layers. Do not stack grits or whole grains higher than 30-40 layers.

II STORAGE INSPECTION CHECKLIST

Date: _____

Inspected by: _____

Warehouse: _____

A. Yard Area Surrounding Warehouse

- ___ 1. Inspect the yard for signs of rodents (i.e., pellets, tracks, burrows, holes, signs of feeding).
- ___ 2. Check to see that conditions do not attract insects (i.e., spilled commodities or other edible materials, empty containers, bird nests, weeds, trash, piled or damaged packing materials).
- ___ 3. Remove trash and unnecessary equipment and supplies regularly.
- ___ 4. Check the general security of the yard area surrounding the warehouse.

B. Warehouse

- ___ 1. Screen openings with wire netting with mesh not larger than 6.35 mm.
- ___ 2. Make doors of tightly fitting metal.
- ___ 3. Check for roof leaks.
- ___ 4. Check for holes in the walls.
- ___ 5. Ensure that the floor is sufficiently hard-packed to prevent burrowing by rodents.
- ___ 6. Check to see that the warehouse is well lit.
- ___ 7. Clean and service the anticoagulant and rodent bait stations regularly, and keep them filled with fresh bait (exterior use only)
- ___ 8. Use rodent tracking powders (exterior use only)
- ___ 9. Use multiple-catch mouse traps, snap traps, and glue boards in the interior of the warehouse and check them weekly.
- ___ 10. Position commodity stacks at least one meter from walls and other stacks.
- ___ 11. Keep passageways clean.
- ___ 12. (For large and very large warehouses) Provide three to four meters wide central gangways.
- ___ 13. Stack at a reasonable height for ease of handling and to prevent damage to containers by crushing or falling from stacks.
- ___ 14. Lift bags by the body instead of corners (to prevent tearing or weakening of the bag).
- ___ 15. Place bags on stacks, do not throw.
- ___ 16. Make sides of stack flush.
- ___ 17. Provide air spaces between the individual stacks.
- ___ 18. Clean empty bags thoroughly before reuse and stack neatly.
- ___ 19. Use packing materials (e.g. cardboard, wood crates) that is clean.
- ___ 20. Stack clean unused packing materials neatly.
- ___ 21. Remove broken packing materials.
- ___ 22. Cover the top of packing materials to prevent spillage of food from damaged containers to ground or floor below.

C. Commodities

- ___ 1. Stack individual commodities separately.
- ___ 2. Separate food stacks from non-food stocks.
- ___ 3. Reconstitute/re-bag commodities from damaged container into good containers, stitch the opening and weigh for correct quantity before stacking.
- ___ 4. Store any spoiled/infested food commodity away from good commodity.
- ___ 4. Observe damaged containers carefully, and fumigate them if insects appear.
- ___ 5. Examine the exterior of stacked food containers to assure that they are clean and free of mold, insects, rodents and birds.
- ___ 6. Set up a program to remove damaged commodities properly.
- ___ 7. Use insecticides or fogs.
- ___ 8. Use fumigants.
- ___ 9. Keep adequate records for a program of stock rotation (i.e. what is first in, is first out, or FIFO).
- ___ 10. Check to see that commodities are stacked on pallets to keep off the floor in both small and large warehouses.

III SHELF LIFE OF AGRICULTURAL COMMODITIES

A. GENERAL REVIEW

Shelf life refers to the average amount of time a product may be store without nutritional or organoleptic (sensory) deterioration. A food product can deteriorate for several reasons: aging, microbiological decay, chemical and physical degradation, texture changes, etc. These modes of deterioration are affected by many factors, both intrinsic (*of* or *within* the product) and extrinsic (*environmental* or *outside* the product). Controlling processing, packaging, handling and storing of the product can slow deterioration of food products. Depending on the product, this date may be a food safety date; however, it primarily refers to the length of time the product can be expected to last without significant deterioration.

<u>Intrinsic Factors</u>	<u>Extrinsic Factors</u>
moisture or water activity (Aw)	storage temperature
salt and mineral content	atmosphere (e.g., oxygen, nitrogen and carbon dioxide levels)
pH	type of packaging
physical state	light exposure
degree of microbiological contamination	water moisture/ air permeability
presence or absence of antimicrobial agents	handling
	relative humidity

B. BEST IF USED BY DATE

Shelf life is different from the “Best if Used by Date”, which is intended to tell you how long the product will retain best flavor or quality. This is not a food safety date and “Best if Used by Dates” are intended as useful guidelines. Some food may deteriorate more quickly and other foods may last longer than the times suggested. A number of factors can shorten the useful life of a food product, such as improper handling and inadequate storage temperatures. As the expiration date is not always noted on the container/bag, the inventory control methods of “first-in, first-out” (FIFO) should be practiced by those responsible for managing commodity inventories and distribution at all levels. Products kept past the “Best if Used by Date” are not necessarily “out of condition”. Food products may be eaten after the “Best if Used by Date” if the product has been properly stored, handled, and the primary container is in good condition.

In either case, the dates assigned to products are based on intrinsic and extrinsic factors, and determined by systematic study or empirical data. Systematic studies are designed to simulate actual or potential storage and handling practices of a given product and estimate shelf life through the course of chemical and analytical testing at specific intervals throughout the expected shelf life. Systematic studies may also rely on accelerated testing when dealing with products with expected long shelf lives. In some cases, shelf life evaluations can be made based on existing information, or empirical data. By gathering information from actual field use, an estimated shelf life can be determined; however, this should be confirmed through systematic studies where the mode of deterioration is a food safety hazard.

Often there is a conflict between quality and the logistic requirements of manufacturing and shipping. Compromises which have to be made should never sacrifice quality (or safety) and statutory quality standards and regulations of the product.

(Source: All Shelf Life material provided by *Contract Management Branch, USDA*)

C. TEMPERATURE AND HUMIDITY

Universal guidelines for controlling temperature and humidity conditions are impossible because these conditions and the operating environment vary from place to place. The basic instructions for field staff are:

- Keep all food commodities in dry condition.
- Do not keep wet food with dry food.
- De-bag wet commodities and dry them under the sun. Re-bag them and weigh them.
- Cross-ventilate the warehouse if possible.
- A sunroof in the warehouse is preferable.
- Covering food commodities with tarpaulin during transportation is mandatory.

IV References

CARE. Food Resources Manual. 1998. Food Aid Management Website: <http://www.foodaid.org> Commodity Management Page.

Monetization Field Manual P.L. 480 Title II Programs. USAID/BHR/FFP/Development Programs. October 16, 1998. http://www.info.usaid.gov/hum_response/ffp/monetiz.htm

Proceedings Commodity Storage and Loss Reduction Project Dissemination Workshops. Port-au-Prince, Haiti, June 29-July 2, 1998, and Johannesburg, South Africa, July 27-29, 1998. Workshops hosted by: CARE, Catholic Relief Services, Food Aid Management, World Vision Relief and Development, and USDA/OFDA. <http://www.foodaid.org> Commodity Management Page.

Save the Children Monetization Manual: Market Analysis, 2.2 Commodity Selection, pp. 2-5

Selected Bibliography of FSRC Resources on Commodity Storage, Commodity Loss, and Commodity Management. Prepared by Jessica Graef for the Commodity Storage and Loss Reduction Project Workshop July 27-29, 1998, Johannesburg, South Africa (see above). Attachment J, pp. 1-10. Food Aid Management, <http://www.foodaid.org> Commodity Management Page.