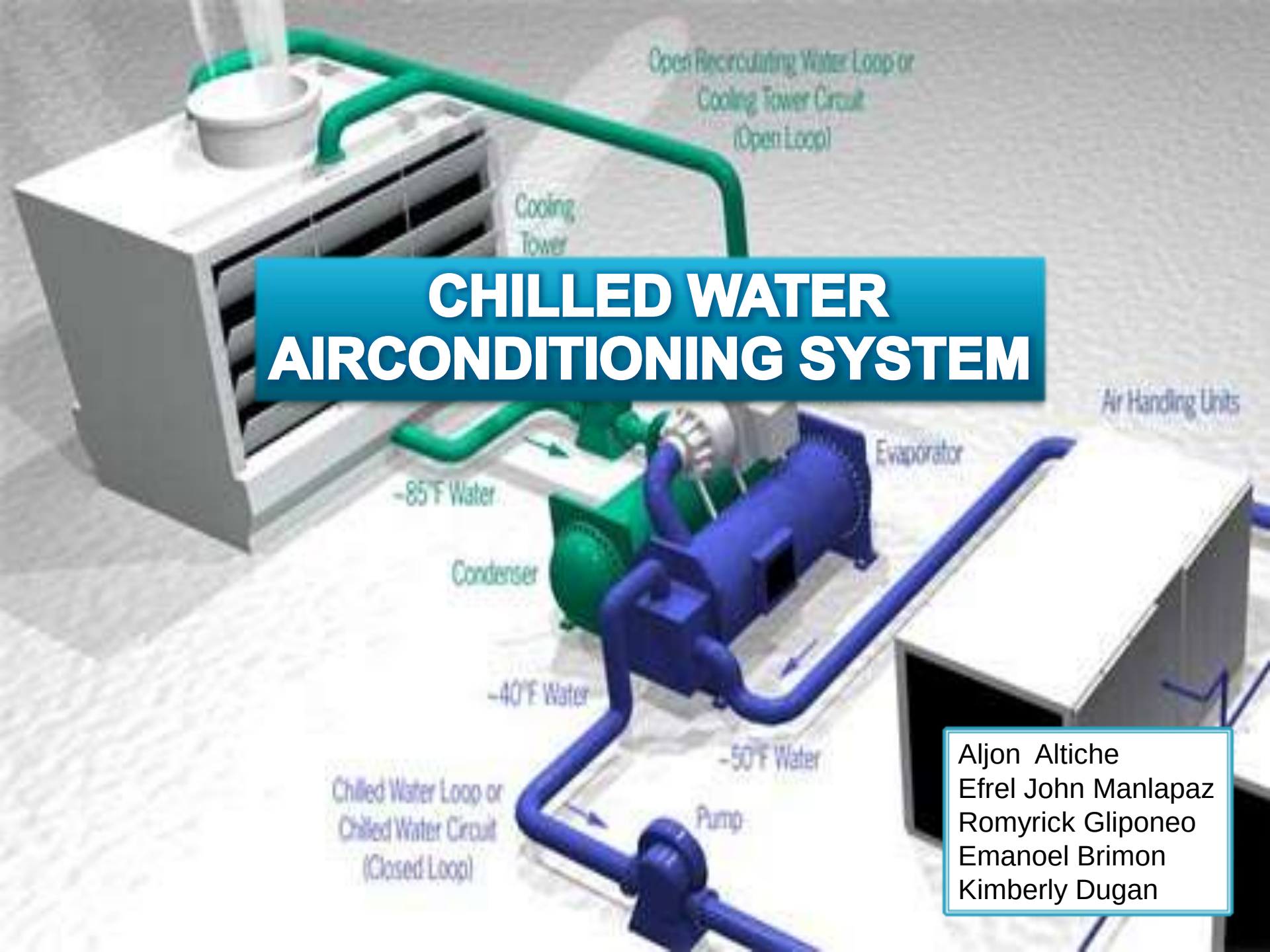

CHILLED WATER AIRCONDITIONING SYSTEM

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Chilled Water Air-conditioning System

Systems that employ **water chillers** are commonly called **chilled-water systems.** As its name suggest, this system makes use of water as its secondary refrigerant. Chiller is used to remove heat from the water which is then circulated through other components to absorb heat from the space.

Chilled water air conditioning systems are commonly used in applications that need large cooling capacity such as hypermarket, industrial process, commercial air conditioning such as offices and factories. More and more homes are using this system to air conditioned their entire house because of its cost-effectiveness and no hazard of having refrigerant piped all over the house.

How it conditioned atmospheric air?

In a chilled-water system, the entire air conditioner is installed on the roof or behind the building. A Water chiller cools water to between 40 and 45 degrees Fahrenheit (4.4 and 7.2 degrees Celsius). The chilled water is then piped throughout the building and connected to air handlers. This can be a versatile system where the water pipes work like the evaporator coils in a standard air conditioner. If it's well-insulated, there's no practical distance limitation to the length of a chilled-water pipe.

Part of a Water Chilled Air-cond. System:

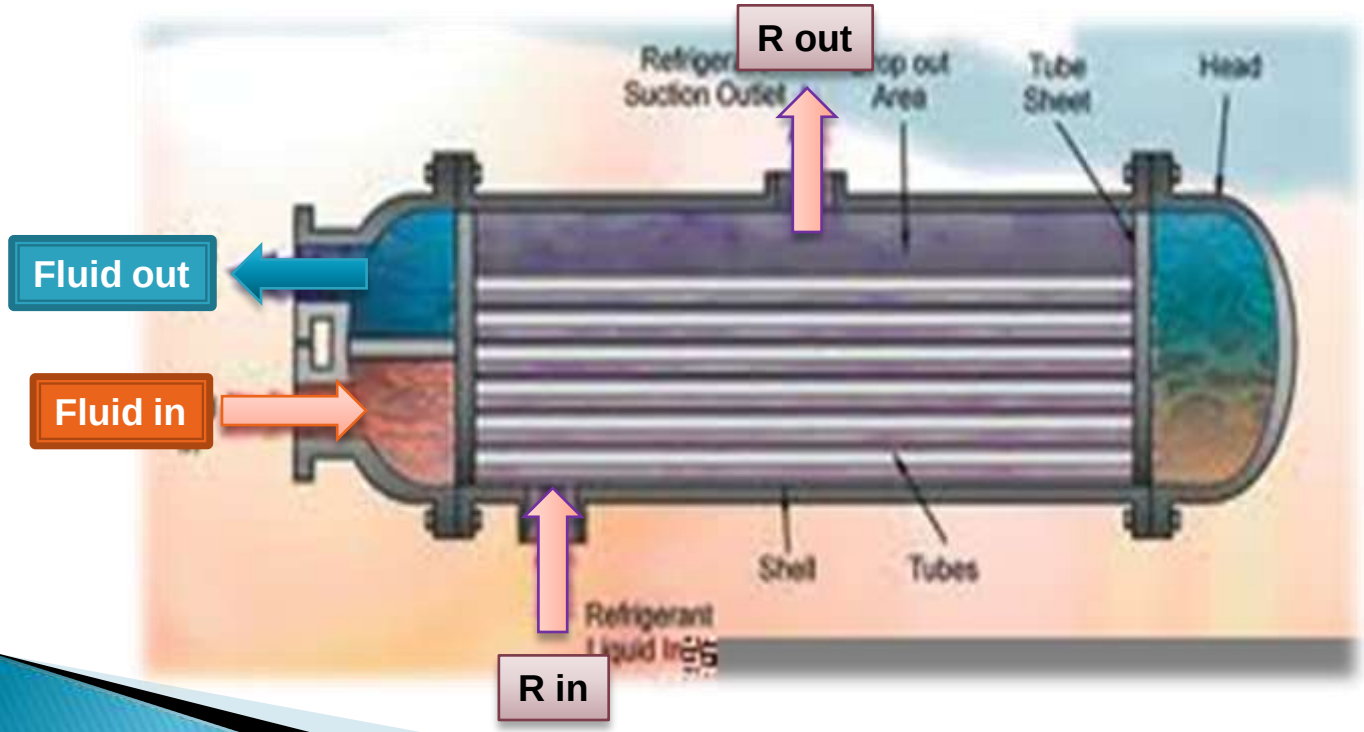
- Water Chiller

A device that removes heat from a liquid via a vapor-compression or absorption refrigeration cycle. This cooled liquid flows through pipes in a building and passes through coils in air handlers, fan-coil units, or other systems, cooling and usually dehumidifying the air in the building. Chillers are of two types; air cooled or water cooled.

Parts of a Water Chiller:

- Evaporator

The evaporator works the opposite of the condenser, here refrigerant liquid is converted to gas, absorbing heat from the air in the compartment.



- Compressor

The compressor compacts the refrigerant vapor and pumps it to the reversing valve.

- Condenser

a equipment that converts a gas to a liquid to obtain either the substance or the released heat

a) Air-cooled condenser - condenser in which refrigerant flows through the tubes and rejects heat to air that is drawn across the tubes.
b) Water-cooled condenser - condenser that rejects the heat of the refrigerant to water flowing through it.

For Water Cooled Condenser:

a) Cooling Tower

Cooling towers are heat rejection devices used to transfer process waste heat to the atmosphere. Cooling towers may either use the evaporation of water to reject process heat and cool the working fluid to near the wet-bulb air temperature or rely solely on air to cool the working fluid to near the dry-bulb air temperature.

b) Condenser water pump unit

is a set of device by using mechanical forces to move the condenser water.

- Expansion valve

a valve through which liquid or gas under pressure is allowed to expand to a lower pressure and greater volume

Other parts of a Water Chilled Air-cond. System:

- AHU - An air handler, or air handling unit often abbreviated to AHU, is a device used to condition and circulate air as part of HVAC system. Usually, an air handler is a large metal box containing a blower, heating and/or cooling elements, filter racks or chambers, sound attenuators, and dampers. Air handlers usually connect to ductwork that distributes the conditioned air through the building, and returns it to the AHU.

- Fan-coil unit (FCU) - A small terminal unit that is often composed of only a blower and a heating and/or cooling coil (heat exchanger), as is often used in hotels, condominiums, or apartments.

- Expansion tank - A component of a closed piping system that accommodates the expansion and contraction of the water as temperature and, therefore, density, changes.

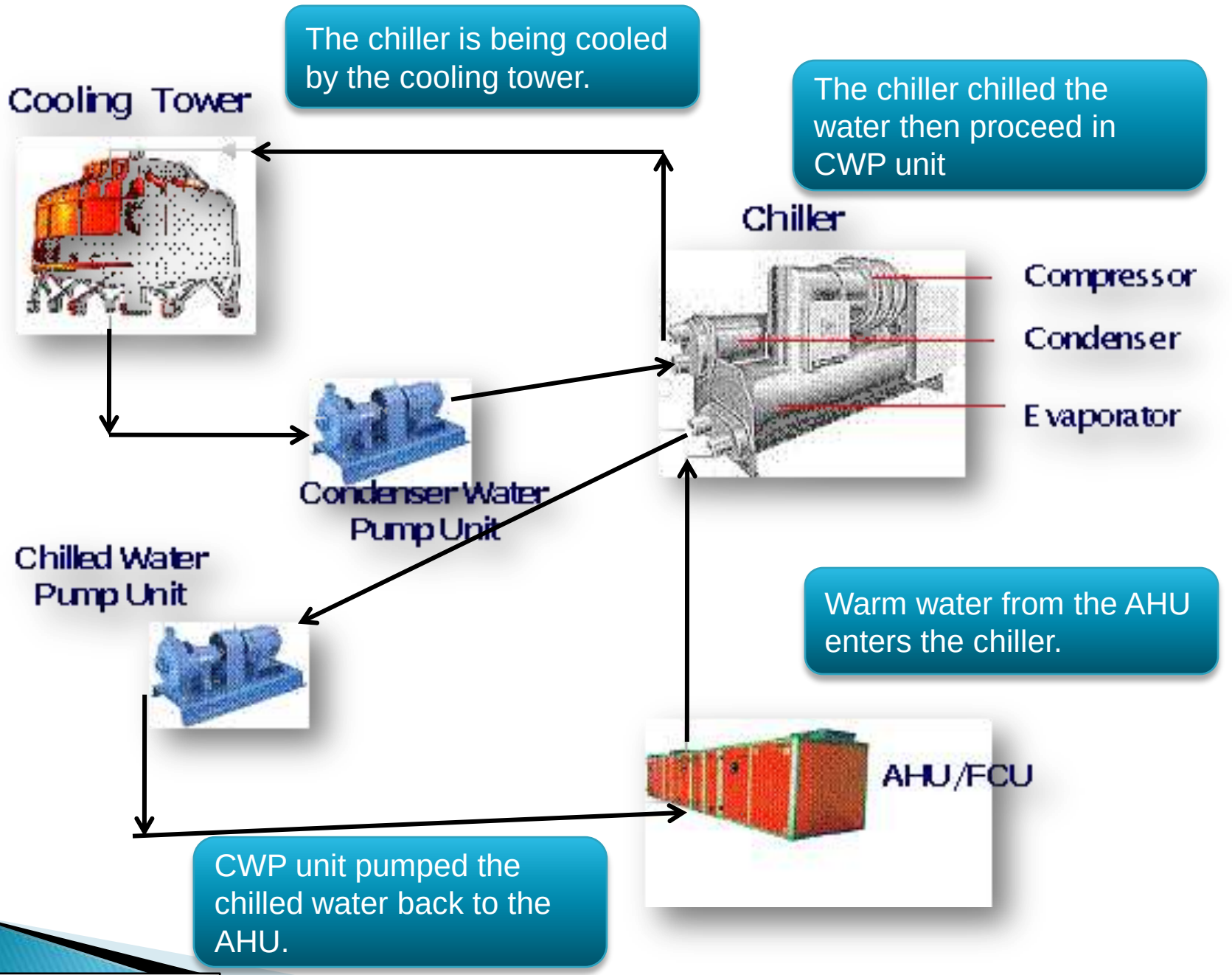
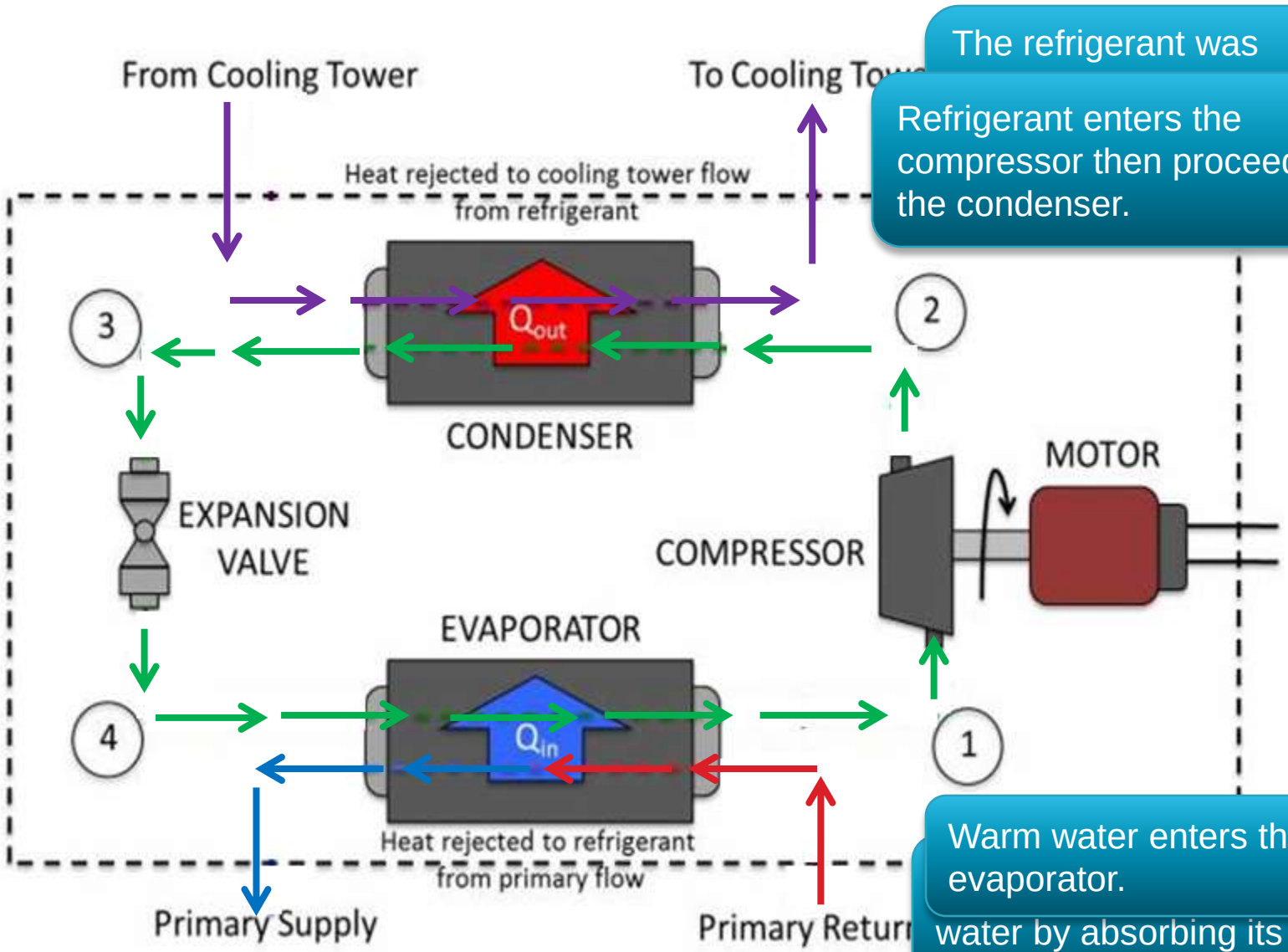


Fig 1. Assembly Diagram:



The refrigerant was

Refrigerant enters the compressor then proceeds in the condenser.

Warm water enters the evaporator.

water by absorbing its heat.

Fig 2. Refrigerant Flow Diagram:

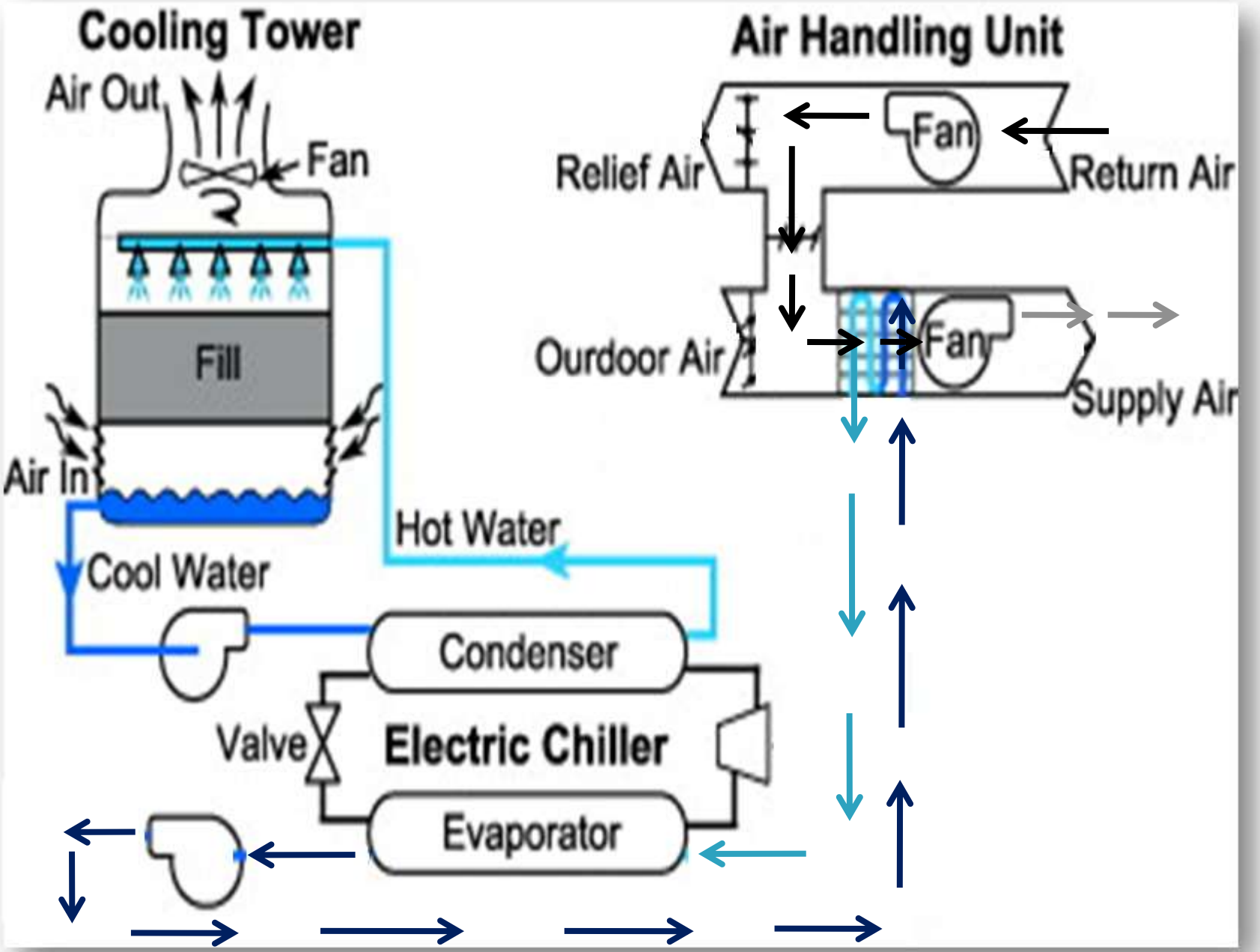


Fig 3. Supply Air and Return Air Flow:

Advantages of Chilled Water Air-con. System:

- The evaporator cools water to about 45 .That chilled water is pumped to cooling coils in the areas being cooled, and a fan draws the air in those areas through the chilled water coils, cooling the air.

  In comparison, with standard air conditioning, the evaporator coil directly cools the air. The refrigerant flows all the way to the air handlers in the areas being cooled, and a fan draws the air in those areas through the evaporator coils, cooling the air.

- With chilled water air conditioning, the compressor is usually mounted on a rack or frame, within a few feet of the evaporator that cools the chilled water. If the condenser is water cooled, it's usually mounted on the same rack. If the condenser is air cooled, it will be installed outside the building.

- One advantage of chilled water air conditioning is that if the chilled water piping leaks somewhere in the building, only water is lost, and repairs only require plumbing work.

  In comparison, with standard air conditioning, a leak in a refrigerant line inside the building will probably require brazing, leak testing with nitrogen, evacuation of the system, and recharging with a refrigerant that is a lot more expensive than water.

- Another advantage of chilled water air conditioning is that if air stops flowing through the cooling coil, the chilled water will simply return to the chiller. Since the water will not have picked up any heat, it will still be cold, and the chiller will respond by unloading and turning off.

  With standard air conditioning, if air stops flowing through the cooling coil, there is a possibility that liquid refrigerant will return to the compressor and damage it.

Installation, Testing, Operation and Maintenance of a Lennox Air Cooled Chiller

Installation:

1.1- Lay-out and Installation requirements

- Air-cooled chillers with helicoids fans such as Ecologic or NEOSYS are designed for outdoor installation. Please consult Lennox prior to implementing other types of installation.

- Locate the chiller where it is least affected by wind (install windbreaks where wind speeds > 2.2 m/s).

- The ground beneath the unit must be flat, level and of sufficient strength to support the weight of the unit with its full liquid charge, and the occasional presence of the usual service equipment. In locations exposed to frost, the supporting surface, if the unit is installed on the ground, must be built on concrete stakes extending downwards beyond the normal depth of frost. It is always advisable to build a supporting surface detached from the general building structure to avoid transmission of vibrations.

- On normal applications, unit rigidity and point load positions enable installation to minimise vibrations. Vibration isolators may be used by contractors on installations requiring particularly low vibration levels.

- It is essential that the units be installed with sufficient free space around them to enable proper circulation of air ejected by the condensers and to provide easy access to all unit components for servicing and maintenance. If the air rejected by the condenser encounters any obstacles.

- To prevent air flow to be reversed due to prevailing winds, units cannot be completely shrouded with a higher, uninterrupted wind shield. If such a configuration cannot be avoided, an air ejection duct must be installed at the same height as the surrounding shield.

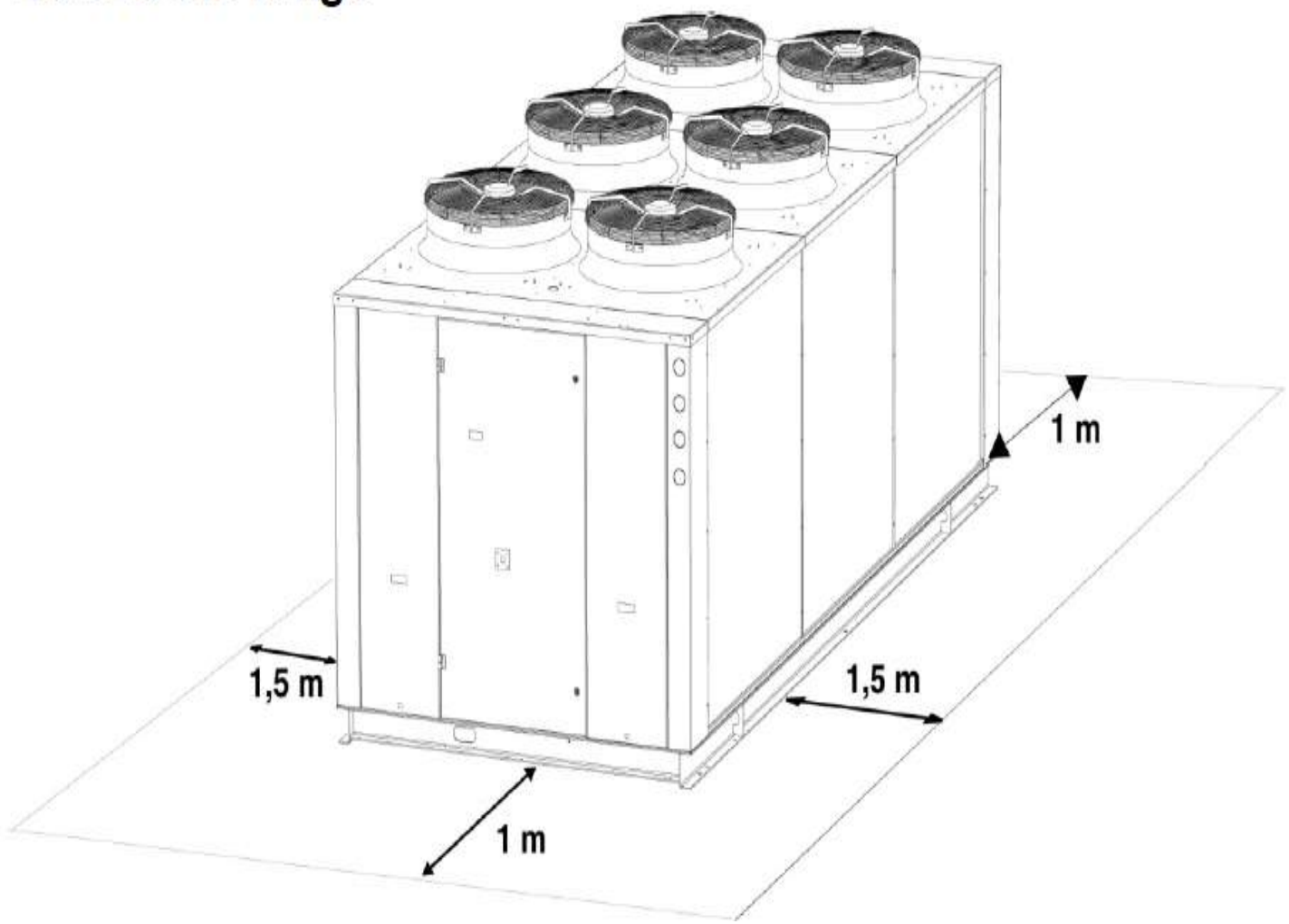


Fig 4. Proper installation of the unit:

1.2 - WATER CONNECTIONS

- The water circulating pump will be preferably installed upstream so that the evaporator/condenser will be subjected to positive pressure. Entering and leaving water connections are indicated on the certified drawing sent with the unit.

- The water must be analyzed; the water circuit installed must include all items necessary for treatment of the water: filters, additives, intermediate exchangers, bleed valves, vents, isolating valves etc... depending on the results of the water analysis.

- The glycol/water solution must be sufficiently concentrated to ensure proper protection and prevent formation of ice at the lowest outdoor air temperatures expected on an installation. Take precautions when using non passivated MEG antifreeze solutions (Mono Ethylene Glycol or MPG Mono Propylene Glycol).

- To enable drainage of the circuit, make sure that drain cocks are installed at all the low points of the circuit.

- To drain the circuit, the drain cocks must be opened and an air inlet ensured.

- The minimum volume of the chilled water circuit must be calculated with the formulas here under. If necessary, install a buffer tank. Proper operation of regulating and safety devices can only be ensured if the volume of water is sufficient.

- A flow switch must be installed on the evaporator water inlet or outlet, so as to enable detection of water flow through the heat exchanger before the unit is started up. This will protect the compressors against any eventual liquid slugging during the starting phase and prevent accidental ice formation in the evaporator, if the flow of water is interrupted.

1.3 - ELECTRICAL CONNECTIONS

First of all, make sure that power supplies from the building to the place where the unit is installed are properly established and that wire gauges are in keeping with the start up and running currents.

Check tightness of all electrical connections. You MUST make absolutely certain that the power supplies applied to the power and control circuits are those for which the electrical panel was manufactured.

A main isolator switch must be inserted between the end of the power supply cable and the unit to enable total isolation of the latter when necessary. Chillers are supplied as standard without a main isolator switch. This is available as an option.

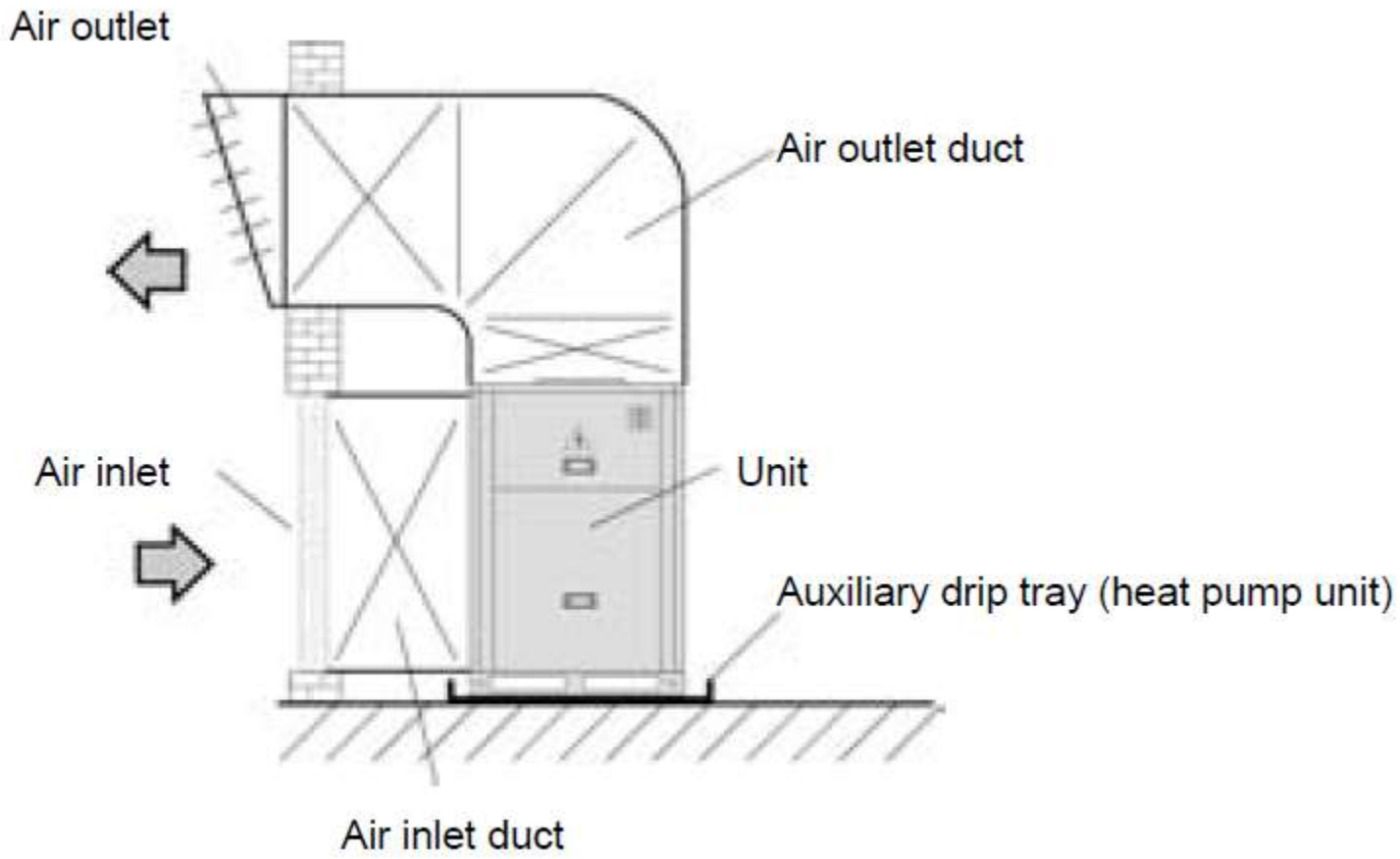
1.4 - SOUND LEVELS

Liquid chillers are a significant source of noise in refrigeration and air conditioning systems. Account is taken of technical constraints, both in design and manufacturing, sound levels cannot be improved much further than specified.

Sound levels must therefore be accepted for what they are, and the area surrounding the chillers should be treated as necessary. The quality of installation can either improve or decrease initial sound characteristics: it may be necessary to provide further treatment such as sound-proofing or installation of screens around units installed externally. The choice of the location for the installation can be of great importance: reflection, absorption, transmission of vibrations.

The type of unit support is also very important: inertia of the room and the structure of the walling, interfere with the installation and its behavior. Determine what level of sound proofing is necessary on the equipment, the installation (silencer, vibration isolators, and screens) and on the building (reinforcement of flooring, false ceilings, and wall coverings).

1. 5- DUCTED UNITS INSTALLATION



Notes:

- Be careful of air cycling between inlet and outlet.
- For air outlet it is recommended to duct each fan separately.

Testing:

Procedure to follow when starting a unit:

1-a) Press the power “ON-OFF” switch. The compressor will only start if the evaporating pressure is greater than the cut-in set point of the low pressure switch. Check immediately the good rotation of the compressor.

Evaporating pressure drops steadily, the evaporator empties itself of the liquid refrigerant accumulated in it during storage. After a few seconds, the solenoid valve opens if any.

1-b) Check on the sight glass (upstream of the expansion valve) that the bubbles disappear progressively, indicating a correct refrigerant charge and without non condensable gas. If the humidity indicator changes colour, indicating the presence of humidity, replace the filter-drier cartridge if the latter is of the replaceable type. Checking the sub cooling after the condenser is recommended.

1-c) Check that, when the cooling load has been balanced by the capacity of the unit, the chilled liquid is at design temperature.

2) Check the current values per phase on each compressor motor.

3) Check the current values per phase on each fan motor.

4) Check compressor discharge temperature.

5) Check compressor oil pump temperatures (semi-hermetic reciprocating compressors).

6) Check suction and discharge pressures and compressor suction and discharge temperatures.

7) Check chilled liquid entering and leaving temperatures.

8) Check outdoor air temperature.

9) Check liquid refrigerant temperature at the condenser outlet.

Unit Operation:

1.0 - Functions of refrigeration circuit components

Thermostatic expansion valve:

The thermostatic expansion valve fitted on each machine has been selected for a given operating range; it must be replaced with a model with the same reference from the same manufacturer.

Filter-drier:

This is designed to remove all traces of humidity from within the refrigeration circuit, since this can impair operation of the unit, by acidification of the oil, which causes slow disintegration of the varnish protecting the compressor motor windings.

High and low pressure gauges:

Sight glass/humidity indicator:

- Enables visual verification of the state of the liquid refrigerant (monophase ou diphasic) in the liquid line, upstream of the thermostatic expansion valve.
- Enables detection of humidity in the circuit.

Crankcase heater:

Every compressor is fitted with a single phase crankcase heater that is activated when the compressor stops to ensure separation of the refrigerant and the compressor oil. It is therefore powered up when the compressor is not running.

High pressure switch:

This pressure switch initiates unconditional stoppage of the unit if compressor discharge pressure exceeds the operating limits. Reset is automatic.

- Screw and reciprocating compressor with R407C high pressure switch equal 26.5 bars.
- Scroll compressor with R407C high pressure switch equal 29 bars.

Fan control pressure switch and thermostat:

The function of these devices is to ensure a level of head pressure compatible with proper unit operation. An increase in outdoor air temperature increases head pressure, and this is maintained at its required value by fan operation.

Antifreeze function:

This function only exists on units designed for brine or glycol/water chilling for which the freezing temperature depends on the concentration of the solution. Whatever type of device is used (see case 1 and 2), cut-out by the antifreeze function causes immediate unit stoppage.

CASE 1: Antifreeze thermostat:

This device monitor chilled liquid temperature at the evaporator outlet. It triggers when the temperature goes below the minimum value (+ 4 C for water).

CASE 2: Antifreeze pressure switch:

This monitors evaporating pressure of the refrigerant. It triggers when the temperature goes below the preset minimum value.

1.1 - Functions of electrical components:

Electronic or cam type anti-short cycle relay:

This device limits the number of compressor start ups. Compressor motor thermal protection: This device stops the motor if winding temperature rises too high and enables it to start up again when temperature drops back to a normal value.

Fan over current protection:

Circuit breaker designed to stop the fan motors in the event of phase over current in relation to the permitted value.

Compressor motor over current protection:

Circuit breaker designed to protect each motor winding against accidental over current.

Indicator lights:

The electrical control box is fitted with indicator lights enabling visualization of the state of operation or non operation of a function or given circuit.

There is also an indicator to show that the unit is powered up, an emergency stoppage indicator for each compressor, an indicator to show stoppage of the compressor via the regulating system (through the main control thermostat which is sensitive to chilled water temperature), a run light per compressor, and a general fan default stoppage indicator (on air cooled units).

Chilled liquid pump interlock:

This interlock is made only if the pump is supplied with the liquid chiller. As soon as the unit is powered up and the remote on/off for the unit is validated, the pump starts running. Prior operation of the pumps is mandatory for compressor operation.

Flow switch for the chilled liquid :

This control device initiates unconditional unit stoppage as soon as the flow of chilled liquid (water, brine, etc...) ensured by the pump becomes insufficient, since this could cause rapid evaporator freeze up. When the contact opens due to a lack of flow the unit must stop immediately.

1.3 - Automatic sequences

Starting sequence:

- Press the unit start switch, the power light will come on ; The control circuit cannot be energized if there is no power supply to the main power circuit.
- Depending on the demand for cooling, the control thermostat authorizes start up of the compressor(s), which takes place in sequence. The compressor run indicating lights come on.

Regulator stoppage sequence:

When the cooling load starts decreasing from its maximum value, the multi-stage control thermostat shuts down successive stages depending on the progressive reduction in return chilled liquid temperature. Depending on machine equipment, staged reduction consists either in shutting down a compressor or activation of a compressor capacity reducer. This continues until the unit shuts down completely through action of the regulator. The compressor regulation stoppage lights come on.

Safety shutdown sequence:

If a default occurs on a circuit, it is detected by the appropriate safety device, (high pressure overshoot, loss of oil pressure, motor protection, etc...) The relay in question initiates unconditional stoppage of the compressor on that circuit and the safety stoppage indicating light comes on.

Loss of power supply:

There are no problems restarting the machine after a loss of power supply of short duration (up to about one hour). If loss of power supply lasts longer than this, when power supply is resumed set the unit to «OFF» with the compressor crankcase heaters activated for as long as it takes to bring sump oil back up to temperature, then restart the unit.

Condensing Pressure control water valve:

This device is available as an option for low capacity water cooled condensing units (MCW). The high pressure control water valve should be installed on the condenser outlet. It enables water flow through the heat exchanger to be varied so as to maintain condensing pressure at an appropriate value.

Maintenance:

1.0 WEEKLY MAINTENANCE

1) Check the compressor oil level. This should be visible through the sight glass with the machine running at full load. Let the compressor operate for 3 to 4 hours before adding any oil. Check the oil level every 30 minutes. If the level does not reach the level indicated above, contact a qualified refrigeration mechanic.

Caution, for units equipped with tandem or trios scroll compressors, the oil level must be checked - and visible - while the compressors are stopped. The oil level with running compressors is not relevant.

2) Overcharging with oil can be as dangerous to a compressor as a lack of oil. Before topping up, contact a qualified technician. Only use oils recommended by the manufacturer.

3) Check the oil pressure.

4) The flow of liquid refrigerant through the sight glass should be steady and without bubbles. Bubbles are a sign of a low charge, a possible leak, or of a restriction in the liquid line. Contact a qualified technician.

5) Check operating pressures. If they are higher or lower than those recorded when the machine was put into service, see the chapter 8.

6) Inspect the entire system so as to detect any eventual abnormality: noisy compressor, loose casing panels, leaky pipes or juddering contacts.

7) Record temperatures, pressures, dates et times and any other observations in the service log.

8) Leak detection is recommended.

1.1 ANNUAL MAINTENANCE

1) Inspect valves and piping. Clean the filters if necessary, clean the condenser tubes. Clean the chilled water piping filters.

CAUTION: The chilled water circuit may be pressurized. Observe the usual precautions when depressurizing the circuit before opening it. Failure to observe these rules could lead to accidents and cause injury to service personnel.

3) Clean any corroded surfaces and repaint them.

4) Inspect the chilled water circuit for any signs of leakage.
Check operation of the water circulating pump and its ancillaries.
Check the percentage of antifreeze in the chilled water circuit, top up as necessary (if antifreeze is used).

5) Carry out all weekly maintenance duties. Every year, the first and last inspection will include the seasonal shutdown procedure or the restarting procedure depending on the case. These inspections should include the following operations:

- Check the contacts of motor contactors and control devices.
- Check the adjustment and operation of each control device.
- Conduct an oil analysis to determine the acidity. Record the results.
- Change the oil if necessary.
- Follow the recommendations given by LENNOX as concerns compressor oil (see the appropriate table).
- Conduct a refrigerant leak test.
- Check motor winding isolation.

Other operations may be necessary depending on the age and the number of hours of operation of the installation

1.2 CLEANING THE CONDENSER:

Air cooled condensers

Clean the coils either with a vacuum cleaner, cold water, compressed air, or with a soft brush (non metallic). On units installed in a corrosive atmosphere, coil cleaning should be part of the regular maintenance program. On this type of installation, all dust gathered on the coils should be quickly removed by regular cleaning.

Multi-tube water cooled condensers

Use a cylindrical brush to remove sludge and other substances in suspension inside the condenser tubes. Use a non corrosive solvent to remove scale deposits.

The water circuit in the condenser is manufactured in steel and copper. A water treatment specialist, given the right information, will be able to recommend the right solvent for removing scale.

The equipment to be used for external water circulation, the quantity of solvent and the safety measures to be taken must be approved by the company supplying the cleaning products or by the company conducting these operations.

1.3 COMPRESSORS / OIL DRAINAGE

Oil for refrigeration equipment is clear and transparent. It keeps its color over a long period of operation. Given that a correctly designed and installed refrigeration system will operate without any problems, there is no need to replace the compressor oil even after a very long period of operation.

Oil that has become dark in color has been exposed to impurities in the refrigeration piping system or to excessive temperatures on the discharge side of the compressor, and this inevitably impairs the quality of the oil. Darkening of the color of the oil or degradation of its qualities can also be caused by the presence of humidity in the system. When the oil has changed color or has been degraded, it must be changed. In this event, before putting the unit back into service, the compressor and the refrigeration circuit will have to be evacuated.


THANK YOU!
Sabi daw sinimbag mo si TITA mo?
Iyo, naghapot kaya!!!