

PROCUREMENT GUIDELINES

**COMPRESSION SYSTEM
REFRIGERATORS AND
FREEZERS**

Procurement Guidelines

Compression System Refrigerators and Freezers

Key information for UNICEF staff and partners, ensuring the effective and efficient procurement of Cold Chain equipment.

This module gives guidance to the procurement of compression system refrigerators and freezers for vaccine storage.

Always make sure that you have the latest version of this document by checking the [CCSP website](#).

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Suggestions and feedback: sd.coldchain@unicef.org

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Acronyms

BPS	Battery Powered System
CCSP	Cold Chain Support Package
CO	Country Office
DOA	Direct Order Arrangement
ILR	Ice Lined Refrigerator
LTA	Long Term Arrangement
PHC	Primary Health Care
PIS	Product Information Sheets
PQS	Performance Quality and Safety
PQT	Prequalification Team
PS	Procurement Services
SD	Supply Division (UNICEF)
SDD	Solar Direct Drive
VC	Vaccine Carrier
WHO	World Health Organization

1 Needs Identification

1.1 Introduction

Refrigerators and freezers are an important link in the temperature-controlled supply chain. The decision to acquire additional Cold Chain equipment should be based on several criteria, most important of which are the current existing storage capacities for vaccines and the anticipated future storage requirements. The procurement of Cold Chain equipment should be based on national policy, Expanded Programme of Immunization (EPI) strategies and according to planned national asset acquisition and replacement policies. Acquiring refrigeration equipment calls for the involvement of EPI managers and logisticians to determine required storage capacities.

1.2 How to Choose Refrigeration Equipment

In areas with an electricity supply of 8 or more hours during a 24-hour period (whether the source is grid and/or generator), the ILRs are particularly suitable because they exhibit a holdover time of more than 24 hours. This can prevent vaccines from damage during power interruptions or regular outages.

In areas with less than 8 hours of electricity during a 24-hour period, solar-powered refrigeration systems should be chosen. Solar powered refrigerators are available as Conventional Battery Powered (BPS) refrigeration systems or Solar Direct Drive (SDD) refrigeration systems. In opting for solar-powered refrigerators, it is important to note that special parameters need to be considered prior to introducing them. System sizing is required for different sites and locations. Refer to the procurement guidelines on [Solar Powered Refrigerators and Freezers](#) for further information.



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Health workers pack ice from a large refrigerator into an insulated 'cold' box and other refrigerated containers at the health centre in the town of Shire in Tigray Region.

Some types of refrigerators include a separate freezer compartment. Depending on the capacity required, it may be necessary to use combined Ice Lined Refrigerator/Freezer equipment or designated ice pack freezers. A decision flowchart for choosing the most suitable option for vaccine storage is given in the WHO [PQS manual](#) (Section E003.5).

1.3 Types of Compressor Type Refrigeration Equipment

There are four different types of compression refrigerators and freezers:

a. Refrigerator

The entire unit is used only for keeping vaccines cool at a temperature of +2 °C to +8 °C.

b. Refrigerator/Freezer

These appliances feature a freezer and a refrigerator..

c. Freezer

Designed for the purpose of water pack freezing only or for storage of frozen vaccines (typically OPV).

d. Refrigerator or Freezer

The entire unit is used either as a refrigerator or as a freezer.

1.4 Ice-Lined Refrigerators (ILRs)

1.4.1 Introduction

Vaccine storage refrigerators are designed to operate in different climatic conditions and exhibit special characteristics. They are known as Ice-Lined Refrigerators (ILRs). The internal refrigerator walls are lined with ice packs/tubes. This ensures that during power outages the vaccine is maintained at the recommended temperature for a specific period of time. The hold-over time for an ILR is the time it takes for the temperature inside the refrigerator to rise from its minimum temperature of 2°C to 10°C.¹

1.4.2 Temperature Stability

ILRs are tested for temperature stability at ambient temperatures of 27°C, 32°C and 43°C in WHO accredited laboratories to ensure that the equipment will perform optimally. The three temperature zones are referred to as cold, temperate and hot zones - corresponding to the maximum temperatures above.

ILRs have excellent temperature recovery qualities. Temperature recovery is the fridge's ability to return to its set operating temperature after being exposed to an elevated temperature. The frequency and duration of door openings will raise the internal temperature of the refrigerator and, depending on the temperature recovery properties this may cause unsafe vaccine storage temperatures.

The temperature recovery in an ILR is very different from domestic refrigerators. ILRs are controlled by highly accurate rapid response thermal sensors. Any deviation from the pre-set temperature is registered in good time. For this reason ILRs do not need to accommodate large loads or contain water bottles to ensure efficient temperature regulation.

1.4.3 Spatial temperature differentials exhibited in domestic refrigerators

Temperature differences inside domestic refrigerators are known as 'spatial temperature differentials'. The temperature inside these models varies from one point to another. Spatial temperature differentials can result from a number of factors ranging from the type of insulation to the method of cooling as well as compartment shapes and loads. For example, the temperature on the top shelf may vary from the temperature on the bottom shelf or from the sides or front to back on each shelf. Fan cooling distributes air in the compartment but this does not guarantee uniform temperatures throughout.

1.4.4 WHO-PQS² listed cold chain products

[WHO-PQS](#) listed ILRs are specially designed to avoid spatial temperature differentials and ensure uniform temperature distribution - eliminating the possibility of placing vaccines in a warm or freezing location. Should vaccine potency be compromised due to contact with cold internal cabinet walls, the WHO prequalification performance test protocol requires wire baskets to be part of the ILR for it to become pre-qualified for safe storage of vaccines.

¹ Full description of hold-over time: The time in hours during which all points in the vaccine compartment remain between +2°C and +10°C, at the maximum ambient temperature of the temperature zone for which the appliance is rated, after the power supply has been disconnected.

² WHO PQS is the WHO product quality system. PQS stands for Performance, Quality and Safety.

1.5 Note on Absorption Type Refrigerators

Although the WHO PQS includes a standard for absorption type refrigerators, UNICEF SD no longer recommends their procurement. Solar powered systems may prove to be the most viable alternative. Absorption refrigerators are poor in efficiency, while it proves difficult to control the temperature within the recommended parameters. Moreover, kerosene absorption refrigerators are environmentally unfriendly and contribute to global warming.

2 Refrigerators and Freezers supplied by UNICEF SD

UNICEF Supply Division (SD) supplies refrigerators and freezers that comply with the quality requirements set by WHO, documented in the [WHO PQS catalogue](#).³ UNICEF SD procures WHO pre-qualified refrigerators and freezers via Long Term Arrangements (LTAs)⁴.

The following compression system refrigerators and freezers are supplied by UNICEF SD (LTA, 2014), available from various manufacturers:

Ice lined refrigerator	30-49 litres
	50-99 litres
	100-119 litres
	120-149 litres
	150-199 litres
	>= 200 litres

Ice lined refr./freezer	50-99 litres
Vaccine freezer	50-99 litres
	100-199 litres
	>200 litres
Ice pack freezer	60 litres (net volume)

Currently available on Direct Order Arrangement (DOA) are:

Ice lined refrigerator	30-49 litres
	50-99 litres
	>= 100 litres
	>= 120 litres
Combined refr./freezer	10-29 litres
	50-99 litres

Compressor freezer	50-99 litres
	>= 100 litres
	>= 200 litres
Refr. or waterpack freezer	
Waterpack freezer	

3 Budgeting

For information about budgeting for procurement, refer to the [General Procurement Guideline](#).

³ In cases where no WHO PQS product exists for a category, UNICEF technical standard applied has been the former PIS (Product Information Sheets).

⁴ UNICEF SD establishes Long Term Arrangements (LTAs) with product suppliers, usually for a period of 24 months. Refer to the document [General Procurement Guideline](#) for further details on LTAs.

4 Ordering

4.1 Starting the Process

Refer to the [General Procurement Guideline](#) and the [UNICEF SD Procurement Services](#) website for general guidance on how to order Cold Chain products and services. In the event that the General Procurement Guideline does not provide sufficient information, please contact the [Supply Division Procurement Services](#) for specific queries.

4.2 Delivery Lead Times

Refer to the section 'When to Order' in the document '[General Procurement Guidelines](#)'.

4.3 Technical Considerations

a. Generator

In some locations, the electricity supply for the refrigerators and freezers is not stable and reliable. In these cases a standby generator is recommended. The WHO pre-qualified refrigerators will remain below +10°C for at least 4 hours when the power is interrupted.

b. Voltage Stabilisers

Refrigerators and freezers have components that are sensitive to power fluctuations. Intermittent national grid power supply, as well as stand-by generators during start-up on heavy load pick-up and shut down, resulting in transients that contribute to system failure. This creates high surges that are detrimental to sensitive components and accessories, leading to their failure. WHO and UNICEF recommend that, unless the mains electricity is highly reliable, ordering a voltage stabiliser for all mains or generator powered equipment. Refer to the relevant module on Voltage Regulators and Stabilisers for further information.

c. Weight and Volume Factors

Estimated weights and volumes of refrigerators and freezers are listed in the [UNICEF Supply Catalogue](#) (click on equipment item for detailed information).

4.4 Ordering Spare Parts

When ordering refrigerators and freezers, the manufacturers' guidelines should be observed in ordering spare parts and consumables. The situation in some countries is such that spare parts cannot be sourced locally at short notice. In these circumstances it may be prudent to order essential spare parts together with the equipment. Some countries have a maintenance workshop tasked with the maintenance and repair of Cold Chain equipment. Such a workshop may keep a stock of essential spare parts, which facilitates a rapid response in case of equipment breakdown. Refer to the Manufacturers' Product Documentation for details on recommended spares.



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Maintenance of a refrigerator in Haiti. Common spare parts for compressor type refrigerators include compressors and thermostats.

5 Transport Handling

Transport handling for compression system refrigerators and freezers requires caution. In the unlikely event of oil circulation in the refrigeration circuit of a compression refrigerator and freezer system, the equipment will be rendered inoperative. Compression refrigerators and freezers should always be transported in the upright position to avoid the oil in the compressor getting into the system cycle. After transportation of these products, a minimum of three hours should be allowed for the stabilisation of the oil before connecting to the power supply.

The necessary local resources for transportation, manpower and time should be included in the planning process. For further information on transport issues refer to the document [General Procurement Guidelines](#).

6 Installation

The efficiency of refrigeration cooling systems depends on dissipation of heat from the condenser. For the efficient operation of refrigerators and freezers, it is recommended that they are installed with a minimum space of 200 mm from the wall to allow for adequate air circulation. This also allows ample space for technicians when they carry out preventive maintenance.

7 Commissioning

Equipment commissioning is a formalised process through which equipment is tested, demonstrated and officially accepted by the owner. Equipment commissioning needs to be conducted to ensure that equipment is functioning properly before it is put to use. In the case of Cold Chain equipment other than cold and freezer rooms, there is no formal commissioning procedure. The forwarding agent delivers the goods to the destination, after which the beneficiary takes care of in-country distribution and installation.

8 User Training

In order for refrigerators and freezers to deliver their intended services, staff using the equipment need to be trained in using the equipment correctly. Training should include routine and preventive maintenance actions, including:

- a) temperature monitoring
- b) cleaning of the equipment
- c) fault reporting.

The User Manual supplied by the manufacturer is an important source of information. Refer to the Manufacturers' Product Documentation for further information on correct use of the equipment.



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A female vaccinator in Faizabad, north-east Afghanistan, takes out vaccines from a deep freezer and prepares them for dispatch to the field.

9 Maintenance

Maintenance serves the purpose of keeping refrigerators and freezers in good working order throughout their lifetime. A distinction is made between corrective and preventive maintenance.

The following functions should be carried out periodically to ensure efficient operation of vaccine refrigerators and freezers.

- a) Regular dusting of the evaporator and compressor
- b) Defrosting when ice build-up is noticed on the evaporator
- c) Cleaning of door seals and application of talc powder
- d) Periodic greasing of hinges

The frequency of these maintenance actions will depend on local circumstances. In addition, supplier specific preventive maintenance tasks should be followed. Refer to the Manufacturers' Product Documentation for further information on routine maintenance.

10 Complaints Handling

For Complaints Handling procedures refer to the [General Procurement Guideline](#).

11 Warranty

For Warranty issues refer to the [General Procurement Guideline](#).

12 Decommissioning

Decommissioning refers to the process of writing-off and physically disposing of equipment that is no longer cost-effective. Countries are advised to adhere to national public sector procedures for the correct disposal of health sector physical assets.

Annex 1: Additional Resources

Links to additional resources specifically on compressor type refrigerators and freezers.

Description	Source
Technician's Handbook for Compression Refrigerators, Part A: Servicing and Repair Techniques	WHO/PATH website
Technician's Handbook for Compression Refrigerators, Part B: Faults and Fault Finding	WHO/PATH website
Handbook for Vaccine and Cold Chain Handlers	UNICEF website (India)

Note: Users of this manual are invited to suggest additional resource materials, to add to this list.

Annex 2: Record of Revisions

Date	Description
April 17, 2014	First draft of this manual, by UNICEF SD\HTC\Cold Chain Unit
June 26, 2014	Second draft, by UNICEF SD\HTC\Cold Chain Unit
August 9, 2014	Update by UNICEF SD\HTC\Cold Chain Unit