USER'S HANDBOOK FOR VACCINE COLD STORES

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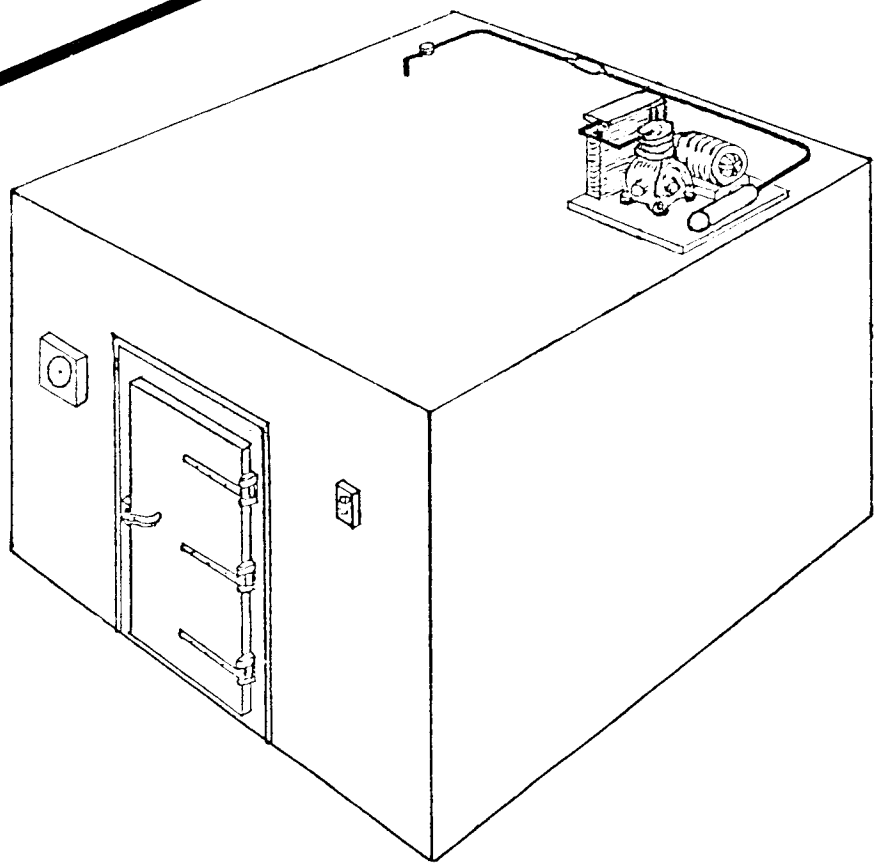

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EPI/LOG/84/22/ Rev.1

USER AND MAINTENANCE HANDBOOKS

This User Handbook, produced by the Expanded Programme on Immunization, is included in two series of cold chain training course materials:

(a) REFRIGERATORS USE, MAINTENANCE AND REPAIR SERIES

This series comprises 18 booklets designed to improve the standards of refrigerator and cold room maintenance and repair, which are grouped into 2 sub-series:

- User and Maintenance Handbooks: Each of the following pairs of handbooks forms a one-day course for people who use cold rooms or compression, kerosene, gas or solar refrigerators:

14. How to look after a compression refrigerator
15. User's handbook for compression refrigerators
16. How to look after a kerosene refrigerator
17. User's handbook for kerosene refrigerators
18. How to look after a gas refrigerator
19. User's handbook for gas refrigerators
21. How to look after a cold store
22. User's handbook for cold stores
25. How to look after a solar powered refrigerator
26. User's handbook for solar powered refrigerators

- Repair Technicians Handbooks: The following handbooks are the basic training materials for a 10-day course for refrigerator repair technicians:

A. Servicing and repair techniques
B. Faults and fault-finding
C. Repair work
D. How to keep stocks of spare parts
E. Task sheets and progress tests
E Add.1 Task sheets on solar refrigerators
F. Instructors handbook
G. Manufacturers spare parts lists
H . Fault-finding and repair of solar powered refrigerators

(b) LOGISTICS AND COLD CHAIN FOR PRIMARY HEALTH CARE SERIES

This series comprises 27 booklets which are designed to estimate the demand for supplies, to store and distribute the supplies properly, and to maintain the equipment required for storage. Following is the complete list of booklets in this series:

1. How to estimate requirements for an existing store
2. How to store supplies
3. How to distribute supplies
4. How to keep records and calculate wastage
5. How to control quality of stocks
6. How to estimate requirements for the first time
7. How to estimate chloroquine requirements for the first time
8. How to estimate ORS packet requirements for the first time
9. How to estimate vaccine requirements for the first time
10. How to estimate contraceptive requirements for the first time
11. How to estimate essential drug requirements for the first time
12. The cold chain game
13. How to improve communication
14. How to look after a compression refrigerator
15. User's handbook for compression refrigerators
16. How to look after a kerosene refrigerator
17. User's handbook for kerosene refrigerators
18. How to look after a gas refrigerator
19. User's handbook for gas refrigerators
20. How to keep stocks of spare parts
21. How to look after a cold store
22. User's handbook for cold stores
23. Instructors guide
24. Evaluation questionnaire
25. How to look after a solar powered refrigerator
26. User's handbook for solar powered refrigerators
27. How to use the vaccine cold chain monitor

Further information on these booklets available from the Expanded Programme on Immunization, World Health Organization, 1211 Geneva 27, Switzerland.

USER'S HANDBOOK FOR VACCINE COLD STORES

This book is to help the users of vaccine cold stores to get the best out of their equipment.

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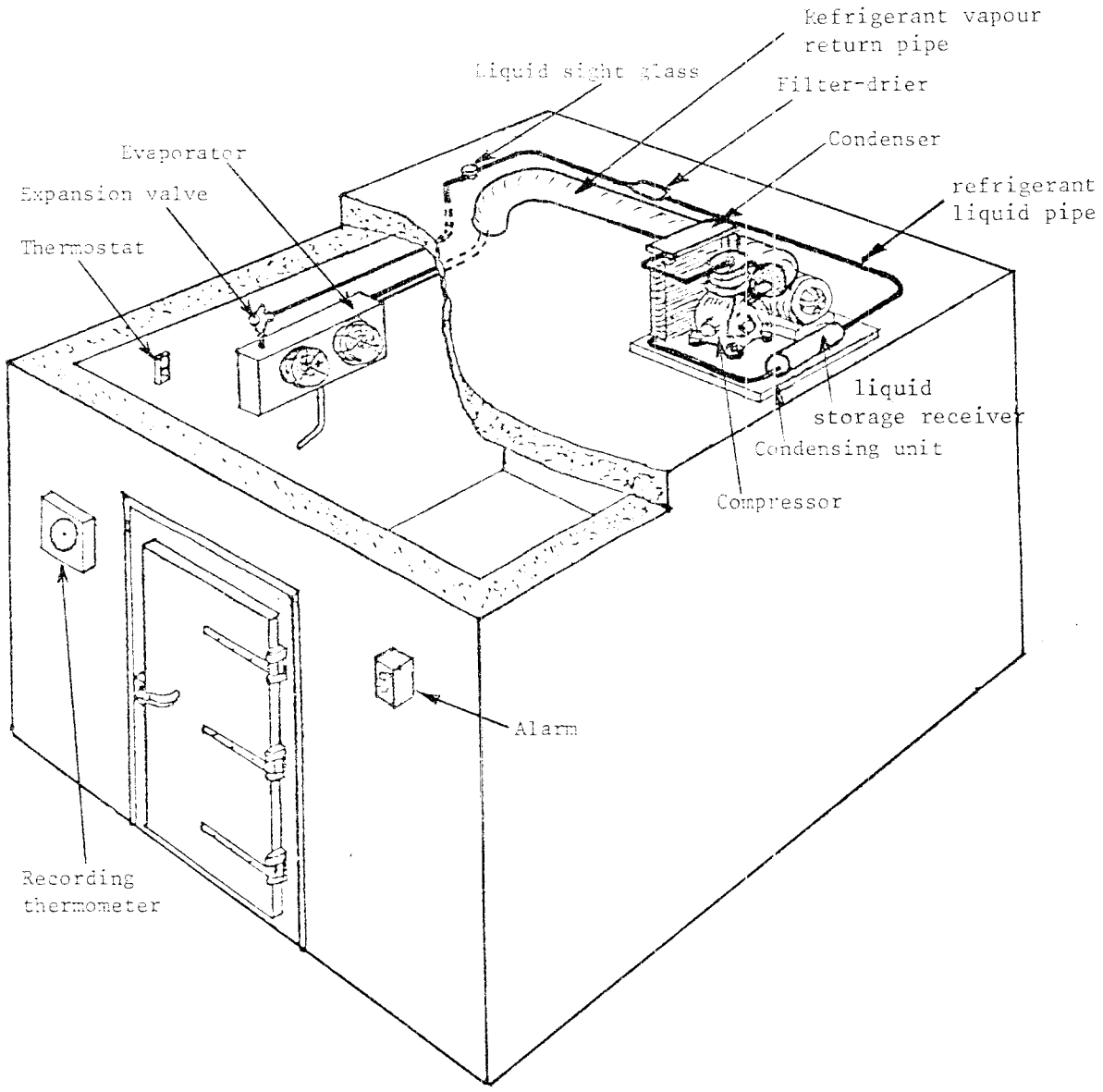
Figure 1 : Main parts of a cold store



Introduction

This book is arranged in six part. The various parts tell you:

- How to work safely;
- How the cooling equipment in a vaccine cold store works;
- How to look after the cold store;
- How to recognise faults and problems;
- How to carry out repairs and maintenance;
- What spare parts and tools are needed.

I. HOW TO WORK SAFELY

Safety for people

1. Before anyone enters a cold store, check that the door can be opened from the inside.

2. Warm clothing is recommended, even for short periods inside a cold store. This is especially important for freezer stores.

3. No-one should remain inside a cold store for more than a few minutes on their own. The body quickly becomes chilled, and reactions become slow.

4. If more than two or three people go inside a cold store at the same time, count the people before they go in, and again when they come out. Make sure no-one is left behind.

Safety for vaccines

1. Open the door as little as possible.

2. Keep the cold store locked and make one person responsible for the key.

3. Switch off cold store lights as soon as you have finished working inside, to avoid unnecessary heat reaching the vaccine.

4. Keep the cold store clean, inside and outside. Make sure there is sufficient space for good air circulation around the vaccine and over the evaporator cooling surfaces. Do not allow the cold store to become overloaded.

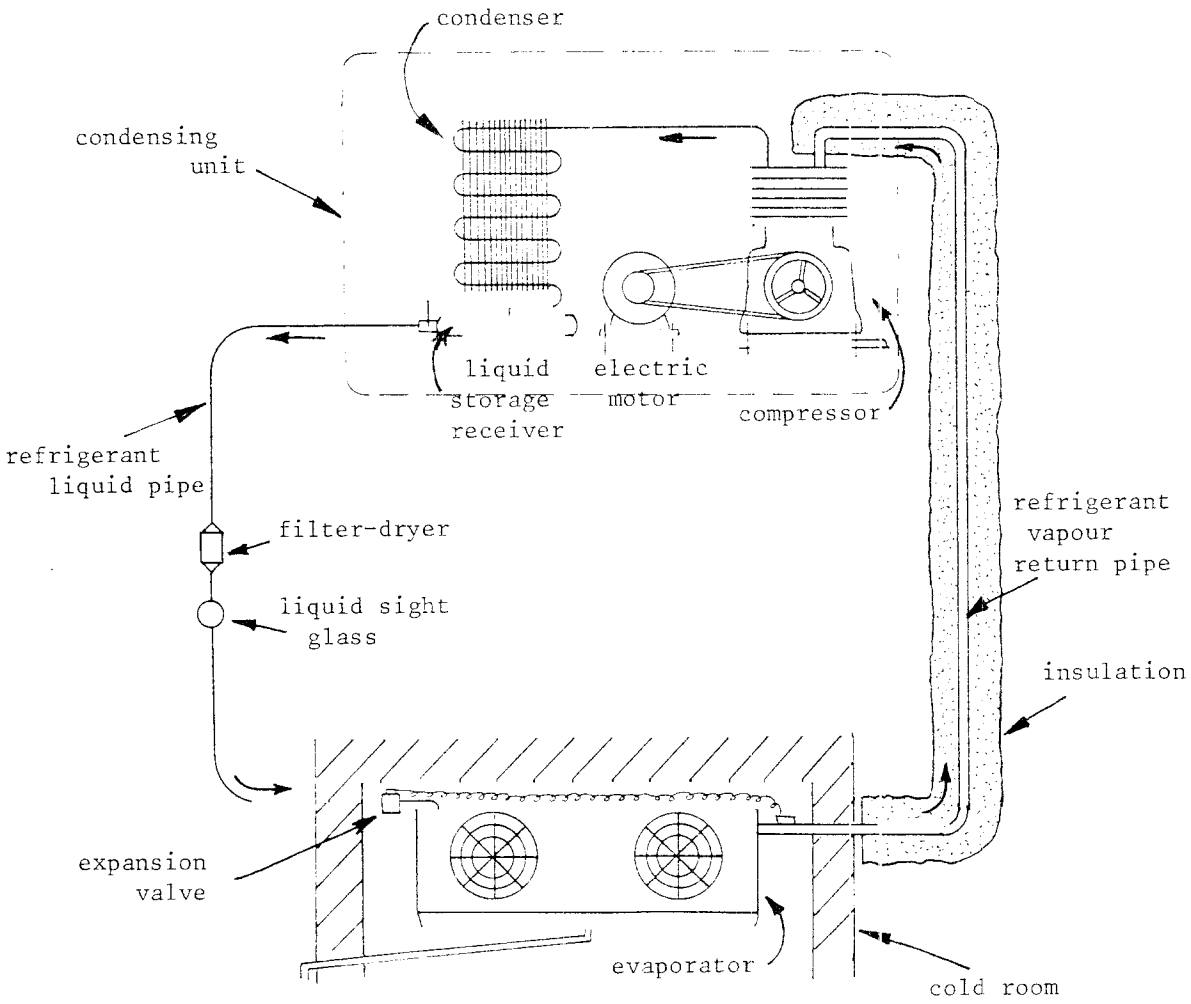
Safety during maintenance

1. When carrying out maintenance involving electrically operated parts, make sure the power is switched off before starting work.

2. When carrying out maintenance on moving parts work very carefully, and switch off the moving part wherever possible. Replace all covers and guards after finishing the work.

3. The refrigerant gas or liquid used in the cooling equipment can be dangerous. When there is a possibility of refrigerant leaking from the equipment, do not use open flames in the area, and do not smoke.

Figure 2 : The cooling equipment



II. HOW THE COOLING EQUIPMENT WORKS

You will be able to look after the cooling (refrigerating) equipment very much better if you understand how it works. Read the following notes carefully and follow the diagrams in Figures 1 and 2. Together, they will help you understand your equipment.

The cooling equipement consists of the following main parts:

The evaporator: this is fixed on one of the inside walls or ceiling of the cold store. It consists of a large number of pipes or tubes with metal fins fitted on the outside. A liquid (the refrigerant) is supplied to the inside of the pipes and it evaporates (turns into vapour) at a low temperature - usually just below $0^{o}C$ for a cold store, or at around $-25^{o}C$ in a freezer store. When the liquid evaporates at this low temperature, it produces a cooling effect and this keeps the contents of the cold store cool.

The condensing unit: this is often fixed on the top of the cold store, but may also be beside or behind the store on the ground. Many well-designed cold stores have two identical units, one in use, and the second to act as a standby. Each unit consist of the following parts:

1. A compressor: this acts like a pump and is driven by an electric motor to pump vapour out from the evaporator as it is formed from the liquid refrigerant. This vapour is compressed (raising its pressure and temperature) and delivered into:

2. a condenser: this consists of a series of pipes fitted with metal fins (similar to the evaporator). The compressed vapour is cooled in these pipes by air from a fan. This causes the refrigerant vapour to condense back into a liquid which passes into:

3. a liquid storage receiver: the main purpose of this vessel is to provide a reservoir of liquid to ensure constant circulation of the refrigerant, but it also provides storage for the refrigerant when repairs have to be carried out. (All the liquid in the system is transferred into the receiver and stored there to prevent loss.)

All these three parts of the condensing unit are fitted together on a metal plate or frame.

Filter-drier: this is fitted to the pipe which carries liquid from the storage receiver and the filter removes small pieces of dirt which might block the system and restrict the flow of refrigerant. The drier absorbs any water in the refrigerant which might otherwise freeze at the expansion valve and would also cause corrosion.

Liquid sight glass: this is also fitted to the liquid pipe, immediately after the filter-drier. It should be completely full of liquid. If bubbles can be seen in the sight glass, you will know that refrigerant has leaked from the system or that there is a blockage somewhere.

The sight glass usually also contains an indicator which changes colour to show whether there is water present in the refrigerant. Normally, green will indicate no water or "dry" conditions, whilst yellow will show that water is present. If this indicator changes from "dry" to "wet", the filter drier is no longer absorbing moisture properly and must be replaced.

The expansion valve: this is supplied with liquid refrigerant from the storage receiver. It then reduces the pressure of the refrigerant, and feeds it into the evaporator. The expansion valve must control this flow very carefully. If it does not supply sufficient liquid to the evaporator, the cooling effect will not be sufficient to keep the cold store at a low enough temperature. If the valve supplies too much liquid to the evaporator, not all of the liquid will turn into vapour inside the evaporator. The "extra" liquid will then be drawn into, and eventually damage, the compressor.

Other parts fitted to the cold store and cooling equipment:

Cold store thermostat: this is fitted to keep the temperature inside the cold store at the required level. When the temperature becomes too warm the thermostat will automatically start the compressor, and the cold store will cool down. When the temperature has become cold enough the thermostat will automatically stop the compressor.

Cold store alarm: this is fitted to protect the vaccine from unsuitable storage temperatures. A bell or hooter will ring loudly if the storage temperature is either too high or too low, and also if there is a failure of the electrical supply to the cooling equipment.

Recording thermometer: this is fitted to provide a record of the temperature inside the cold store. A circular chart rotates inside a case with a glass front. A pen continuously marks the cold store temperature on the chart.

Safety controls: most cold stores are fitted with a number of safety devices to protect the equipment and the user if faults should develop:

1. High pressure cut out: designed to prevent the pressure in the system from becoming too high.

2. Low pressure cut out: arranged to switch off the compressor if system pressure becomes too low.

3. Oil differential cut out: ensures that proper oil lubrication of the compressor is maintained.

4. Motor overload protectors : prevent the electric motors from damage due to excessive load and heat.

5. Electrical fuses: protect the entire system, from damage due to excessive power.

(Note: Not all cold stores will be fitted with every one of these controls.)

* * * * * *

All parts of the cold store and its cooling equipment require regular attention. This book gives instructions on how to maintain the cold store in good order.

III. HOW TO LOOK AFTER THE COLD STORE

General points

1. Keep the outside of the cold store as cool as possible. This will reduce the work of the cooling machinery. If the cold store is outdoors, trees or other screens help to keep sunlight off the surfaces. If the cold store is inside a building, good ventilation or air-conditioning will help to keep it cool.

2. Inspect the inside and outside of the cold store. Carry out small repairs, painting scratches, adjusting door hinges and oiling locks. Report any severe damage immediately to the repair technician.

3. If you have an emergency standby electrical generator, make quite sure that you know how to use it before the main supply fails. Keep the starter battery charged and in good condition, and ensure you have a good stock of fuel. Keep the starting handle in a safe place, near to the generator.

4. Find where the main switch and electrical supply fuses are. Make sure that you have spare fuses and know how to fit them.

5. Find out the name and telephone number of the cold store supplier or agent. Have the number ready for use in case you need it quickly.

6. Find out the names and telephone numbers of other cold stores or refrigerator users in the area. Find out if they would be willing to store your vaccines temporarily if you ever have an emergency. Do this before any emergency occurs.

7. Ensure that you have as much ventilation as possible around the condensing unit(s). Do not allow vaccine boxes etc., to be placed on or near the cold room, or in doorways and passages. This reduces the ventilation.

8. Listen to the equipment. Learn what it sounds like and how long it runs when it is operating properly. This will help you to recognise faults before they become too serious. Cold stores run more during the hot season. The running time of the unit may vary considerably depending on the outside temperature, how often the door is opened, etc. For most cold stores, the running time should not be more than three quarters of the day. In practice, this could mean that in any 10 minute period, a typical unit might run for 7 minutes and rest for 3 minutes, whilst for larger cold rooms or heavy load conditions, running times may be considerably longer.

Periodic attention

Every day:

- Check the temperature of the cold store. It must be between 0 and +8°C, or between -15 and -25°C for a freezer store.

- Look at the chart recorder and examine the record of temperature since your last check. It should have remained within the correct limits at all times.

- Listen to the cooling machinery. If you notice any unusual noise, or the unit seems to run longer than normal, you must find the reason. See "Fault finding charts" on pages 17 to 22..

- Go into the cold store. Check:

    1. Air flow: There should be a good flow of cold air coming from the evaporator. If this is not happening, see page 25, para 3.

    2. Noise: The evaporator fan should be running quietly. If it is squeaking, rattling or vibrating, see pages 19-22.

    3. Water: If there is water on the floor, the evaporator drain pipe has probably blocked, see page 25, para 2.

- At the end of each working day make sure that:

    1. all lights in the cold store are switched off;

    2. there is nobody still inside;

    3. the door of the cold store is securely closed and locked (if there is no lock, you should fit one or ask the technician to do so).

Every week

- Remove the paper chart from the temperature recorder and keep it carefully. Write the date on it. Wind up the recorder clock mechanism and re-fill the ink containers. Fit a new chart and restart the recorder at the correct time and date. Write the date on the new chart.

- Check the liquid sight glass. It must be completely filled with liquid and show "dry" conditions. If you see bubbles, there may be a leak of refrigerant; refer to page 26. If the moisture indicator shows "wet", the filter-dryer probably needs changing. Ask the technician to check and replace it if necessary.

- Check the ice and frost formation on the evaporator. Switch off the evaporator fan and remove the evaporator front cover. Look at the pipes and fins. If they are coated with ice more than 6mm (1/4 inch) thick, the evaporator must be defrosted (page 25, para 1).

- Test the cold store alarm. Press the button marked "battery test" (see page 43). The alarm should sound with a loud intermittent signal. If it does not, the alarm is faulty, and you must notify the repair technician immediately.

- Feel the outside of the electric motor whilst it is running. If it is too hot for you to place your hand on it, notify the repair technician. The motor may be overloaded.

- If your condensing unit has rubber belts driving the compressor and fan, switch off the compressor at the main switch and carry out the following:

    1. Check the belts which drive the condenser fan and compressor. If they are loose, tighten them (see page 44). If they are worn, damaged or oily, replace them (see page 45). Remember to replace any safety covers or guards if they have been removed.

    2. Check the oil level in the compressor (see page 47). If it needs topping up, notify the repair technician.

(Note: many compressors are not driven by belts from a separate motor, but the motor and compressor are joined directly together, and are sealed inside a metal case. The checks described under 1. and 2. in this paragraph do not apply to them.)

Every month

- Switch off the condensing unit:

  1. Examine all connections and parts in the refrigeration system for leakage of oil. If a connection is leaking, both refrigerant and oil will escape. The refrigerant will evaporate into the air but the oil will remain on the surface where the leak has occurred. If you find any leak, but are unable to repair it (see page 27), call the repair technician immediately.

  2. Make sure that the compressor and electric motor have not become loose and that the driving belts are correctly tensioned and lined up (pages 45-46).

  3. Remove all dirt and dust from the outside of the compressor, the electric motor, the condenser and its fins. Use a piece of cloth to wipe any oil or grease off the compressor and motor. Use a soft brush to clean the condenser (see page 24). Remove all dirt from the spaces between the fins. Take care not to damage the fins.

  On completion of 1.-3., switch the condensing unit on again. If your cold store has a second standby unit, you should normally use the units alternately, one month at a time. In this case, the unit which has been in use for the past month now becomes the standby unit. It is important that you carry out the periodic checks described above before changing over to the standby unit. In this way, the standby unit will always be ready for use when needed.

- If you have a standby generator, check the battery electrolyte level, and the oil and fuel levels of the engine. Start the generator, and make sure that it runs properly. Refill the fuel tank, and make sure the generator is ready for use when needed.

- Check that the cold store door is sealing properly. It is important that the door closes onto its seal, to prevent warm outside air from entering. Check this by standing inside the store with the door tightly closed and the inside lights switched off. If the door is not sealing properly, you will see light from outside. Page 51 tells you what to do.

- Check the vaccine stock. Count each type of vaccine in the store, and ensure that the actual amount agrees with that shown on your stock register. Use all old vaccine stocks before starting to issue new stocks, and re-check the expiry date of each batch you have in stock. Make sure that all vaccines are in their proper place in the store.

IV. HOW TO RECOGNISE FAULTS AND PROBLEMS

The cooling equipment is not working properly when any of the following occur:

1. The condensing unit will not start (see page 13).

2. Not enough cooling; storage temperature too high (above +8°C for cold stores or above -15°C for freezer stores) (see page 14).

3. Too much cooling; storage temperature too low (below 0°C for cold stores or below -25°C for freezer stores) (see page 16).

4. Storage temperature correct but the condensing unit runs for very long periods (see page 17).

5. Storage temperature correct but the condensing unit runs noisily (see pages 19-22).

Fault finding tables:

On pages 13-22 you will find a table for each of the symptoms described above. These tables are to help you find the fault if your cold store is not working properly. Use the tables as follows:

1. Always start checking with the fault shown in box 1 at the top left of the page. Answer the question in the box.

2. If the answer to the question is "no", follow the "no" line to the right, and find what steps you must take to correct the fault.

3. If the answer to the question is "yes", follow the "yes" line downwards to box 2, which shows the next most likely fault. Answer the question in box 2.

4. Follow the "no" or "yes" lines, whichever applies.

6. Make quite sure that a fault does not exist before going on to the next box.

7. If, after checking all the possible faults, the cold store is still not working properly, start again at box 1 and check everything again.

8. If, after checking all possible faults twice, the cold store is still not working properly:

   - Switch on the standby condensing unit or, if you have no standby,

   - transfer the vaccine to another cold store or refrigerator at the correct temperature, and then, in either case:

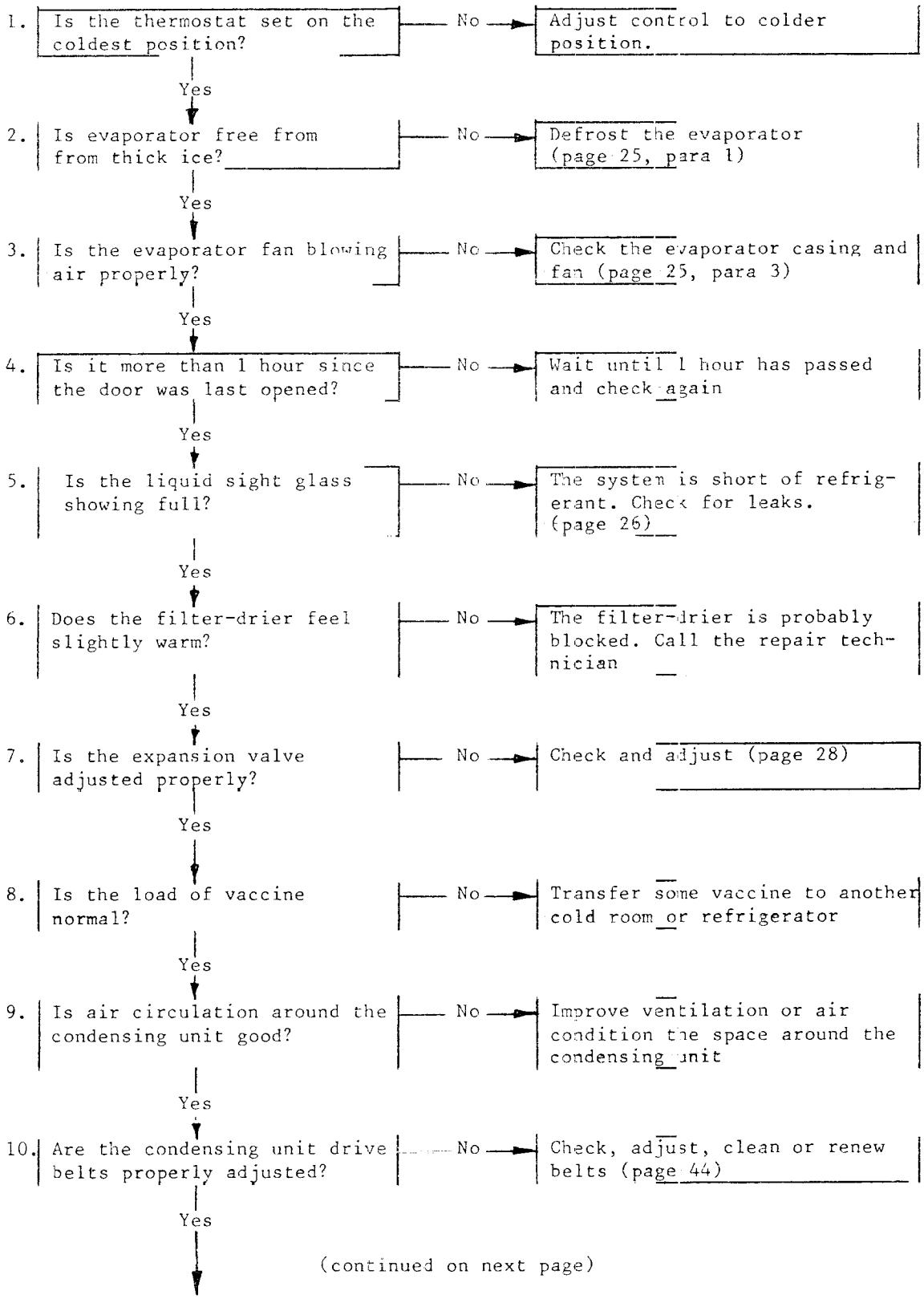
   - immediately notify the repair technician to repair the faulty unit.

FAULT FINDING TABLE 1 - CONDENSING UNIT WILL NOT START

1. Is electric power available? (page 35)
   - No → Switch on standby generator.
   - Yes ↓
2. Are the fuses intact?
   - No → Repair the fuses (page 37)
   - Yes ↓
3. Does the thermostat "click" if turned to a colder setting?
   - No → Check the thermostat (page 30)
   - Yes ↓
4. Are the safety cut out buttons pushed in? (page 40)
   - No → Reset the safety cut-outs and investigate the cause of them being activated (page 42)
   - Yes ↓
5. Are the moter overload protectors set?
   - No → Reset the protectors (page 39)
   - Yes ↓
6. Is the supply voltage correct (page 36)
   - No → Switch on the standby generator
   - Yes ↓
7. Are all electrical connections secure?
   - No → Repair, clean and tighten as necessary (page 39)
   - Yes ↓
8. Is the compressor electric motor making a buzzing noise?
   - No → There may be an internal fault in this motor. Switch on the standby condensing unit and notify the repair technician
   - Yes ↓
9. This electric motor has probably failed. Switch on the standby condensing unit and notify the repair technician

WORK SAFELY - SWITCH OFF POWER BEFORE CHECKING FUSES OR SECURING ELECTRICAL CONNECTIONS

FAULT FINDING TABLE 2 - NOT ENOUGH COOLING (STORAGE TEMPERATURE TOO HIGH)



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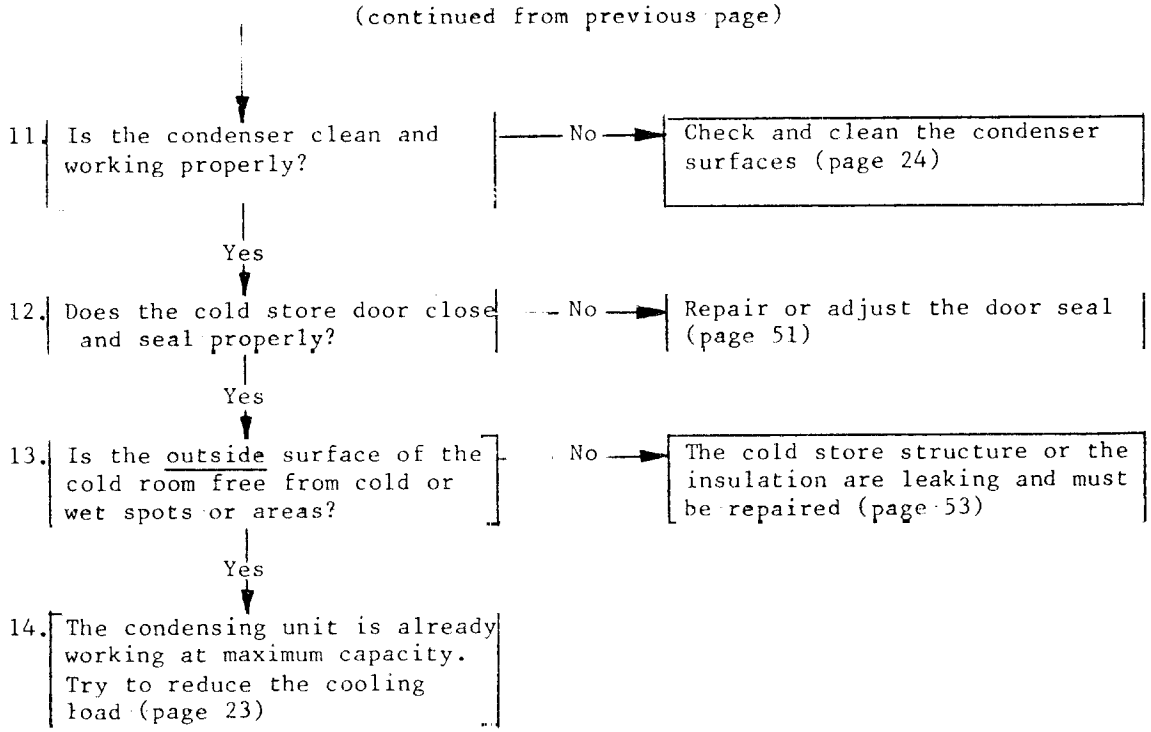


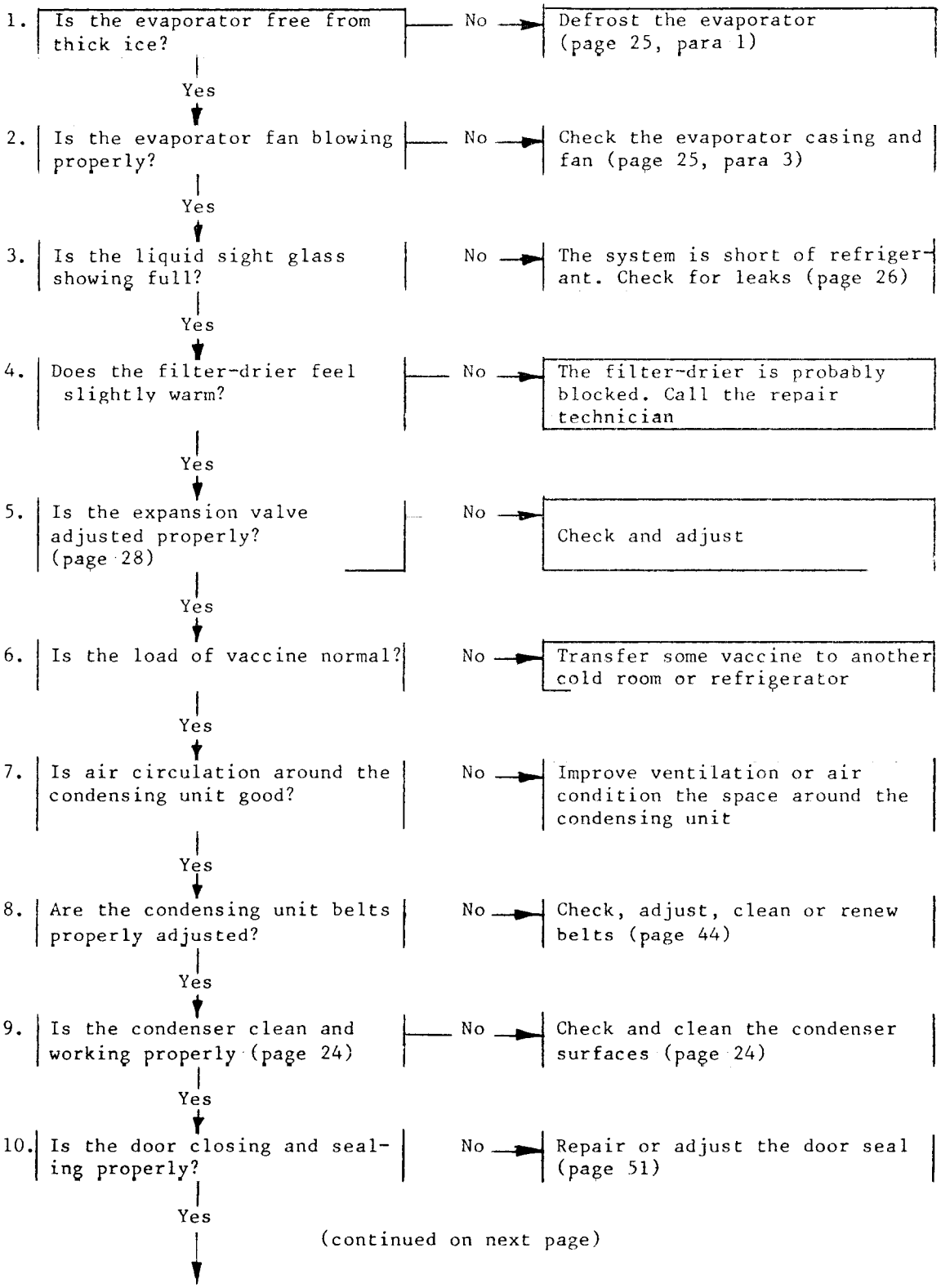
SAFETY - MOVING PARTS, FANS, BELTS, ETC., CAN BE DANGEROUS.
SWITCH OFF BEFORE WORKING WHERE EVER POSSIBLE

FAULT FINDING TABLE 3 - TOO MUCH COOLING (STORAGE TEMPERATURE TOO LOW)

1. Is thermostat set on the warmest position?
   - No → Adjust thermostat to warmer position
   - Yes ↓
2. Is it at least 30 minutes since last adjusting the thermostat?
   - No → Wait 30 minutes and check the temperature again
   - Yes ↓
3. Is the condensing unit still running and the temperature too low?
   - No → Wait. The cold store temperature is still rising
   - Yes ↓
4. The thermostat is faulty, and must be replaced (page 32)

SAFETY - TEMPERATURES BELOW 0° WILL DESTROY DPT, TT AND DT VACCINES. DO NOT ALLOW YOUR STORE TO GET TOO COLD.

FAULT FINDING TABLE 4 - TEMPERATURE CORRECT, BUT UNIT RUNS TOO LONG OR CONTINUOUSLY



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11. Is the outside surface of the cold room free from cold or wet spots or areas

— No → The cold store structure or the insulation is leaking and must be repaired (see page 53)

Yes

12. Does turning the thermostat to a warmer position cause the condensing unit to stop?

— No → The thermostat is faulty and must be replaced (page 32)

Yes

13. The condensing unit is working at maximum capacity. Try to reduce the cooling load (page 23)

SAFETY - WORK CAREFULLY
- REMEMBER THE SAFETY POINTS ON PAGES 3 AND 4

FAULT FINDING TABLE 5 - TEMPERATURE CORRECT BUT UNIT NOISY

5.1 Loose, rattling noises

1. Have covers for belt drives been tightened?
   - No → Check bolts and screws and tighten or replace (page 48)
   - Yes ↓
2. Are condenser and evaporator fan blades rotating freely?
   - No → Carefully bend away any part touched by the fans (page 48)
   - Yes ↓
3. Are the casing and covers of the evaporator and condenser secure?
   - No → Check bolts and fixings. Tighten or replace (page 48)
   - Yes ↓
4. Does the loose, rattling noise seem to come from inside the compressor or motor?
   - No → Check other possible sources. The noise may not be from the cooling equipment
   - Yes ↓
5. Call the repair technician immediately. There may be a major fault developing.

SAFETY - WORK CAREFULLY
- SWITCH OFF MOVING PARTS BEFORE WORKING WHEREVER POSSIBLE

5.2 Dry, squeaking noises

1. Are the driving belts dry, clean, correctly tensioned and lined up?
   - No → Check, clean, adjust or renew belts as necessary (page 44)
   - Yes ↓
2. Have all bearings and other moving parts been properly lubricated?
   - No → Lubricate as necessary (page 49)
   - Yes ↓
3. Does the dry, squeaking noise seem to come from the compressor or motor?
   - No → Try to locate the noise when first starting the condensing unit (page 48)
   - Yes ↓
4. Call the repair technician immediately. There may be a major fault developing.

WORK SAFELY - SWITCH OFF MOVING PARTS BEFORE CLEANING, ADJUSTING OR LUBRICATING

5.3 Heavy, knocking or banging noises

1. Are the holding bolts for the compressor and motor secure?
   - No → Replace and/or tighten as necessary (page 49)
   - Yes ↓
2. Are the mounting springs for the compressor holding the unit firmly?
   - No → Renew or tighten the springs (page 49)
   - Yes ↓
3. Is a heavy knocking or banging noise coming from the compressor or motor?
   - No → Check other nearby equipment. The noise may not be from the cooling equipment.
   - Yes ↓
4. Have the compressor and motor bearings been checked for wear?
   - No → Ask the technician to check for wear and noise. (page 49)
   - Yes ↓
5. Call the repair technician immedately. There may be a major fault developing

SAFETY - HOLDING BOLTS AND MOUNTING SPRINGS ARE PROBABLY NEAR MOVING PARTS.
SWITCH OFF BEFORE WORKING WHENEVER POSSIBLE

5.4 Regular, vibrating noises

1. Have all pipes on the condensing unit been fixed securely and prevented from touching other parts?
   - No → Carefully fix or bend pipes which may be vibrating against other parts (page 50)
   - Yes ↓
2. Have all fan blades been checked for damage and secure fixing on shafts?
   - No → Check and repair as necessary (page 50)
   - Yes ↓
3. Are the holding bolts for the compressor and motor secure?
   - No → Replace and/or tighten as necessary (page 49)
   - Yes ↓
4. Are the mounting springs for the compressor holding the unit securely?
   - No → Renew or tighten the springs (page 49)
   - Yes ↓
5. Does the regular vibrating noise seem to come from inside the compressor or motor?
   - No → Check other nearby equipment. The noise may not be from the cooling equipment.
   - Yes ↓
6. Call the repair technician immediately. There may be a major fault developing.

SAFETY - SWITCH OFF AT THE MAIN SWITCH BEFORE WORKING ON FANS, BELTS AND OTHER MOVING PARTS.

V. HOW TO CARRY OUT REPAIR AND MAINTENANCE

What to do if the "cooling load" is too high

The "cooling load" is the amount of work which the cooling equipment must do to remove heat from the cold store. If heat enters the cold store too fast, the cooling load can become too great. The equipment will run for too long and may eventually break down. This can be prevented by reducing the cooling load as far as possible in the following ways:

1. Do not leave the cold store door open when loading or unloading vaccines.

2. Open the door only during the coolest part of the day.

3. Make quite sure that the door is sealing properly (see page 51).

4. Examine the outside of the store for cold air leaks between joints, or areas where condensation or ice appear on the surface, (see page 53).

5. Keep the outside of the cold store as cool as possible - in particular, protect the outside from direct sunlight (see page 8, para 1).

6. Do not leave the lights inside the cold store switched on when they are not required. These lights give off a lot of heat which must be removed by the cooling equipement.

The "cooling load" will naturally be greater in very hot weather than at other times of the year. It is especially important to remember these points during the hot season, when the risk to the vaccine is greatest.

How to check and clean the condenser

If the condenser is not working properly, the efficiency of the whole system will be greatly reduced.

Take the following action:

1. Check that the condenser fan and its motor are operating properly. The condenser fan may be driven by separate motor, or it may be joined to the compressor motor. If a separate motor is used, this will have its own fuses and overload. Check for proper rotation of the fan and a good strong flow of air over the condenser.

2. Switch off the condenser fan and inspect the conderser surfaces. They must be clean, with sufficient space to allow a good flow of air between the fins. There is a natural tendency for paper, plastic bags, leaves, etc. to be sucked onto the condenser surface by the action of the fan. Clean between and around the fins with a soft brush, and sweep or blow away all dirt, dust and rubbish.

3. If the condenser fan is driven by belts from an electric motor, make sure that these belts are not broken or slipping. See page 44.

4. If the condenser fan is connected to the shaft of the electric motor, make sure that the drive is secure (start the motor and make sure that the fan rotates properly).

5. If the condenser is fitted with two or more fans, check that they are all rotating properly and freely.

6. Make sure that there is no restriction to air which flows to or from the condenser.

7. Check that the condenser is receiving a good flow of the cleanest, coolest air available.

If the compressor is still not working properly or if you are not able to repair any problems found, notify the repair technician.

How to take care of the evaporator

It is quite normal for ice and frost to form on the tubes and fins of the evaporator. A thin layer of ice does not affect the cooling performance. However, if the ice or frost becomes more than 6 mm (1/4 inch) thick, it must be removed by "defrosting".

1. To defrost the evaporator:

   - Switch off the compressor.
   - Replace the evaporator front cover and switch on the evaporator fan or defrost heaters, if fitted.
   - Allow the evaporator fan to blow air through the pipes and fins until all of the ice has melted.

2. Check that the water collecting in the drip tray is draining away outside the cold room. If it is not, the drain pipe in the evaporator casing may be blocked. Remove any blockage in the drain pipe using a long piece of wire. If the blockage cannot be removed from inside the evaporator, the drain pipe may be damaged or blocked outside the cold store. Examine the whole length of drain pipe. Clean the outlet so that the water runs away. Check that the pipe is not damaged or leaking.

3. While you are looking at the evaporator, check also to see that the evaporator fan is blowing air through the tubes and fins properly (place your hand at the back of the evaporator where the air comes out). If the air flow is poor or none at all, this will greatly reduce the cooling performance.

   Switch off the evaporator fan and remove the evaporator front cover again. Check that:

   - The fan rotates properly. Make sure that the motor drive is not slipping or that the belts, if fitted, are not broken or slipping (see page 44).
   - Check the fan motor. This will have its own fuses and overload, perhaps in a separate fuse box, but in many cases inside the main fuse box for the cooling equipment.
   - Check also that no pieces of ice which might prevent the fan from turning remain inside the casing. If the fan is free to rotate, but does not start when the electricity is switched on, the motor may have failed. Call the repair technician.

How to check if the system is losing refrigerant

If the system is losing refrigerant, the compressor may either run for very long periods or very short periods, depending on how much refrigerant has been lost. Examine the liquid sight glass - it should be completely full of liquid. If bubbles can be seen when the compressor is running normally, refrigerant is escaping. Check for leaks as follows:

1. Switch off the compressor and condenser and evaporator fans.

2. Carefully examine all connections in the system for leakage of oil. If oil is leaking, refrigerant will also be leaking.

3. Make up a solution of soap (or liquid detergent) and water. Put this on all connections, especially where you think there may be leakage. Bubbles will appear at the point where refrigerant is leaking. Check especially the connections shown in Figure 3 on page 27.

4. Try to stop any leakage by carefully tightening the connections.

5. Switch on the compressor and fans and, even if you have stopped the leak, tell the repair technician that the system is "short of refrigerant".

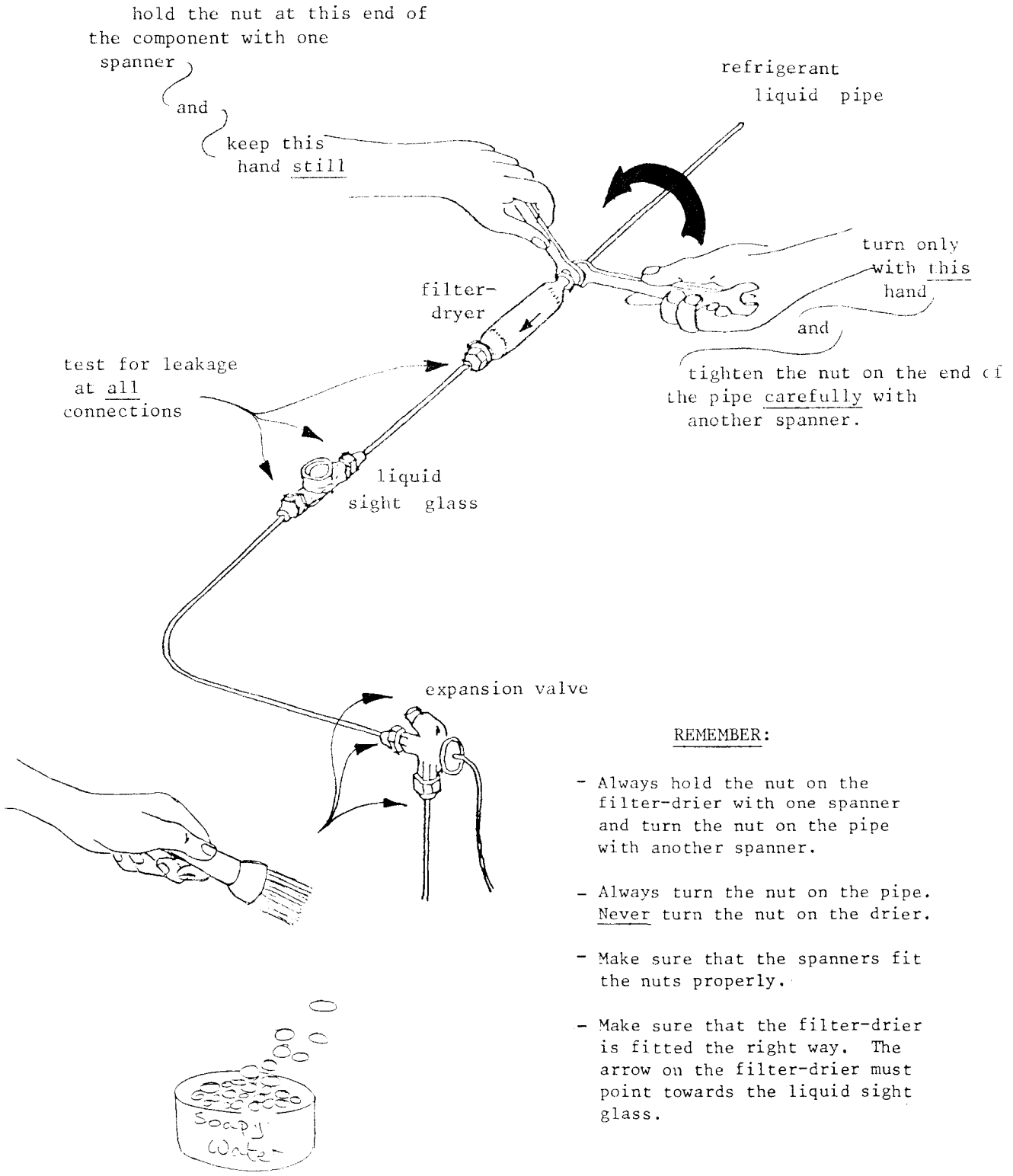
Until the repair technician is able to re-charge the system, try to reduce the cold store cooling load as explained on page 23.

If the system has lost all of the refrigerant, you may not be able to detect this by checking the liquid sight glass (a completely full glass has a very similar appearance to a completely empty glass). However, in this case there will be no cooling at all from the evaporator, and the compressor may only run for a few minutes at a time, only to be constantly switched off by the low pressure cut out. This is called "short-cycling".

In this case, the cold store temperature will very quickly become too high, and you must act urgently to protect the vaccine. Switch on the standby cooling unit if you have one, or if not, move the vaccine as quickly as possible to another cold room or refrigerator at the correct temperature.

Figure 3 - Testing for leakage of refrigerant

If you find any leaks, try to stop them as follows:



REMEMBER:

- Always hold the nut on the filter-drier with one spanner and turn the nut on the pipe with another spanner.
- Always turn the nut on the pipe. Never turn the nut on the drier.
- Make sure that the spanners fit the nuts properly.
- Make sure that the filter-drier is fitted the right way. The arrow on the filter-drier must point towards the liquid sight glass.

How to check and adjust the expansion valve

If the expansion valve is not passing enough refrigerant into the evaporator, the compressor may either run for very long periods or "short cycle" depending on the setting. In either case, there will not be enough cooling and the cold room temperature will be too high. Check the setting and, if necessary, adjust the valve as follows:

- Find the pipe which carries vapour from the evaporator in the cold room back to the compressor. This pipe will usually be insulated. Feel the pipe at the point just where it leaves the evaporator.

- Does the pipe feel cold or have frost on it?

- If it does, the expansion valve is probably correctly adjusted and working properly.

- If it does not feel cold, or have any frost on it, the expansion valve is not passing enough refrigerant into the evaporator. Adjust as follows:

1. Remove the cap nut which protects the adjusting screw (see figure 4).

2. With a screwdriver or spanner of the correct size, turn the adjusting screw anti-clockwise by half a turn exactly.

3. Now WAIT for at least 15 minutes to see whether any change in the evaporator pipe temperature occurs.

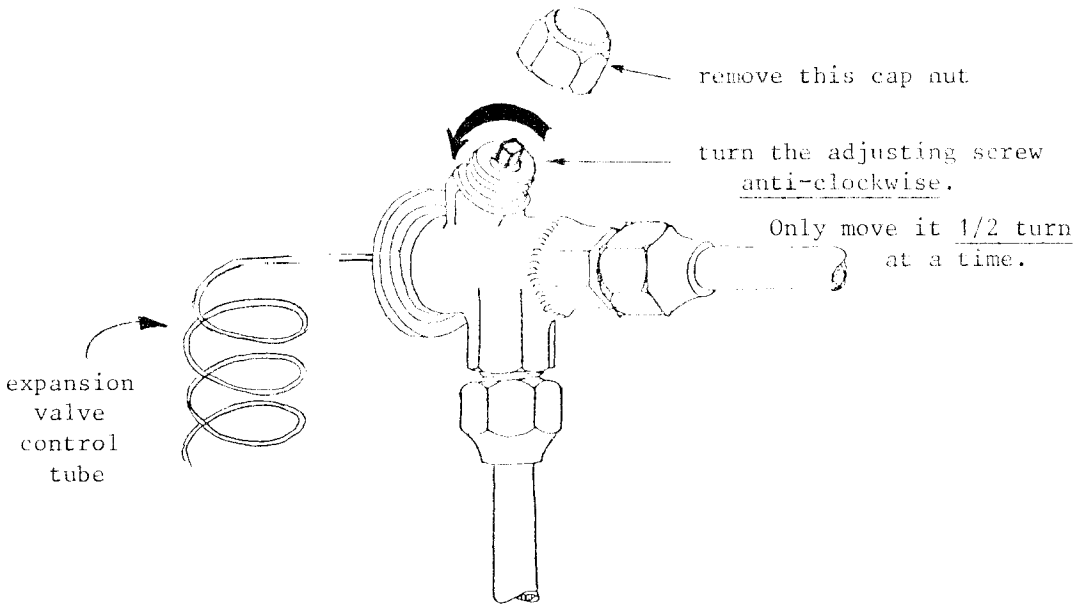
4. The vapour return pipe where it leaves the evaporator should just begin to have frost forming on it. If a lot of frost forms, you have opened the expansion valve *too much*, and must turn the adjusting screw clockwise again. Failure to do this will damage the compressor. It may also cause the oil differential cut out (if fitted) to switch off the cooling equipment completely (see page 42).

5. If the pipe starts to feel colder, you may turn the adjusting screw another half turn if needed, to cause a small amount of frost on the evaporator exit pipe. Remember to WAIT after each adjustment, to allow time for the temperature to change.

6. If adjusting the screw does not change the temperature of the evaporator exit pipe, turn the screw back to its original position and notify the technician. The expansion valve is probably faulty, or the system may not have sufficient refrigerant.

7. After making adjustments, replace the protective cap nut for the adjusting screw. Use TWO spanners for this job, in the same manner as shown in Figure 3.

Figure 4 - Adjusting the expansion valve



How to check the thermostat

1. Switch off the power supply to the condensing unit at the main electrical supply switch.

2. Remove the front cover of the thermostat (see Figure 5).

3. Remove one of the electrical supply wires to the thermostat (it does not matter which one). Join it to the other supply wire, as shown in Figure 5 (bottom diagram).

4. Replace the front cover of the thermostat.

5. Switch on the electrical supply.

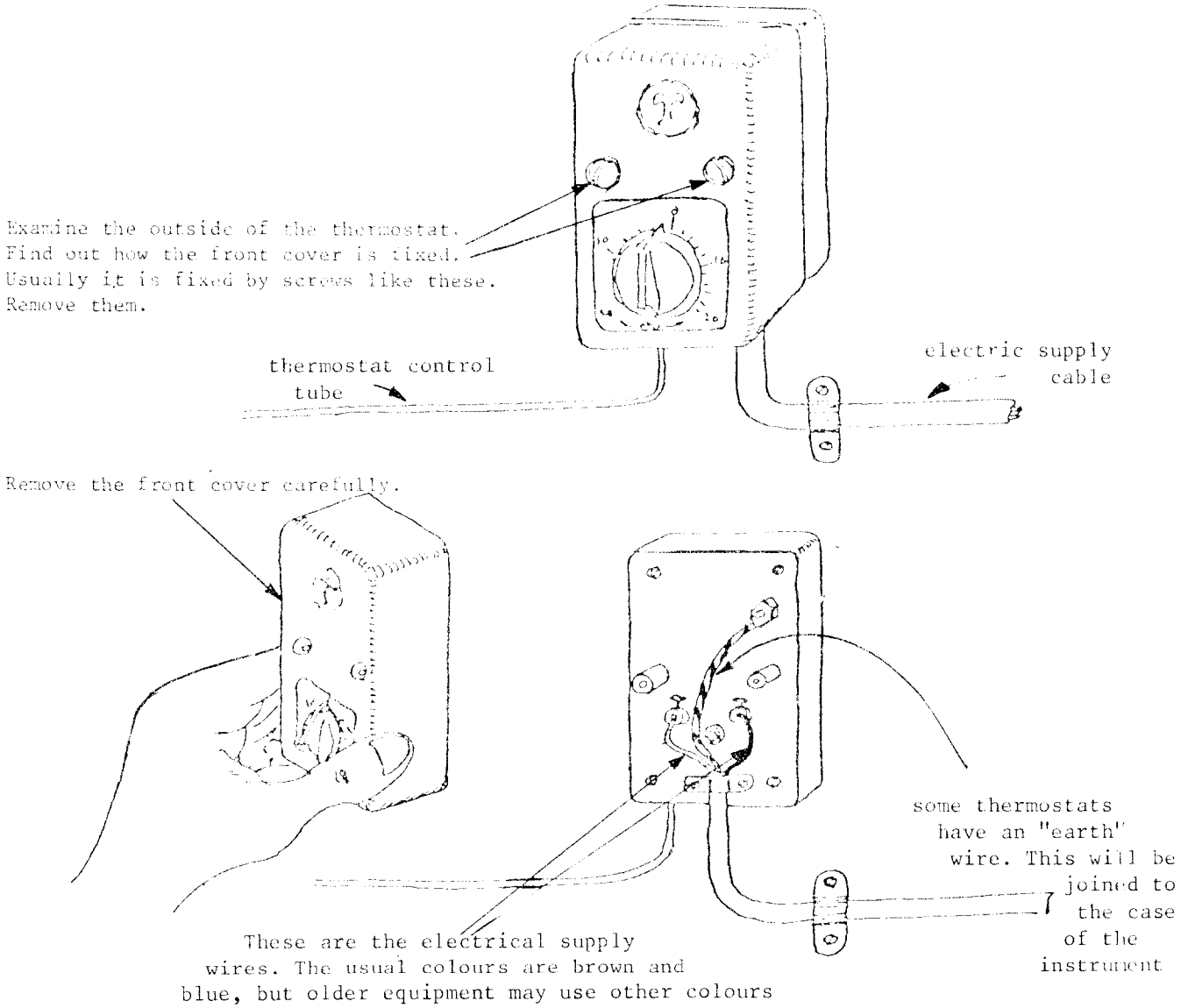
6. If the compressor starts, the thermostat is faulty and must be replaced. How to do this is explained on page 32.

7. If the compressor does not start, the thermostat is probably working correctly, and this is not the fault.

8. Switch off the electrical supply and replace the electrical supply wires in their original positions, as shown in Figure 5 (centre diagram).

9. Switch on the electrical supply again.

Figure 5 - Checking the thermostat



How to replace a faulty thermostat

1. Before starting work make quite sure that you have the correct replacement thermostat.

2. Switch off the power supply to the condensing unit at the main electrical supply switch.

3. Locate the thermostat control tube inside the cold store and loosen the clamp which holds it, as shown in Figure 6.

4. Remove the control knob and front cover of the thermostat.

5. Remove both electrical supply wires to the thermostat. Remove also the "earth" wire if there is one.

6. Pull the control tube out of its clamp.

7. Remove the screws which hold the thermostat case to the cold store wall.

8. Remove the complete faulty thermostat.

9. Before starting to fit the replacement thermostat:

   (a) clean the ends of the electrical supply wires and make sure they are in good condition;
   (b) clean the surface under the control tube clamp;
   (c) now fit the replacement thremostat to the cold store wall.

10. Replace the screws which hold the thermostat case to the wall. Tighten them until the thermostat is held firmly in position.

11. Fit the control tube of the replacement thermostat into the clamp. Handle this tube very carefully. Make sure that you do not pull the end which is joined to the thermostat or bend the control tube more than necessary.

12. Tighten the clamp until the control tube is held firmly in position.

13. If the thermostat is mounted on the outside of the cold store, repair the hole where the control tube passes through the cold store wall. Adhesive plaster or insulating tape wound around the outside of the control tube makes a good seal.

14. Thread the electrical supply cable into the new thermostat.

15. Connect the green or yellow and green "earth" wire (if there is one) to the thermostat case.

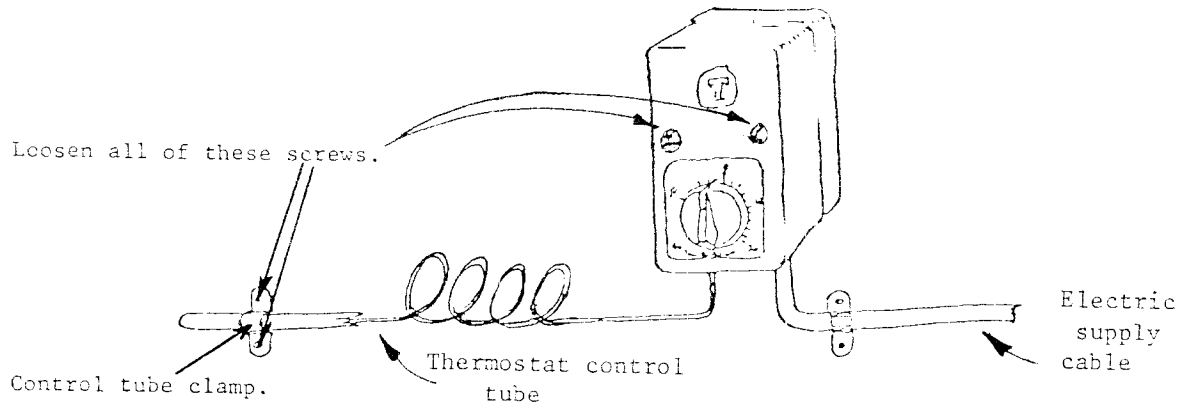
16 Connect the other two electrical supply wires to their terminals and tighten them. (It does not matter which colour wire is fitted to which terminal.)

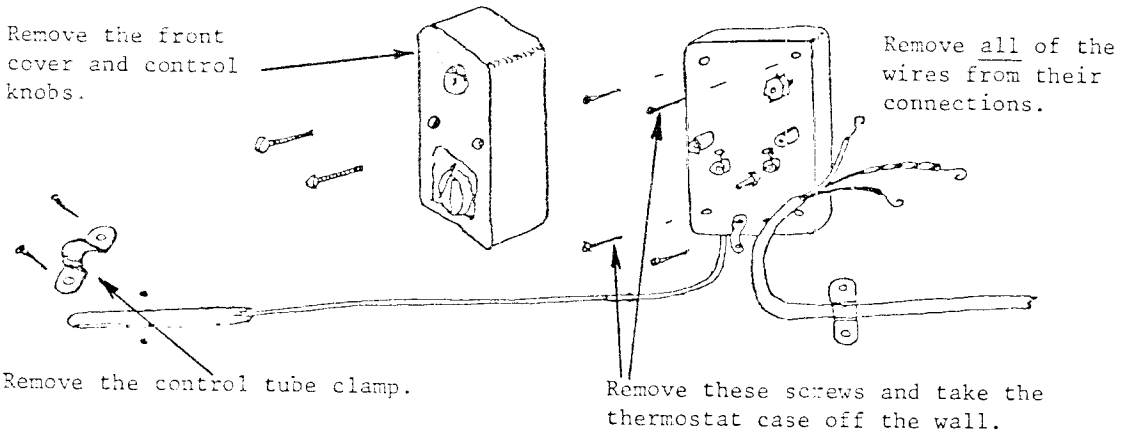
17. Replace the control knob and front cover of the thermostat.

18. Switch on the electrical supply.

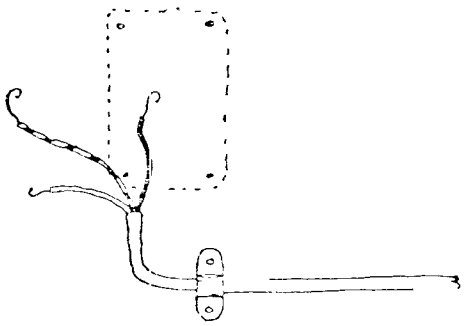
19. Adjust the thermostat to give the correct storage temperature.

Figure 6 - Removing a faulty Thermostat





When fitting the replacement thermostat:



1. Make sure that the ends of the wires are clean, and in good condition.

2. Make sure that the wires are fitted tightly to their terminals.

3. Make sure that the green or yellow and green "earth" wire is joined to the casing - the other two wires can be joined to either terminal.

4. Handle the control tube very carefully. Do not force or strain it in any way, and do not bend more than necessary.

5. Clean the surface under the control tube clamp.

6. Tighten the clamp so that the control tube is held firmly.

What to do if the electrical supply fails

If the condensing unit will not start, the electrical supply may have failed. Always make sure that there is a supply of electricity before looking for other faults.

To check whether the electricity supply is on:

1. Switch on the lights in the cold store. If the lights do work, the electricity supply has not failed, and the problem must be elsewhere.

2. If the lights in the cold store do not work, check whether other lights or electrical appliances in the same building are working. If they are not working, the local electricity supply has probably failed.

3. Start the standby electrical generator, and use this until the local supply comes back on again.

4. If lights in other parts of the building are still working, a fuse for the cold room may have failed (see page 37).

How to check whether the supply voltage is too low

If the supply voltage is too low, the compressor will either not start at all, or "short cycle". Take the following action:

1. Test the voltage at the compressor terminal box if you have the use of a suitable electrical measuring instrument. It should not be more than 15% below the voltage marked on the manufacturer's name plate on the condensing unit. (For example, if the name plate shows 220V, the voltage should not be lower than 185V).

2. If you do not have a measuring instrument, the following symptoms of low voltage will help you to find if this is the fault:

   (a) Lights in the building will not shine as brightly as normal.
   (b) Fluorescent tube lights will usually not work at all.
   (c) Electric fans and other motors will run much more slowly than usual.
   (d) When the compressor starts, or tries to start, the store lights will become even less bright.

3. If the supply voltage is too low for the compressor to start and run properly (it buzzes but will not start, or keeps short cycling), switch the cooling equipment off immediately. Low voltage will very soon damage the compressor motor, and all other electric motors too.

4. Keep the cold store door tightly closed until the supply voltage rises to normal again.

5. If you have a standby electrical generator, use this to run the cooling equipment until the local voltage returns to normal.

6. If the voltage is often low, ask the repair technician to fit a voltage stabilizer in the main supply to the cooling equipment.

What to do if a fuse fails

1. Find the main fuse box. It is usually metal and fixed on the wall near to the main door or entrance to the building.

2. Many cold stores also have their own separate switch and fuse box fixed on the wall or the side of the store.

3. Switch off the electrical supply at the main switch. Work carefully. Do not touch anything inside the fuse box until you are quite sure that the electrical supply is switched off.

4. Open the fuse box and, if the fuses are not marked, pull them out one at a time and examine them (see figure 7).

5. If the fuses are of a type where a wire can be seen joining the two ends, the fuse which has failed will be burnt and the wire will be broken. Replace the broken wire with another piece of the same size. Use only proper fuse wire, and make sure you use the same size as before.

6. If the fuses are of a type where the wire cannot be seen, proceed as follows:

   (a) Take out the first fuse and replace it with a new one of the same size, or

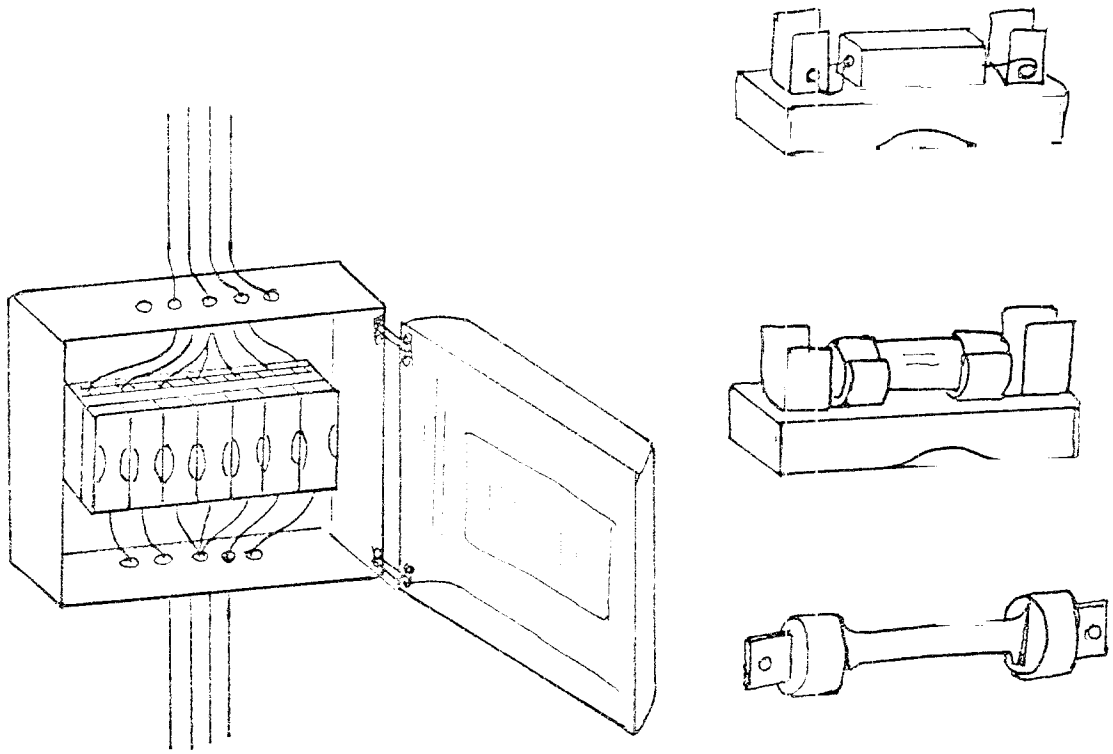
   (b) If you have no spare fuses; take out the first fuse and exchange it for one of the same size from the other end of the fuse box.

   (c) Switch on the supply again. If the compressor starts, the fuse which you replaced was faulty. If the compressor does not start, you have not yet found the fault.

   (d) Switch off the supply. Return the first fuse to its original position. Now take out the second fuse and exchange it with a new one, or one from the other end of the fuse box.

   (e) Switch on the supply. Does the compressor start? Continue changing the fuses until you have identified the fuse that was faulty.

Figure 7 : Fuse Box and Types of Fuse



7. Replace the faulty fuse with a new one of correct size and type.

   - Mark the fuse for the refrigeration circuit, so that you can find it again easily in future.
   - Close the cover of the fuse box securely.
   - Switch on the supply.
   - Throw away the faulty fuse so that it does not get re-used by mistake.

8. If the fuse fails again, there is a fault in the electrical circuit. Change over to the standby unit. If a fuse again fails, or if you have no standby unit, keep the cold store door tightly closed. In both cases, ask the repair technician to repair the electrical fault immediately.

How to check electrical connections

If there are loose, broken or very dirty electrical connections to the cooling equipment, the condensing unit may not start. Take the following action:

1. Switch off the electrical supply.

2. Carefully examine the electrical wiring, at all joints and connections and especially:

   (a) at the main switch fuse box
   (b) at the compressor motor terminal box
   (c) at the evaporator fan
   (d) at the thermostat
   (e) at the safety cut-outs
   (f) at the condensing unit control panel (if fitted).

   - All connections must be tight and reasonably clean.
   - If they are loose, tighten them.
   - If they are very dirty, remove, clean and then replace them.
   - Examine each wire and make sure that it is not damaged.

3. When you are sure that all connections are secure, switch the electrical supply on again.

How to check the motor overload protectors

Sometimes the electrical fuse box will also contain the starting controls for the motors driving the compressor and the fans on the evaporator and condenser.

Alternatively, these starting controls may be in a separate box or "control panel" where the cooling equipment is turned on and off.

In either case, a "motor overload" protective cutout may be included in the starting control. This acts as a safety switch, and cuts off the supply to the motor if it takes too much electric power, or is "overloaded".

The overload switch (if fitted) will probably be a small coloured button (often red) inside the fuse box or control panel, and may have to be "reset" by hand if it has been activated.

As for the other safety cutouts on the cooling equipment (see pages 40-42), these types of protector will not automatically switch on the supply again. They must be reset each time they have been activated before they will allow the motor (or even the whole cooling system) to start again.

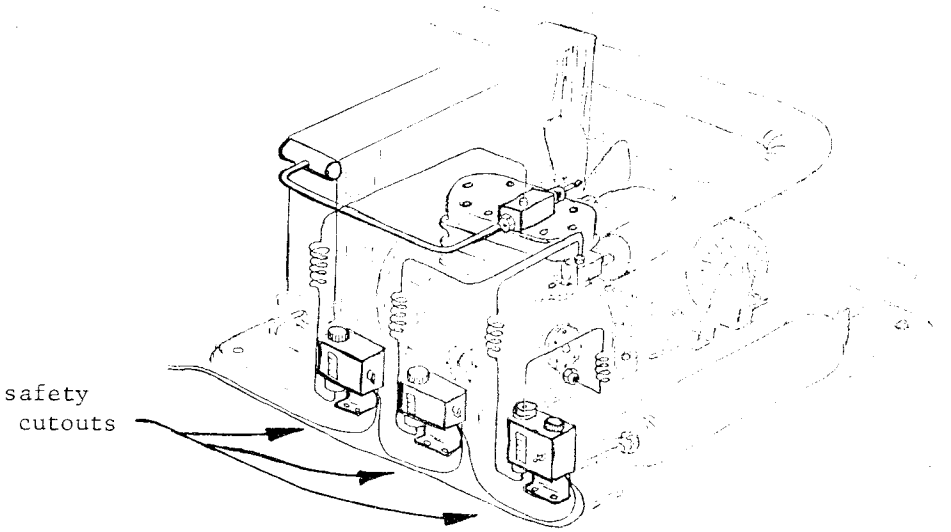
Ask the technician whether your cold room has this type of overload protector, and if so, ask him to show you how to check and reset them.

Always check the reset buttons on the motor overloads if the condensing unit will not start. If frequent "motor overloads" occur causing the cooling equipment to switch off, inform the technician. He will need to check the cause of the motor or the cooling system using too much power.

How to check the safety cut outs

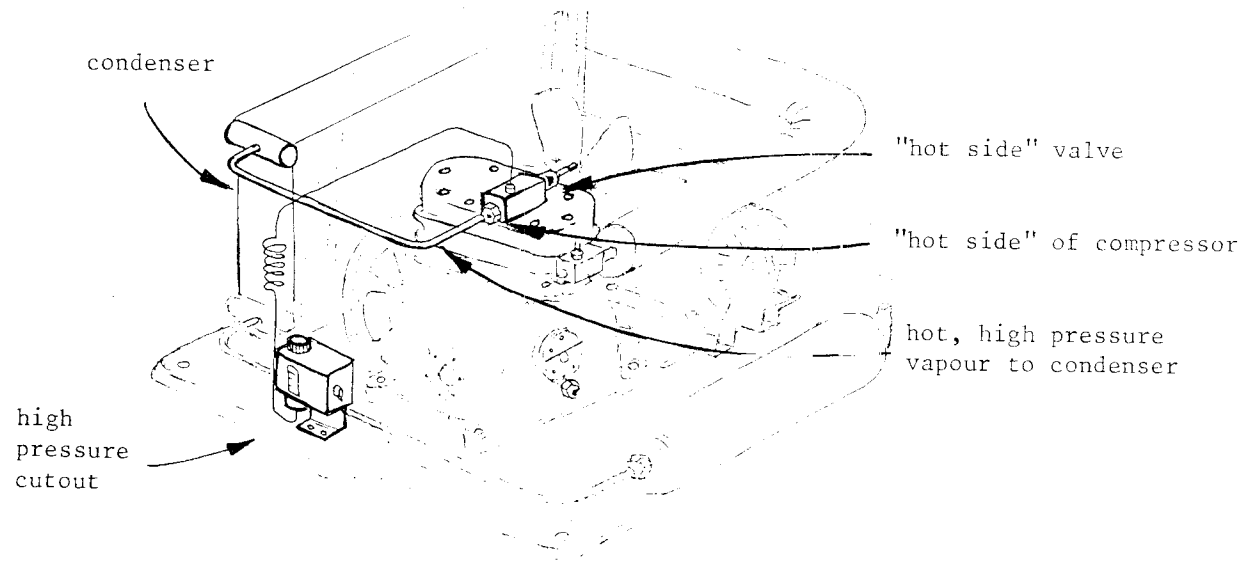
The safety cutouts are usually in one or more small boxes fitted to the condensing unit, near the compressor (see figure 8). The boxes may all have a similar appearance, but by following the small pipes which connect them to the compressor, the function of each can be identified as follows:

Figure 8 : Condensing unit and safety cutouts



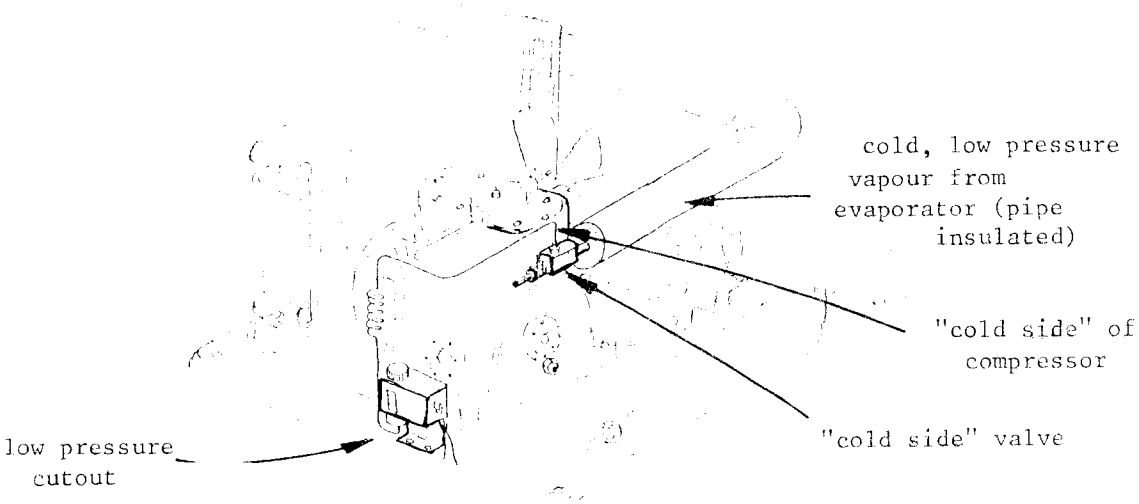
(a) The High Pressure Cutout is joined to the "hot side" of the compressor, where the hot, high pressure vapour leaves on its way to the condenser. Usually, there will be a valve at this point, and the high pressure cutout is often joined as shown:

Figure 9 : High pressure cutout connections



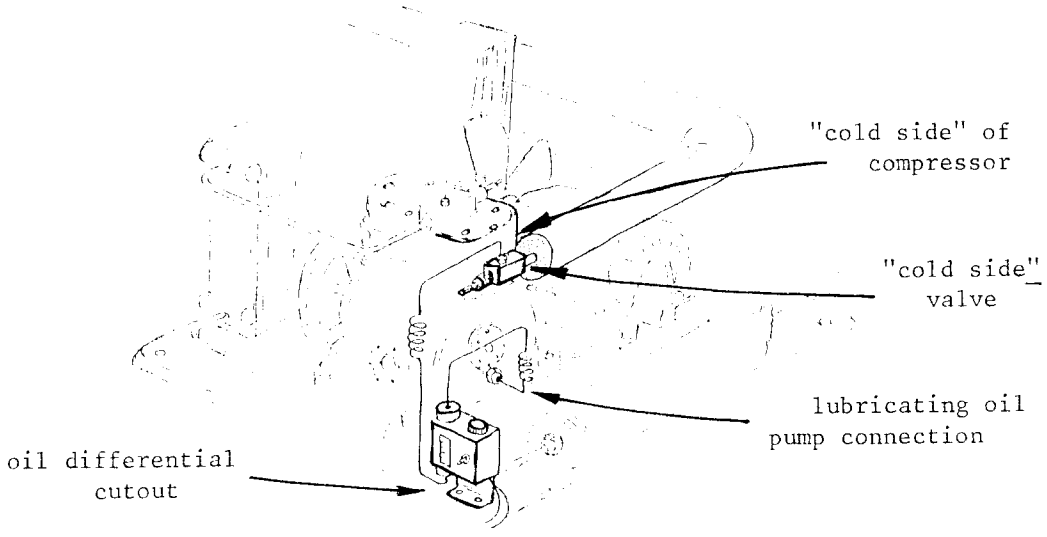
(b) The Low Pressure Cutout (if fitted) is joined to the "cold side" of the compressor, where the cold, low pressure vapour enters on its return from the evaporator. There will usually be a valve at this point also, and the cold vapour return pipe will probably be insulated. The low pressure may be joined as shown:

Figure 10 : Low pressure cutout connections



(c) The Oil Differential Cutout (if fitted) has two small pipes connecting it to the compressor; one joined to the "cold side", as for the low pressure cutout, and the other joined to the lubricating oil pump inside the compressor. This pump is usually near the bottom of the compressor, and the oil differential cutout connections may appear as follows:

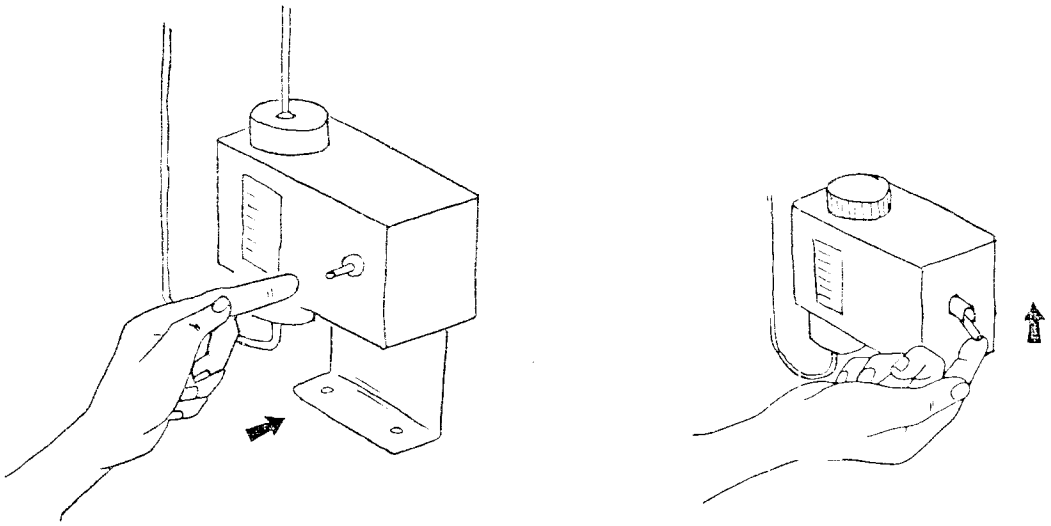
Figure 11 : Oil differential cutout connections



All these cutouts operate in the same way - by switching off the electric supply to the compressor if the pressures of refrigerant or oil are not correct. When pressures return to normal again, many of these cutouts will not automatically switch the supply on again; they must be reset by hand, before they will function again, and allow the condensing unit to start.

This type will have a "reset" button on the cutout, which must be pushed by hand to return it to the "on" position. Figure 12 shows two types of reset button, but other types may be found, depending on the manufacture of the cutout.

Figure 12 : "Resetting" safety cutouts



Always check the "reset" buttons on the safety cutouts if the condensing unit will not start. If any one of them has been activated by unusual pressure, the cause must be found and the fault rectified before trying to re-start the cooling equipment.

If the high pressure cutout has been activated, it means that the condenser needs attention (see page 24).

If the low pressure cutout has been activated, it means either that the evaporator needs attention (see page 25), or the expansion valve needs attention (see page 28).

If the oil differential cutout has been activated, it means that either the compressor has insufficient oil (see page 47), or that the expansion valve is incorrectly set (see page 28).

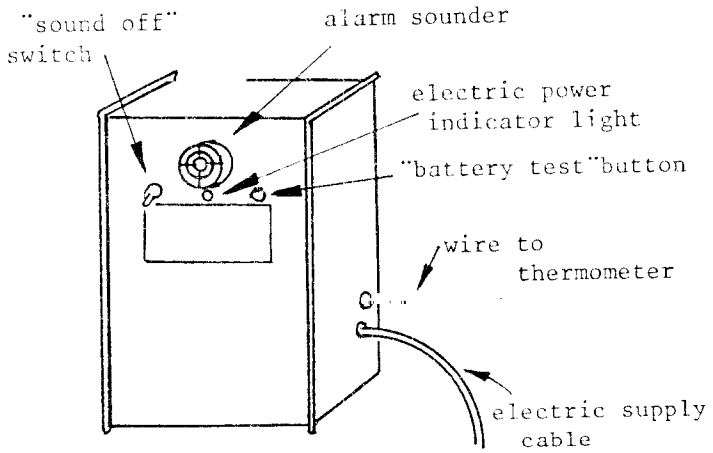
How to check the cold store alarm

The alarm unit is designed to warn the user if the cold store temperature is either too high or too low. A loud hooter will sound if the temperature is not correct, and will continue sounding until the temperature returns to normal, or until the alarm is switched off.

The alarm operates on electric power, but also has an internal battery, so that it can still function even if the electric power fails.

It is important to check the alarm regularly to ensure proper operation, and also to ensure that the internal battery is in good condition. To allow you to test the alarm at any time, even when the temperature is correct, a special "battery test button" is provided for this purpose (see Figure 13).

Figure 13 - Cold store alarm unit



Every week, test the alarm unit by pushing the button marked "battery test". The alarm should sound with a loud, intermittent signal for as long as the button is pushed. If the alarm does not sound, it is faulty and will not give a warning if the cold store temperature is incorrect. It must be repaired immediately. Ask the technician to check and rectify the problem.

How to check, adjust or renew the compressor driving belts

Sometimes the compressor is driven by a separate electric motor, with one or more rubber driving belts. (The condenser and evaporator fans may also be driven in this way).

If these belts are slipping, worn, broken or not correctly lined up, they cannot drive the compressor properly. Check as follows:

1. Switch off the electrical supply.

2. Examine the belts.

3. If they are in good condition but are too loose and slipping, adjust them as shown in Figure 14 (a). Do not tighten belts too much - this will cause the bearings on the compressor and motor to wear quickly. Check for the correct tension as shown in Figure 15.

4. If the belts are damaged at the edges, oily, broken or worn, replace them as shown in Figure 14 (b).

   Important:

   (a) Clean the driving pulleys and remove all oil, grease or dirt from their surfaces before fitting the new belts.

   (b) If only one belt in a set is broken or worn, the complete set must still be replaced.

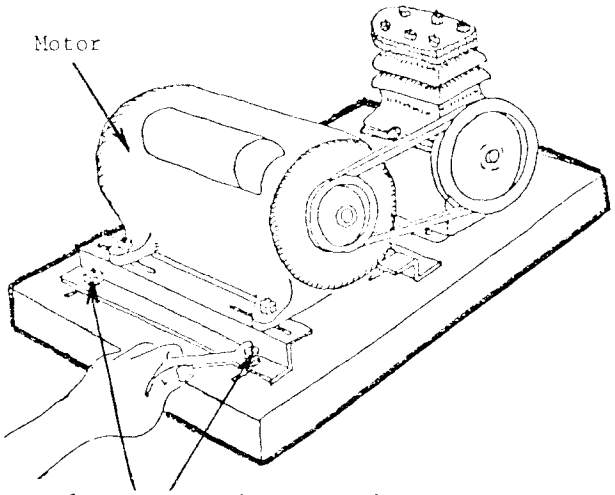
   (c) The belts must be properly lined up to each pulley, as shown in Figure 16. If this is not done, the belts will wear out very quickly, amd will not drive properly.

5. The day after adjusting or fitting new belts, check that they have not worked loose.

6. One week after fitting new belts, adjust them again - they will have stretched and will usually have become too loose.

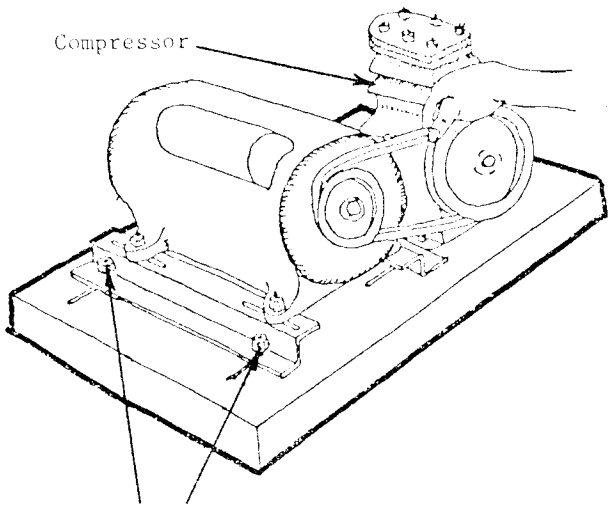
Figure 14 : Belts and belt drives

(a) How to adjust the belts



1. Loosen these holding bolts.
2. If the belts are too loose and slipping, move the motor further away from the compressor.
3. Tighten the holding bolts again.

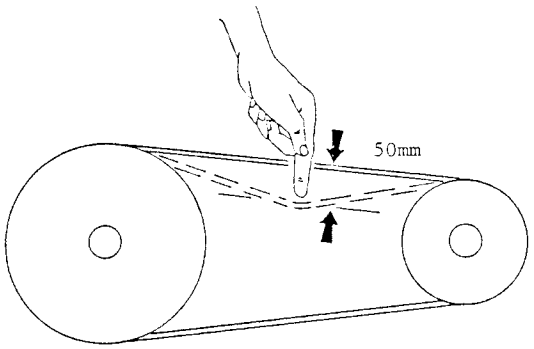
(b) How to replace the belts



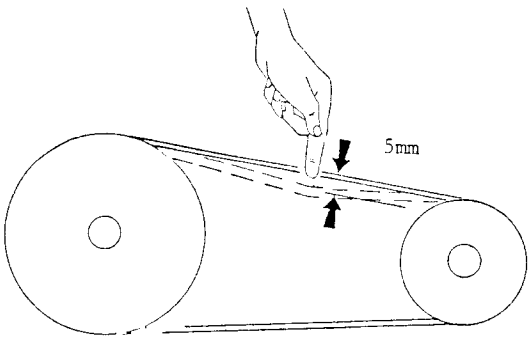
1. Loosen these holding bolts.
2. Move the motor towards the compressor as far as possible.
3. Lift the belts off the two pulleys and fit new ones.
4. Adjust the new belts to the correct tension (see Figure 15).
5. Tighten the holding bolts again.
6. Replace any covers or guards which have been removed.

Figure 15 : Drive belt tension

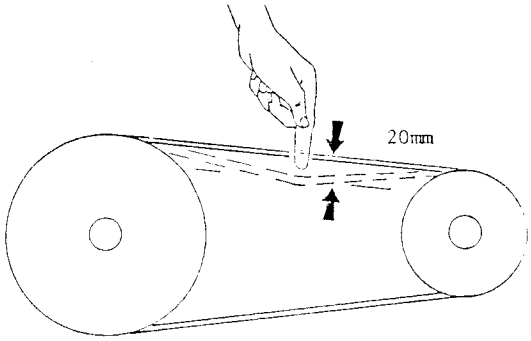
Push on the belt halfway between the two pulleys. Measure or estimate how far you can push the belt in.



a) Belt too loose

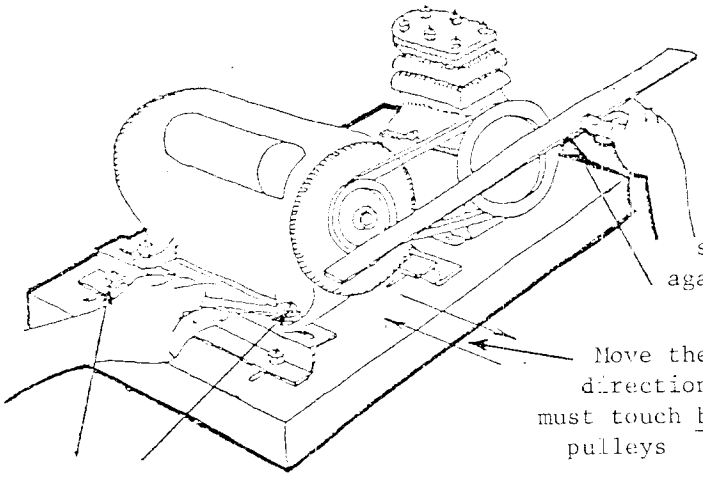


b) Belt too tight



c) Tension correct

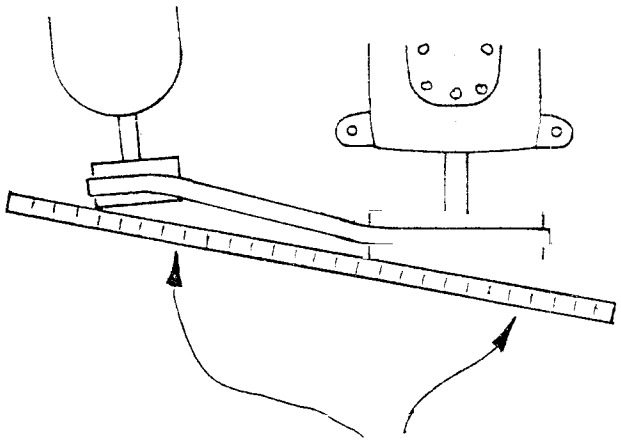
Figure 16 : How to line up the belts



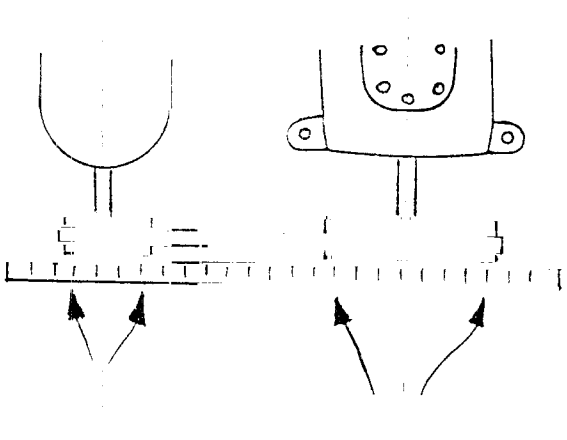
1. Loosen these bolts.

2. Place a straight edge of metal or wood across the faces of both the motor and compressor pulleys.

3. Move the motor in the direction of the arrows until the metal or wood edge is exactly touching both sides of both pulleys as shown.



Incorrect: straight edge not touching here.



Correct: straight edge touches both sides of both pulleys.

4. Tighten the motor holding down bolts again.

5. After tightening the bolts check again that the motor is still in the correct position. It may have moved as the bolts were being tightened.

How to check the compressor oil level

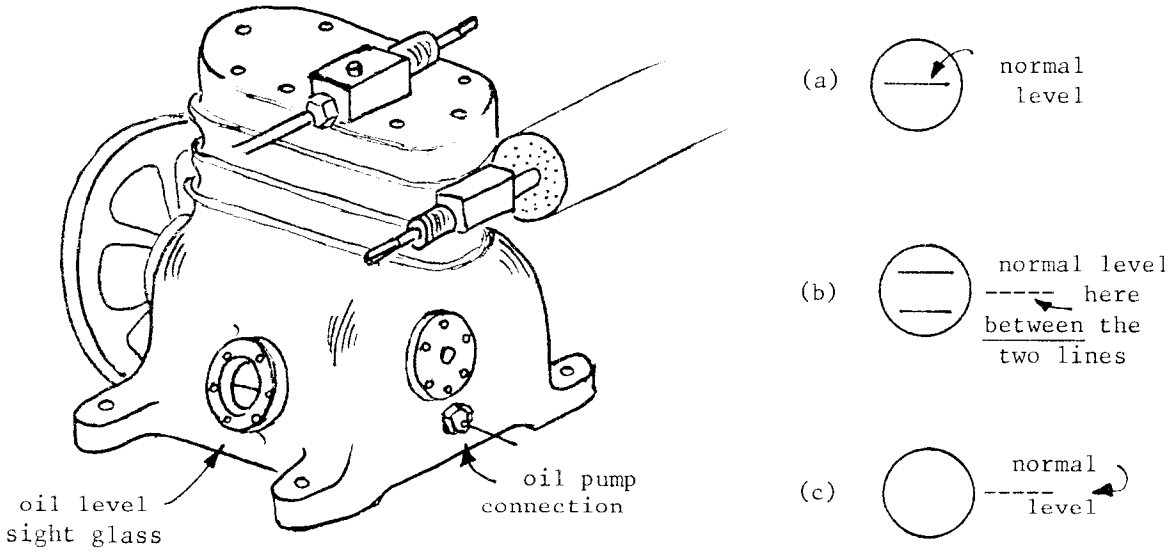
The compressor must have a sufficient supply of lubricating oil at all times. Most compressors have an oil level sight glass fitted on the side or end of the compressor, so that the amount of oil inside can be checked.

- The sight glass may have a line marked on it, which shows the normal oil level (Figure 17 (a)).

- Sometimes, the glass may have <u>two lines</u>, which indicates that the oil level must be kept <u>between</u> the lines (Figure 17 (b)).

- Some sight glasses have <u>no</u> marking and in this case, the oil level should be kept <u>halfway</u> up the glass.

Figure 17 : Compressor <u>oil</u> level sight glass



The oil level should be checked every week. It may be necessary to use a lamp to enable you to see properly. Check it carefully.

If the oil level is below normal, notify the technician, and ask him to top up the oil. Do <u>not</u> attempt to do this job yourself.

What to do if the cooling machinery runs noisily

If the cooling machinery starts to make more noise than normal, pay attention to it. Noises are the first indication of a major fault, and will enable you to notify the repair technician before the equipment breaks down. A condensing unit is running noisily if any of the following sounds can be heard:

Rattling - Squeaking - Knocking - Vibrating

Examine the condensing unit with the compressor running. Listen for the noise and try to find what is causing it. Get someone else to switch off the electrical supply (at the main switch) and then switch it on again - when the compressor first starts you can usually hear the noise more easily.

1. Loose, rattling noises are often caused by the following:

   (a) Loose protector covers on belt drives. The bolts may have become loose or may be missing. Tighten or replace the bolts.

   (b) Condenser or evaporator fan blades touching another surface, such as the casing or fins. If this is happening, carefully bend away the part that is touching the fan blades (do not bend the fan blades themselves).

   (c) Check the evaporator casing, particularly the front cover. The cover must not rattle. Tighten all fixing screws and bolts. If necessary, carefully bend the inlet and outlet pipes so that they do not rattle against the sides of the casing.

   (d) A fault inside the compressor. If this seems to be the cause, notify the repair technician.

2. Dry, squeaking noises are often caused by the following:

   (a) Belts that are dirty, oily, too loose, too tight, not lined up properly, or touching another surface.
   Take the action described on page 44 to make sure that all belts are clean, dry, properly adjusted and lined up.

   (b) Moving parts that need oil or grease. Make sure that fan and motor bearings are lubricated if required, but:

   - Do not oil or grease electric motors unless a greasing point is provided.

   - Do not use more lubrication than necessary. Too much oil or grease may get inside motors and onto the driving belts, etc., and will prevent them from working properly.

   (c) A fault inside the compressor. If this occurs, notify the repair technician.

3. Heavy knocking or banging noises are usually the most serious. They may be caused by the following:

   (a) The bolts holding down the compressor being loose or missing. Tighten or replace the bolts.

   (b) Compressor mounting springs that have weakened or broken. Ask the repair technician to replace the mounting springs.

   (c) Condenser or electric driving motor bearings worn. The repair technician should check and replace the bearings if necessary.

   (d) A fault inside the compressor. If this occurs, switch off the condensing unit immediately, change over to the standby unit, and notify the repair technician as soon as possible.

4. Regular, vibrating noises are often caused by the following:

   (a) Loose or missing bolts which hold down the compressor, motors or fans. Replace and/or tighten the bolts.

   (b) Weak or broken compressor mounting springs. Ask the repair technician to replace the mounting springs.

   (c) Condensing unit pipes which are not secured, and are able to vibrate against nearby parts. Secure them with clips, or carefully bend the pipe away until the noise stops.

   (d) Fan blades that are damaged or have become loose on the fan shaft. Examine all fans. If any are loose on their shaft or damaged, notify the repair technician.

   (e) A fault inside the compressor. Notify the repair technician if this seems to be the cause.

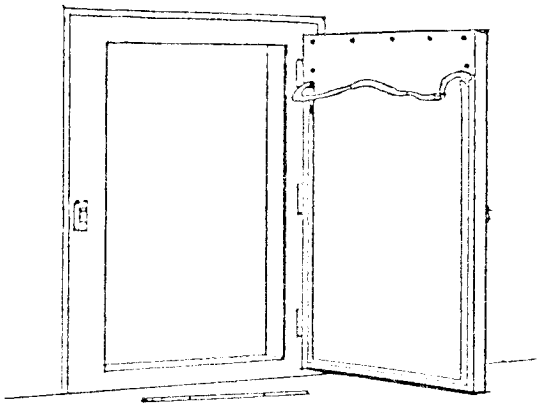
   (f) A fault in the cooling system which causes the compressor to vibrate. Notify the repair technician.

How to repair or adjust the cold store door

If the cold store door does not close tightly and seal properly, warm air will enter the store. This increases the cooling load, reduces the effectiveness of the condensing unit, and increases its running time.

1. Examine the door seal.
   If it is cracked and split, badly worn, or damaged in any other way, it must be replaced. Figure 18 shows how to do this.

Figure 18 : Fitting a new door seal

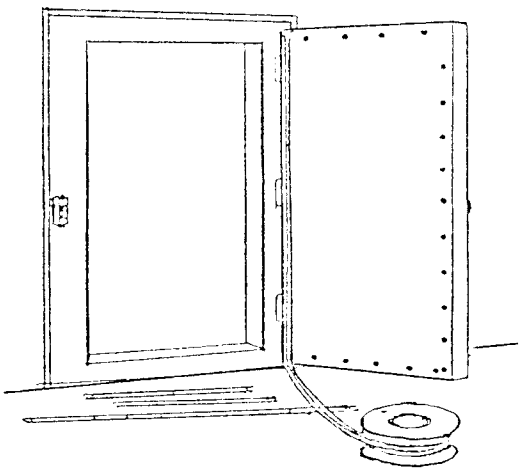


(a) Removing the old door seal

- The seal may be fixed to the door with screws, clips, metal strips or with glue.
- Remove the screws or fixings and pull off the old seal.
- Clean the edge and also the door frame where the seal will touch.

(b) Fitting a new seal

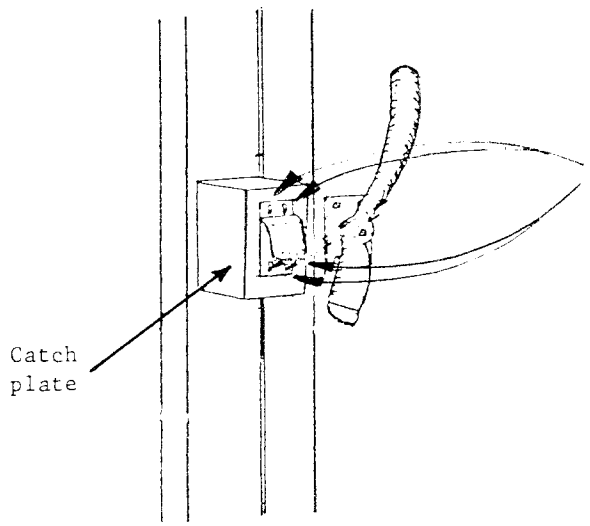
- Make sure the new seal is the correct size. If it is too large, the door will be difficult to close.
  If it is too small, it will not make a proper joint.
- Cut a suitable length, and starting with the inside edge of the door first, fix the new seal in place.
- Replace the screws or fixings tightly to ensure a good joint.
- Take special care at the corners. If you leave air spaces, warm air will leak in when the door is closed.



Temporary repairs can be carried out if a replacement seal is not available. Use adhesive plaster or insulating tape to fix strips of rubber to the door surface at those points where the outside light can be seen. Ask the technician to get the correct seal material as soon as possible.

2. Examine the door handle and catch. It is designed to pull the door tightly onto its seal.
The metal surfaces can wear with continual use, and the door will not close tightly. The door catch can sometimes be adjusted, as shown in Figure 19.

Figure 19 - Adjusting the door catch

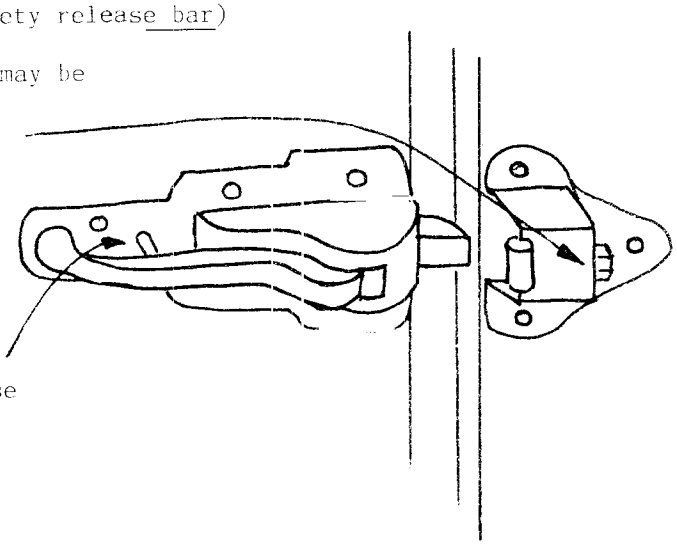


a) Jam plate type catch

1. Loosen these screws
2. Move the catch plate down
3. Tighten the screws again
4. Check the door again and make sure that it fits tightly onto the seal

b) Roller type catch (with safety release bar)

The tightness of the door seal may be adjusted by turning this screw on the roller plate.



How to check for leakage in the structure or insulation

1. Many cold stores are built from insulated panels which are bolted together when the cold store is built.

2. Some form of jointing material is needed between the panels to prevent warm outside air entering the cold store. This is usually a hard rubber strip. A sealing compound is applied to the strip. Often the joint is then covered on the outside with a 50mm (2 inch) wide sealing tape.

3. Warm air will enter the cold store if:

   (a) the jointing material has not been properly fitted between the panels,
   (b) there has been any movement of the panels,
   (c) the jointing material has become weak (with age or excessive heat).

4. Even if the joint is poor, it is not usually possible to see light through the space between the panels, but you may feel cold air on your hand.

5. Examine all joints if you think they are leaking. Cold air passing out of the cold store will cause excessive condensation or ice to form on the outside of the walls. This shows where the joint is leaking.

6. If there are large spaces, temporary repairs can be carried out by pushing newspaper into the space and then placing a strip of adhesive plaster over the outside.

7. In all cases of leakage or suspected leakage of cold air, notify the repair technician. He can carry out a more permanent repair by injecting a sealing compound into any spaces and joints in the cold store structure.

VI. WHAT SPARE PARTS AND TOOLS ARE NEEDED

This section is divided into three lists:

List 1: Those spare parts which the user of the cold store will need for the work described in this book.

List 2: The tools which the cold store user will need to carry out this work.

List 3: Spare parts which the repair technician will require if major faults occur. He will bring his own tools to carry out the repair, but the correct parts to suit the actual equipment must be available.

When ordering spare parts always state:

- Manufacturer and model or type (shown on the data plate)
- Serial No. (shown on the data plate)
- Cold store size and condensing unit voltage
- Type of refrigerant used
- Spare parts description (use the words given in this book).

The location of a data plate will vary from cold store to cold store. Often it can be found on the condensing unit or on the body of the compressor.

LIST 1

Spare parts needed by the cold store user

	Description of part	Recommended quantity
1.	Cold store thermostat	one
2.	Fuse for electrical circuit	five
3.	Set of belts for compressor drive	two
4.	Set of belts for condenser fan drive	two
5.	Set of belts for evaporator fan drive	two
6.	Cold store door seal	one

Note: Not all items will necessarily be fitted to all cold store cooling equipment.

LIST 2

Tools needed by the cold store user

Description of tool	"Unipac" number*	Recommended quantity
1. Maintenance kit**	PIS code E7/04	one
2. Wrench, adjustable 200mm	40 946 00	one
3. Oiler, 0.25 litre	40 685 00	one
4. Brush, nylon bristles	40 184 70	one
5. Grease gun	80 360 00	one

When ordering them:

1. Give the exact information shown above.
2. State that they are required for the maintenance and repair of a vaccine cold store.

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*All of these tools are available from:

UNIPAC
UNICEF Plads
Freeport
DK-2100 Copenhagen Ø
Denmark

**Tool kit contents:

Chisel	1	Screwdrivers, Philips	3
File, flat	1	Screwdrivers	5
File handle	1	Vice, hand	1
Hammer, 360 gm	1	Wrench, adjustable	1
Pliers	1		

LIST 3

Spare parts for use by the repair technician

For all cold rooms	Recommended quantity
1. Liquid line filter-dryer	two
2. Thermostatic expansion valve and 2 filters	two
3. High pressure safety cut-out	one
4. Low pressure safety cut-out	one
5. Condenser fan bearings	one
6. Condenser fan motor bearings	one
7. Condenser fan motor thermal overload	one
8. Compressor suction service valve	one
9. Compressor delivery service valve	one
10. Starting relay	two
11. Starting contactor (set)	two

For units fitted with open compressors

1. Shaft seal	two
2. Set of suction and delivery valves	two
3. Electric drive motor and starter	one
4. Motor thermal overload	one
5. Set of compressor gaskets	two
6. Oil pressure safety switch	one

For units fitted with semi-hermetic compressors

1. Valve plate, complete	two
2. Rotor and thrust washer	one
3. Oil pressure safety switch	one
4. Motor thermal overload	one
5. Motor starting relay	one
6. Set of mounting springs	one
7. Set of gaskets	one

For units fitted with hermetic compressors

1. Motor/compressor unit	one
2. Starting condensor	two
3. Motor protector	two

Note: Not all items will necessarily be fitted to all cold store cooling equipment. Use this list as a guide when deciding what items should be held by each cold store.

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