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DEFROSTING

1. INTRODUCTION

This bulletin is presented to cover the methods used and problems experienced with defrosting of coils for chill and frozen areas, It does not necessarily apply to display cases and multi tier equipment found in supermarkets. This type of equipment will be covered later in a further technical bulletin.

Defrosting of the cooling surfaces is necessary for operating cold and chill areas that are to be maintained below 4 C. If not carried out efficiently it creates extra work for engineers often in difficult locations and hostile environments, unnecessary costs to the customer in electricity usage,

The intention of this bulletin is to set out the different methods of defrosting and the problems that may be associated.

2. SYSTEMS AVAILABLE

The following is a review of the various methods of defrosting that are commercially available.

Off cycle - Evaporator fans are left running with the compressor not operating using room air to defrost the evaporator coil block.

Electric - Electric heater elements are fitted into the evaporator coil block to raise coil block temperature and melt the frost and ice.

Hot gas - Discharge gas from the compressor is diverted into the evaporator and used for defrosting,

Reverse cycle - The purpose of the evaporator coil block and condenser are reversed to warm the evaporator to achieve defrosting.

Secondary Refrigerant Installations - The coil block contains a fluid in the form of a secondary refrigerant. These systems either use electric elements in the coil block or circulate a warm fluid though the coil block.

Water defrosting - Water is fed through sparge pipes on the top of the coil to cascade over the coil block surfaces to melt the ice.

3. METHODS OF OPERATION

The following describes the principle of operating different defrosting systems.

3.1 OFF CYCLE DEFROSTING

Off cycle defrosting can only be successfully used for room temperatures down to 3°C if the evaporator coil block is to be cleared of frost and ice during each defrost cycle.

It is important when selecting equipment for off cycle defrosting that the compressor duty is sufficient to achieve the desired temperatures and still allow time for defrosting.

The compressor should only be required to run for a maximum time of between 16 and 18 hours per day under maximum design conditions, as the time to remove any frost build up by using the room air will be greater than the time for mechanical defrosting systems.

The evaporator must be in balance with the performance of the compressor.

The temperature difference between the room temperature and the evaporating temperature must be narrow.

Temperature differences greater than 6° K (°K as against °C is used to express a difference in temperature) will lead to the evaporator coil block forming ice and frost that is difficult or impossible to clear.

There are a number of approaches to off cycle defrosting time cycles and these will depend on the application.

The first is to have short defrost 20 to 30 minutes every 2 or 3 hours. Another is to have longer periods of 60 to 90 minutes every four or six hours.

If the area is for production purposes that shuts down once or twice a day when cleaning takes place, then one or two very long defrosts may work.

Some forced air cooler manufacturers produce a chart showing the relationships between frost build up, air flow and evaporation temperature. These should be considered when designing a system with off cycle defrost.

If the compressor is only slightly oversized then the suction pressure will be lower, as will be the evaporating temperature.

Under these circumstances frost forms more easily as the coil block surface temperature will be well below the air entering dewpoint temperature.

It would be better to run an oversized compressor at part load if this facility exists.

In practice any room below 4°C will be difficult to operate without some form of defrosting and a programmed off cycle can allow operation of room temperatures down to 3°C.

Some energy conscious customers may object to running the evaporator fans 24 hours a day which may be necessary to stop frost build up and take advantage of the circulating room air with the compressor switched off.

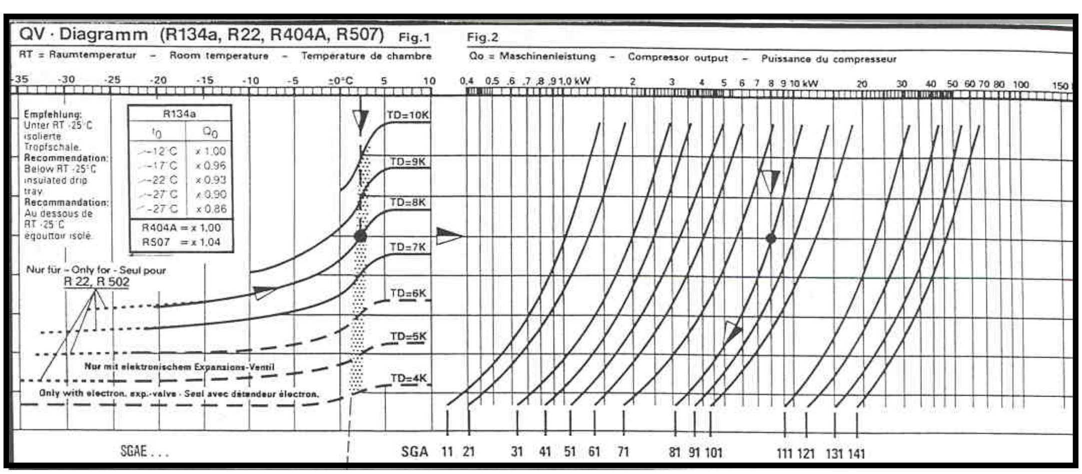

Figure1 - Chart of evaporator performance

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The off cycle defrost program is usually controlled by a time clock switching off the compressor as required.

Regular inspection of the evaporator coil block is required especially at the bottom to make sure the coil is fully clearing. Off cycle defrosting is prone to a small residual ice build up following each defrost. When accumulated this gives operating problems (discussed later) and is very difficult to remove.

Advantages of Off Cycle Defrosting

- Simple to install requiring only a time clock.
- Inexpensive to operate as no heaters or compressor operation is required.

Disadvantages of Off Cycle Defrosting

- Difficult to set up
- Regular periods when room temperature control may be lost.
- During maximum design conditions with long running of compressors icing up problems may be experienced.
- If the compressor is oversized frost removal will be more difficult.
- With high room loads and low outside ambient compressor head pressure control may be required.
- Difficult to make use of floating head pressure for minimum energy operation.

Troubleshooting with off cycle defrosting

The following table gives a guide to problems that may be experienced.

Table 1 - Troubleshooting with off cycle defrosting

Symptom	Cause	Remedy
Coil not clearing of ice.	Room temperature too cold.	Raise room temperature.
	Off cycle too short.	Increase length of defrost cycle.
	Shortage of refrigerant	Correct refrigerant charge.

3.2 ELECTRIC DEFROSTING

Achieved by sheathed elements in the evaporator coil block and electric heaters in the drip tray. The operation of the heater elements in a controlled manner between two and eight times per day depending on application achieves defrosting.

The normal defrosting sequence is the 'pump down method'. Where at initiation of the defrost, by a timer, the liquid line solenoid closes and the system pumps down.

The compressor and evaporator fans continue to run until the suction pressure falls (to a point below the normal running pressure but above the low pressure cut out point).

The defrost low pressure switch stops the compressor and cooler fans, the defrost heaters are then energised for a set time period which should be interrupted by a defrost termination thermostat.

The defrost termination thermostat prevents unnecessary heat being added to the room and de-energizes the heaters when a predetermined temperature in the coil block has been achieved. If the defrost timer failed, the termination thermostat would have cut out the heaters to prevent damage to the evaporator coil, due to overheating.

Some termination thermostats have a dual facility to act as a fan delay on resumption of the refrigeration cycle to ensure that any free moisture is frozen & not blown over the product. They do not allow the fans to start until the residual moisture on the coil block has been frozen.

The positioning of the phials for these thermostats is extremely important and the manufacturers instructions need to be followed.

The overall defrost period is controlled by a timer that will initiate the required number of defrosts per day. The normal sequence being every six hours i.e. four times per day. Other arrangements may be used depending on application.
The timer can also have other features such as defrost period duration, temperature termination, pressure termination and

defrost cycle inhibit.

Termination by time override is recommended to limit the length of the defrost cycle and switch off the heaters should the termination thermostat not have functioned.

The setting of the defrost termination thermostat and the time clock must insure there is a drain down period at the end of the defrost cycle of about 10 minutes when the heaters are off to let residual heat dissipate and moisture drip off and not be evaporated as steam into the room.

Recently introduced are electronic controllers that have all the above facilities available. The cooler location is important, as access to service and remove the heater rods is vital.

The drip tray of the cooler will have heaters fitted to make sure any ice falling from the coil block melts and drains away.

With large evaporators there may be gaps between the coil block and the drain tray. Having the drip tray heaters only operative with the coil block heaters result in residual ice build up in the drip tray.

In these circumstances it is an advantage to have the coil block heaters and drain tray heaters wired and controlled separately. Then the drip tray heaters can be on during the drain down period at the end of the defrost cycle.

Advantages of Electric Defrosting

- Relatively simple system with minimum components.
- Economic system to install.
- Lends to self-contained stand-alone systems.

Disadvantages of Electric Defrosting

- There is a considerable time delay before any frost or ice melts, especially in low temperature applications.
- The electrical load for the heater elements can sometimes be greater than the electrical load from the compressors.
- Care must be taken to ensure the compressor does not operate with the heaters. Under these circumstances the total power drawn may exceed the incoming protection and the plant cuts out.
- When the gap between the coil block and the drip tray is large the warm drops of water can re-freeze on hitting the colder surface of the drain tray if the drain tray is not heated.
- In some instances it may be necessary to fit a hatch in the insulation panels to facilitate removal of the heater rods.
- Coolers that are located close to each other and defrosted separately can suffer from moisture in the form of steam ‘hopping’ from the defrosting cooler to the refrigerating one.
- There is a potential danger with electric defrosting if adequate safety devices and controls are not used. Of overheating the elements. This can lead to a fire developing.
- Heater rods can also suffer from ‘creep’ – if they are not properly secured the heater rod can move in the tube due to continual expansion and contraction.
- The electrical connection can then short out against either the cooler casing or distributor tube arrangement. In some cases the spark generated can blow a hole in the copper return bends. Leading to a major escape of refrigerant into the storage area.

Troubleshooting with Electric Defrosting

Table 2 on the next page gives a guide to problems that may be experienced.

3.3 HOT GAS DEFROSTING

Hot gas from the compressor discharge is used to defrost the coolers. This is an efficient way to defrost a coil block as heat is added inside the cooler tubes. Lower surface temperatures than with electric defrosting prevail.

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Table 2 - Troubleshooting with Electric Defrosting

Symptom	Cause	Remedy
Iced up drip tray.	Drain line blocked. Drip tray heaters faulty. Drip tray heaters not on during drain down period.	Clear drain line. Replace heaters. Change wiring so drain tray heaters are on for complete defrost cycle.
Defrost terminates prematurely.	Wrongly set or positioned termination thermostat.	Check thermostat setting and location of phial.
Fan blades iced in place after a defrost.	Peripheral heaters not working. Peripheral heaters not fitted.	Repair faulty heaters. Fit fan Peripheral heaters.
Steam comes from cooler during defrost	Defrost Termination thermostat not cutting out heaters.	Adjust or replace defrost termination thermostat.
Coil block not fully clearing at top	Faulty heaters. Defrost termination to quick.	Check heaters and replace. Adjust termination thermostat.
Drip tray frozen up.	Faulty drip tray heaters.	Replace faulty heaters.
Water carry over from evaporator.	Free moisture not freezing onto coil surfaces.	Insufficient drain down time following termination. Fan delay too short to allow “snap freeze”.

Because of the lower temperatures there is less likelihood of steam and condensation coming from the coolers and being deposited as ice on the ceiling and walls around the cooler.

There are various forms of hot gas defrosting and the intention of the following is to give a guide as to what may be found in the field.

The simple application for small display case coils is to inject hot gas into the evaporator just after the expansion valve. The compressor continues to run and creates hot gas from the vapour being drawn from the suction of the evaporator.

The defrost cycle is started and stopped by a time clock energising the hot gas vale. This valve may be three ports to fully divert the discharge gas or a two port valve in a branch line from the discharge line. This latter arrangement relies on the evaporator being at a lower pressure than the condenser and the hot gas taking the easiest path of flow. Another method is to use a three or four port hot gas valve. This method can only be used on multiple evaporator installations as hot gas is only admitted to one evaporator at a time.

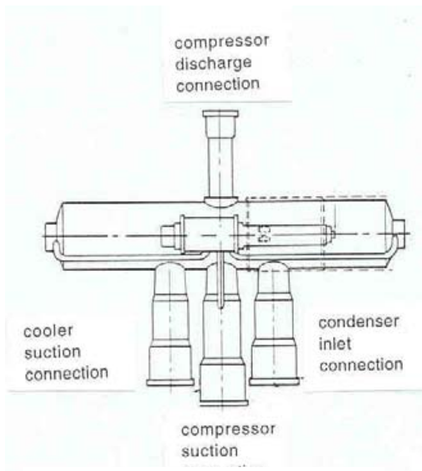

Figure 2 - Four port valve

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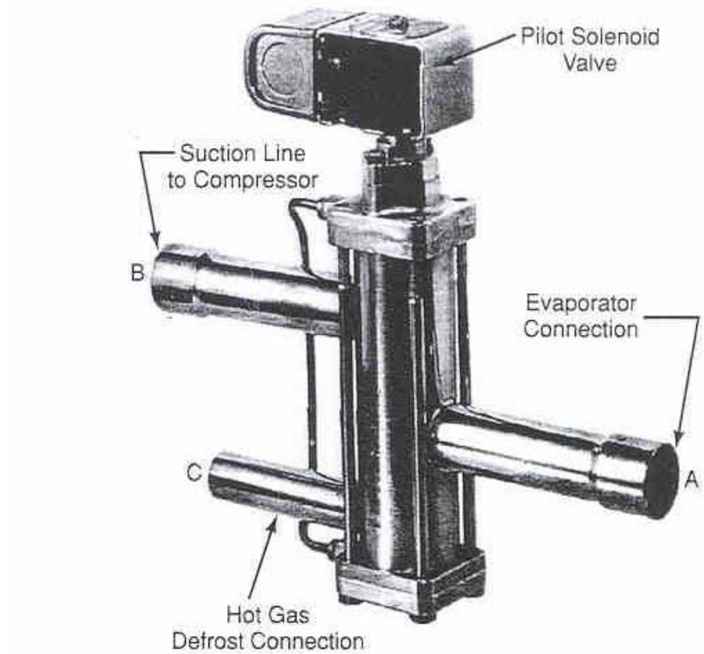

Figure 4 - Three Port Valve

With this type of installation the flow of discharge gas is completely blocked off when the valve is de-energised. Therefore, these valves must only be used in a discharge line header and not in the main discharge line.

Care has to be taken to ensure that sufficient heat can be drawn from the operating coolers to defrost the selected cooler. As a guide, for chill applications with three evaporators installed, allowing two refrigerating whilst the third is defrosting, usually operates satisfactorily. For frozen areas it will require four evaporators, with three pumping into one for an efficient defrost operation. The hot gas valves are usually in the plant room and a suction line comes back from each cooler to the hot gas valves.

A similar method is used for supermarket installations where a pack is installed. A two port or the three port valve as shown is used. The valve is used to allow hot gas to flow down the suction line into the coil block selected for defrosting.

With three and four port hot gas check valves are required to allow the vapour condensed into liquid in the coil block back into the system.

An industrial system may incorporate a number of valves and operate as follows (see Figure 5).

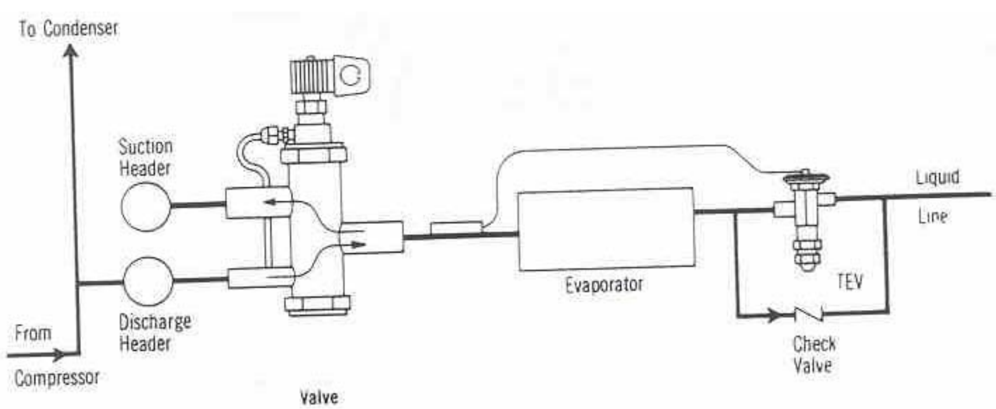

Figure 5 – Three Port Valve Installation

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DEFROSTING OF PUMP CIRCULATED AMMONIA COOLERS

COMPONENT / FUNCTION	Fans	Drain heaters	Fan heaters	A	B	C	D	E	F	I
Refrigerate	E	E	D	D(S)	E(O)	E(O)	D(S)	D(S)	O	D(S)
Off on T'stat	E/D	E	D	D(S)	E(O)	D(S)	D(S)	D(S)	O	D(S)
Defrost	D	E	E	E(O)	D(S)	D(S)	E(O)	E(O)	S	D(S)
Drain down	D	E	E	E(O)	D(S)	D(S)	D(S)	E(O)	S	E(O)
Fan delay	D	E	E	D(S)	E(O)	E(O)	D(S)	D(S)	O	D(S)

S-shut
O-open
E-energised
D-de-energise

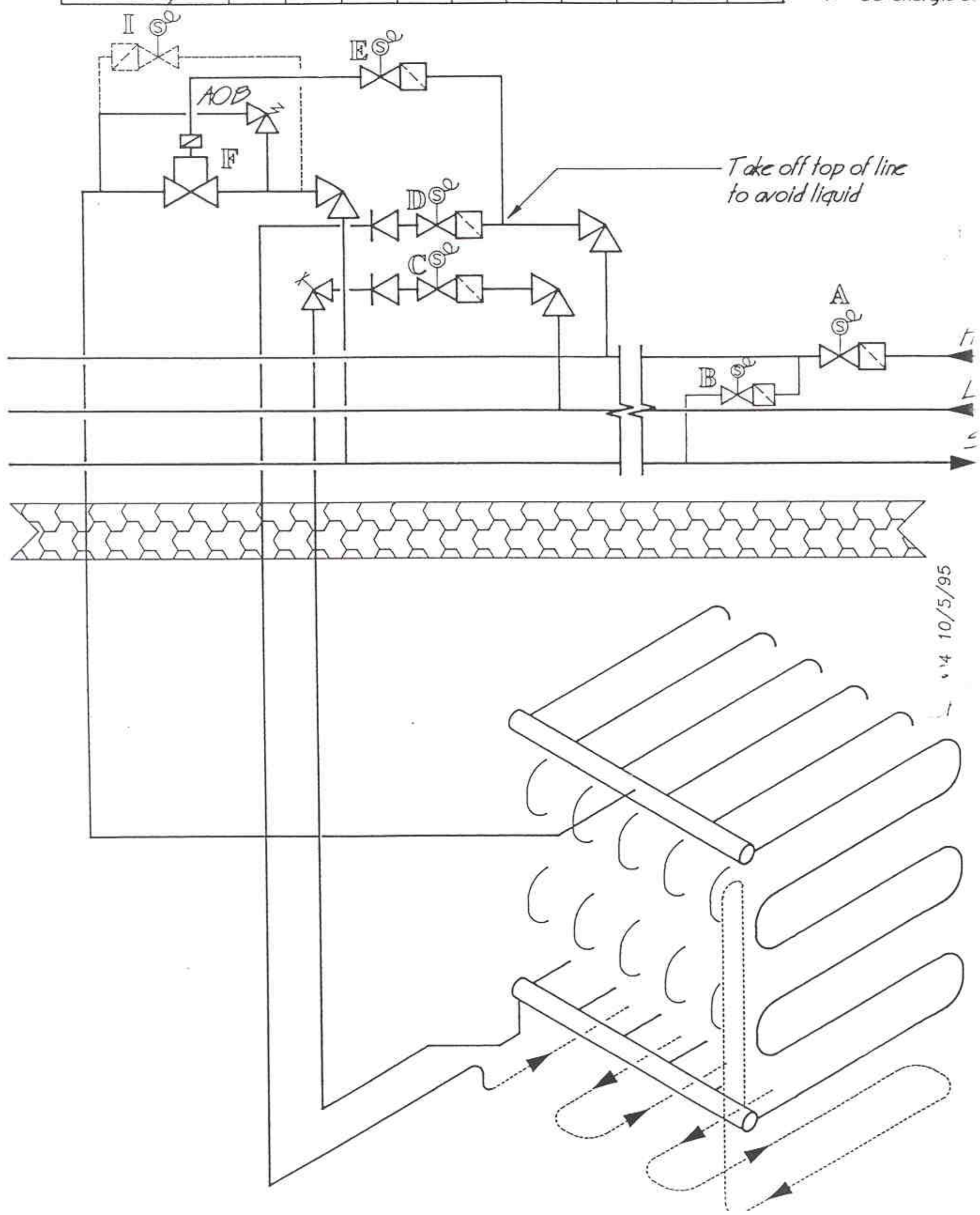

Figure 6 – System Sketch

When all the coolers are refrigerating the main hot gas valve A in the plant room will be shut and the bleed valve B will be open to prevent condensation in the extended hot gas line.

The liquid supply solenoid valve C will be opened as will the automatic suction valve F which will be held open by its spring in the absence of a pressure signal from valve E which will be de-energised.

The local hot gas solenoid valve D will also be shut. The non-return valve between D and the cooler prevents reverse flow through the de-energised solenoid valve.

When the cooler is switched off by thermostat, the liquid line solenoid valve C will be shut and the cooler fans may be running or not depending upon the operating regime.

When defrost is called for, the fans will be switched off and the fan peripheral heater (if fitted) will be energised. Valve A will be energised and valve B will be de-energised.

The liquid supply solenoid valve will be de-energised, the hot gas solenoid valve D will be energised, as will the pilot valve E which energizes to supply hot gas pressure to shut the main pilot operated suction valve F.

During the defrost cycle the pressure in the cooler will rise to the setting of the AOB (liquid release valve). The valve will lift to reduce the pressure and re-seat. The setting of this valve usually depends upon the refrigerant and tends to be between 6- 8.5 bar (80 to 120psi).

The defrost will continue for a set time, usually determined at commissioning, in general a large steel cooler will take at least 20 minutes to defrost.

When the defrost reaches the end of its set time, the local hot gas solenoid valve D will be de-energised to terminate the supply of hot gas but valves A and E will be kept open so that the high pressure vapour in the cooler will not be suddenly released.

After an appropriate drain down time valves A and E will be shut and valve C opened so that refrigeration can commence. By this time the refrigerant pressure in the cooler will be much reduced due to the cooling effect of the cold store air so that when valve liquid condensed in the hot gas line can be returned to the accumulator via the wet suction line. F opens it does so relatively gently. At the same time valve B is opened so that any.

In the same way as electric defrost the fans will be unable to run until after a fan delay or “snap freeze” period. The peripheral heaters will remain energised so that free moisture does not freeze between the fan blades and the casing.

This system is used extensively on large pump circulation plants or for multiple cabinets served by a central pack. Not all the control valves shown may be necessary but proper safeguards to prevent liquid hammer are required.

With hot gas defrost systems a quicker more efficient defrost is achieved if the hot gas is not first taken into the drip tray. It is better to install electric heaters in the drip tray and have these on during the complete defrost cycle. The hot gas can then be piped directly into the coil block.

Advantages

- Heat for defrosting is directed at the point where it is required, giving effective defrosting in half the time of comparable electric systems.
- Single coolers can be defrosted whilst remainder are refrigerating thus maintaining store temperature.

Disadvantages

- The compressor discharge pressure has to be artificially raised during defrost to ensure enough hot gas is available, this increases plant power consumption and reduces efficiency.

- Additional pipe work may be required on some systems with the need to bring a suction line from each coil block back to the plant room.

Troubleshooting with Hot Gas Defrosting

Table 3 gives a guide to problems that may be experienced.

Heat is directly applied at the most appropriate place in the cooler, as opposed to the delay with electric defrosting, due to radiant heat being the main source.

3.4 REVERSE CYCLE DEFROSTING

As the name implies the refrigeration system has its components reversed where the evaporator becomes a condenser and the condenser becomes an evaporator.

To achieve this method of defrosting the use of a four port slide or ball valve is used.

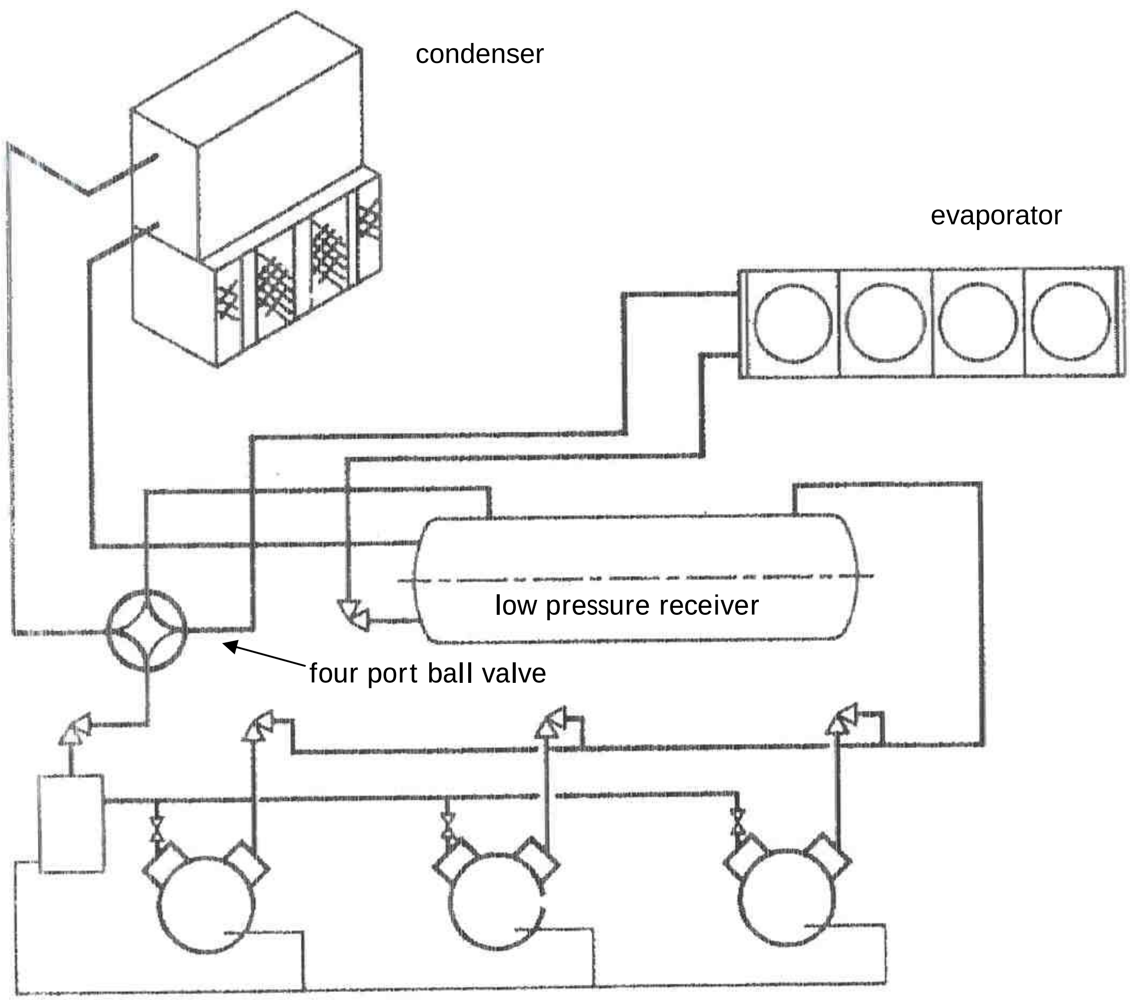

Figure 7 – Circuit Diagram

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Table 3 - Troubleshooting with Hot Gas Defrosting

Symptom	Cause	Remedy
Lack of heat at evaporator	Low refrigerant flow. Too much ice on evaporator. Hot gas valve not seating.	Check system charge. Check strainers and non return valves Modify defrost cycle. Check actuator settings and valve seats.
Defrost terminates prematurely.	Wrongly set or positioned termination pressure switch.	Check switch setting and pressure is being sensed in the evaporator or suction line (normal operation).
Compressor runs at low suction pressures	Low mass flow at compressor	Incorrect setting of reverse flow expansion device. Check refrigerant charge
Fan blades iced in place after a defrost.	Perripheal heaters not working. Peripheral heaters not fitted.	Repair faulty heaters. Fit fan Peripheral heaters.
Drip tray frozen up.	Faulty drip tray heaters. Drain line blocked.	Replace faulty heaters. Clear blockage.
Defrosts are erratic.	Valve missaligned.	Check valve is positioned as recommended by manufacturer.
Water carry over from evaporator	Free moisture not freezing onto coil surfaces.	Insufficient drain down time following termination Fan delay too short to allow "snap freeze"

At the start of defrost the liquid line solenoids close and the evaporator is "pumped down".

The system pressure is allowed to equalize (to minimize the load on the valve drive motor).

After a suitable time delay the valve moves through 90 degrees to the defrost position.

This then allows all the compressor discharge gas to travel up the suction line to the evaporator, where it condenses and is then passed along the liquid line (in the opposite direction to the refrigeration cycle) and is expanded through a hand regulating valve or, in smaller systems, a standard thermostatic expansion valve and allowed to enter the condenser.

The air (and water if evaporative) is reduced in temperature and discharged to atmosphere by the condenser fans.

The vapour from the condenser is taken back to the compressor suction (via suction trap or low-pressure receiver in some systems).

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Advantages

- Heat for defrosting is directed at the point where it is required, giving effective defrosting in half the time of comparable electric systems.
- Plant efficiency is much improved as power consumption during defrosts is less than during refrigeration and the shorter defrosting times ensure that the cold store temperature recovery is much quicker.
- Maintenance is simpler as most components are outside the refrigerated space and therefore more accessible.
- Up to six coolers can be defrosted simultaneously at a suitable time when the room is not heavily utilized.
- As with hot gas defrost systems a quicker more efficient defrost is achieved if the hot gas is not first taken into the drip tray. It is better to install electric heaters in the drip tray and have these on during the complete defrost cycle. The hot gas can then be piped directly into the coil block.

Disadvantages

- The refrigerant charge is sometimes determined by the ability of the plant to defrost and sufficient storage of the excess refrigerant during normal operation is required.
- Small commercial type reversing valves can have large pressure drops across them leading to system inefficiencies. A correctly sized valve will not have this problem.
- Additional components, such as non-return valves, are required to bypass the expansion devices when flow is in the opposite direction.
- Two stage or compound compressors will need some form of interstage cooling during the defrost cycle. This cannot be taken from a location that is at a lower pressure than the intermediate pressure during defrost.

Trouble shooting with reverse cycle defrosting

Table 4 gives a guide to problems that may be experienced.

3.5 DEFROSTING SECONDARY REFRIGERANT INSTALLATIONS

For environmental reasons and limiting refrigerant charge more secondary refrigerant systems are being installed.

The primary refrigerant is limited to the plant room cooling a fluid such as water for high temperature applications. A glycol or one of the new potassium acetate or format based fluids for lower temperatures.

When these installations require defrosting one of the following principles is used.

The coil blocks are fitted with electric heater elements for what in principle is an electric defrost cycle. The secondary refrigerant flow is stopped and the heaters energised. The program is the same as electric defrosting using a time clock and defrost termination thermostat and fan delay facility.

The other method of defrosting secondary refrigerant systems is to use a warm secondary refrigerant. The principle operates in a number of ways.

The coil block can have a second circuit to be used for warm secondary refrigerant in a separate system. This is known as a four pipe system as there are four pipe connections on the coil block to form the two independent circuits. Fluid is heated in the plant room usually from the compressor discharge gases and pumped around what is called the warm defrost circuit. Fluid temperatures of about 10 °C to 15°C are required.

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Table 4 - Trouble shooting with reverse cycle defrosting

Symptom	Cause	Remedy
Lack of heat at evaporator	Low refrigerant flow Too much ice on evaporator Four way valve not seating	Check system charge Check strainers and non return valves Modify defrost cycle Check actuator settings and valve seats
Defrost terminates prematurely	Wrongly set or positioned termination pressure switch	Check switch setting and pressure is being sensed in the evaporator or suction line (normal operation)
Compressor runs at low suction pressures	Low mass flow at compressor	Incorrect setting of reverse flow expansion device Check refrigerant charge
Fan blades iced in place after a defrost.	Peripheral heaters not working. Peripheral heaters not fitted.	Repair faulty heaters. Fit fan Peripheral heaters.
Drip tray frozen up.	Faulty drip tray heaters. Drain line blocked.	Replace faulty heaters. Clear blockage.
Defrosts are erratic.	Valve missaligned.	Check valve is positioned as recommended by manufacturer.
Water carry over from evaporator	Free moisture not freezing onto coil surfaces.	Insufficient drain down time following termination Fan delay too short to allow “snap freeze”

The system is reasonable efficient but has a high installation cost. The method of control is to close cold circulation valves and open the warm circuit on defrost demand.

A similar system to the above known as a three pipe installation circulates warm secondary refrigerant through the coil block but using the cooling circuit.

As the warm secondary refrigerant comes into the coil it pushes the cold fluid out. This arrangement gives a quicker defrost as the complete coil block is feed with warm fluid.

Heat exchangers and pumps are required in the plant room. With a three pipe system only a single supply pipe is needed. With careful design a return pipe can be avoided.

This arrangement is more efficient and costs less to install.

The latest technology defrosts the coil locally. With each coil block (or pairs of coil blocks) having their own defrost system. This arrangement is sometimes called an “integrated defrost system”

A run around circuit with pump and heater are provided for each coil block. Warmed secondary fluid is circulated locally.

Figure 8 shows a typical circuit arrangement.

The heater and pump can be in the cooler case work (as shown below) or in the roof space above contained within a cabinet.

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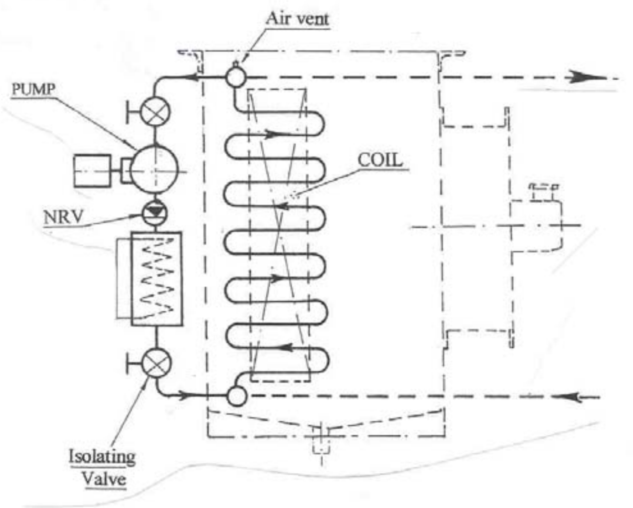

Figure 8 - Integrated defrost circuit

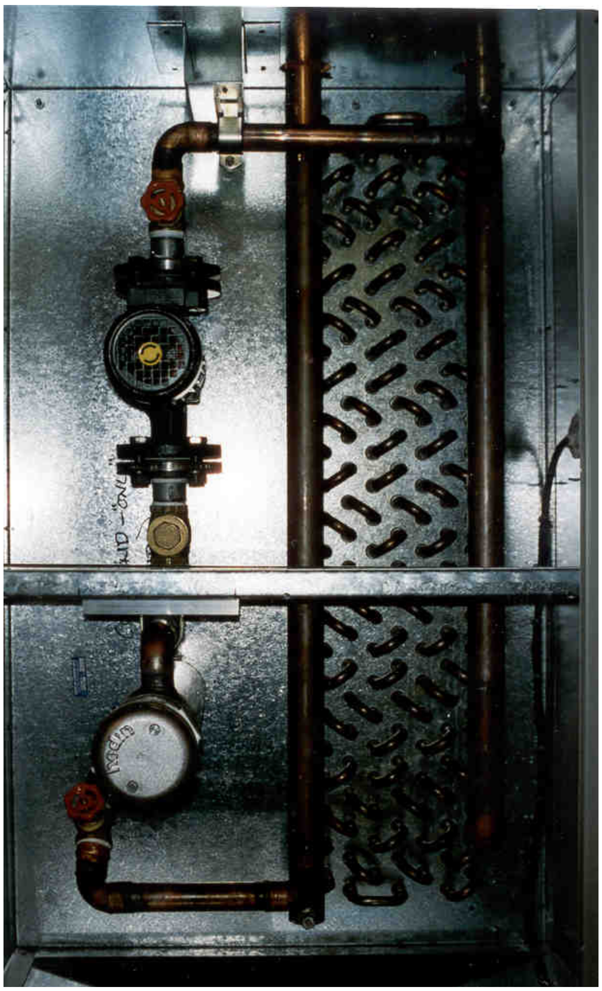

Figure 9 - Equipment installed in cooler casing

Advantages

- Heating from inside the tubes gives efficient low temperature defrosting.
- With three and four pipe installations recovered heat can be used, but energy savings are offset by need for pump energy.
- Integrated systems are simple to install.
- Integrated systems are easy to maintain with local equipment.

Disadvantages

- Three and four pipe systems require piping ring main installations and associated maintenance
- Integrated systems with local heater and pump may use more energy, but this is off set by capital cost saving of the installation.

Trouble shooting with secondary refrigerant defrosting systems

Table 6 gives a guide to problems that may be experienced.

3.6 WATER DEFROSTING

Coil blocks can be defrosted by the use of water running over the fins and tube. It is a very effective method of defrosting and found favor in areas where regular cleaning of the coil block was required.

With the high cost of water and the availability of cleanable coolers few water defrost installations remain in operation. The only exception to this are spiral chillers and freezers that may only be defrosted once per day. Some installations have even longer period between defrosting.

With water defrost deep drip trays were required and oversize drain lines to ensure water does not back up and over flow the drip tray.

There were some systems that stored water in a tank that was heated from the compressor discharge gas. This water was then recirculated around the defrost circuit. This arrangement would not be acceptable today with current legislation concerning legionella and the need to chlorinate water systems.

Advantages

- Quick clean defrost.
- Maintenance straightforward.

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Disadvantages

- High cost of water.
- Subject to flooding with drain line and drip tray faults.

Table 6 - Trouble shooting with secondary refrigerant defrosting systems

Symptom	Cause	Remedy
Lack of heat at evaporator	Heaters of inadequate rating with integrated systems. Poor pipe insulation on three and four pipe systems. Insufficient hot gas duty three and four pipe systems.	Increase heaters installed. Improve pipe insulation. Consider supplementary heat.
Defrost terminates prematurely.	Wrongly set or positioned termination pressure switch.	Check switch setting and pressure is being sensed in the evaporator or suction line (normal operation).
Fan blades iced in place after a defrost.	Peripheral heaters not working. Peripheral heaters not fitted.	Repair faulty heaters. Fit fan Peripheral heaters.
Drip tray frozen up.	Faulty drip tray heaters. Blocked drain line.	Replace faulty heaters. Clear blockage.
Water carry over from evaporator	Free moisture not freezing onto coil surfaces.	Insufficient drain down time following termination Fan delay too short to allow “snap freeze”

Table 7 - Troubleshooting with water defrosting

Symptom	Cause	Remedy
Lack of heat at evaporator	Water supplied at to low temperature.	Raise water supply temperature
Defrost terminates prematurely.	Wrongly set termination time clock.	Check time clock duration
Drip tray overflows,	Blocked drain line. To greater flow of water.	Clear and clean. Set flow to correct value
Fan blades iced in place after a defrost.	Peripheral heaters not working. Peripheral heaters not fitted.	Repair faulty heaters. Fit fan Peripheral heaters.
Water carry over from evaporator	Free moisture not freezing onto coil surfaces.	Insufficient drain down time following termination Fan delay too short to allow “snap freeze”

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Troubleshooting with water defrosting

Table 7 gives a guide to problems that may be experienced.

3.7 DEFROSTING PROBLEMS

If the defrost cycle especially with electric defrosting is not carefully set up then frost and snow on the panels around the coolers will occur.

Coolers located close together if not defrosted at the same time may suffer from moisture transfer.

If drip tray heaters are not on for the full defrost cycle i.e. on during the drain down period drip may ice up as shown below.

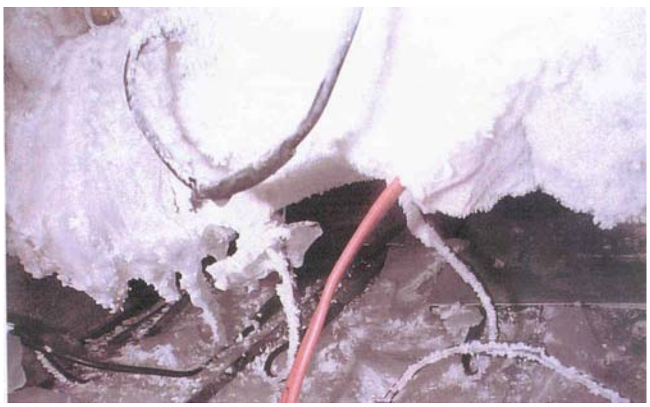

Figure 10 – Iced Up Drip Tray

Poor control of infiltration air and incorrect defrost set up can result in coolers icing over, the result is little duty and possible fan motor failure.

Moisture in systems particularly with electric defrosting can develop bubbles on the return bends. Moisture can lodge in the return bend joint and the continual freezing and thawing creates the blisters which eventually result in refrigerant leakage.

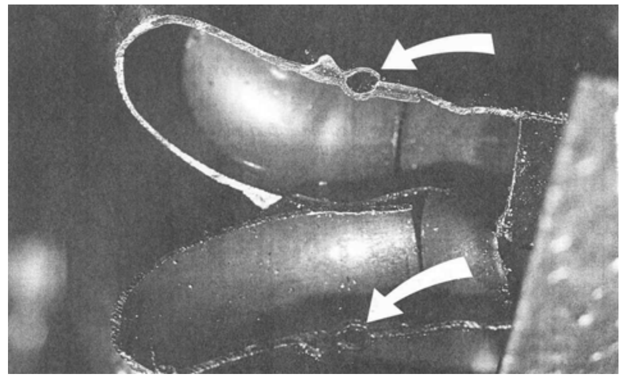

Figure 11 – Typical Blister Damage

If coil blocks ice up and this is left for long periods of time the thawing and freezing of water next to the tube surface will in time collapse the tubes. This usually happens at the bottom of the coil and during maintenance inspections the formation of ice at the bottom of the coil should be looked for. Unless the defrost cycle is adjusted, cooler tubes will collapse.

This problem is not normally seen with hot gas or reverse cycle defrosting. This is probably due to the heat being applied inside the tube and around the return bend which evaporates the water entrained in the return bend joint during the defrost cycle.

Figure 12 Collapsed cooler tube

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With off cycle, hot gas and reverse cycle defrost systems a shortage of refrigerant will be a problem.

Off cycle defrosting with low refrigerant charge lead to low suction pressures and the frost and iced formed difficult to remove. Low refrigerant charge may stave part of the coil, which leads to ice build up at the bottom of the coil.

With hot gas and reverse cycle low refrigerant charge may limit the amount of heat available for defrosting.

4. DEFROSTING AIDS

Some cooler manufacturers fit short socks to the fans of draw through coolers. These drop down during defrost to close of the fan outlet and help retain the heat in the coil block. This facility is some times called "defrost shut off"

If the are large quantities of moisture then socks may freeze in place. Any ice forming can be dangerous if blown off the socks when the fans start up.

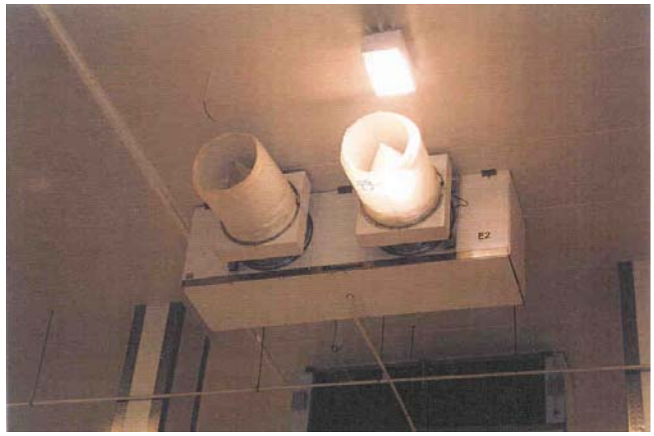

Figure 13 Typical Sock Installation

Floor mounted coolers with vertical airflow must have dampers in the air discharge to stop the chimney effect during a defrost. These can be electrically operated or closed by gravity when the fans are switched off.

To retain the coil block heat cowls on the air return can be installed. To avoid a chimney effect they should only be used with socks or dampers on the fans.

5. ACKNOWLEDGEMENTS

The Service Engineers Section of the Institute of Refrigeration would like thank Alan Kerbyson of Star Refrigeration for taking time to prepare this technical bulletin.