MICRO AIR MECHANICAL SDN BHD

Installing, Operating & Troubleshooting

Content

1. Installation

1.1-Transport

On the receipt of the new unit, please check the following points. It is the customer's responsibility to ensure that the unit arrives in good working condition. Any uncertainty or damage noticed upon delivery should be reported to Micro Air Mechanical Sdn Bhd.

- The exterior of the chiller has not been damaged in any way (esp. condenser coil fins).
- The chiller delivered matches the order and delivery note.

1.2-Storage

In the occasion where the chiller is to be stored for a period of time before use, users must take note of certain precautions:

- There is no water left in the chiller (water tank, pipes).
- Plastic film fully protects the unit.
- Ensure that all electrical panels are closed.
- Keep the chiller in a dry and clean area.

1.3-Lifting

Prior to moving the chiller, ensure that the installation site is suitable for installing and can support the weight of the chiller with its associated services.

NOTE: Lifting and handling must be carried out carefully by qualified personnel to avoid jolting the frame, panels, electric box, condenser coil fins, etc…

1.4-Layout and installation requirement

The following points are important during the installation of the chiller:

- Locate chillers where it is least affected by wind, has sufficient supply of fresh air and has minimal sun exposure.
- Certain chillers are designed for outdoor installation. Please consult MAM prior to installation.
- The ground of the installation site must be flat, leveled and has sufficient strength to support the weight of the chiller with its associated services.
- It is important that the chiller must be installed at places with sufficient free space around them to allow sufficient circulation of air ejected by the condenser fan and to allow easy maintenance and services. Insufficient space around the chiller and blockade at the direction of the fan will reduce the heat exchange capacity of the chiller as the hot air ejected by the fan will be circulated back into the chiller. If such configuration is unavoidable, air duct should be used.

1.5-Water connection

The water pipes connected to the chiller must not transfer any vibration, radial or axial force to the heat exchanger. The following points are important in water connection:

- Install drain connections at all low points to allow drainage.
- Install stop valves close to entering and leaving water connections.
- After leakage test, insulate cold water pipe to prevent condensation and heat absorption which will reduce the cooling capacity.

2. Preliminary Check

2.1-Checklist before startup

Before startup or test run, make sure that all **valves** on the refrigeration circuit are fully **opened**. Starting a compressor with discharge valve closed will either trip the high pressure safety switch, **blow** the **cylinder head gasket** or **internal safety pressure disc**. After taking care of the above points, carry out the following checklist:

1. All apparatus interlocked with the unit (liquid pumps, cooling tower, fan, etc) are in working order.
2. Place all water valves and refrigerant valves in their operating positions and start the water circulating pump. Ensure that the main power supply is isolated and the unit is correctly earthed and check that earth continuity is correctly done.
3. Check the tightness and cleanliness of all electrical connections. Also make sure that thermostat bulbs are correctly inserted and tightened. Make sure all capillary tubes are fastened and all sensors are fitted correctly.
4. Make sure the power supplied to the unit corresponds to its operating voltage.
5. Make sure all water circuits are filled with water and air is bled out at all high points, cooling tower and fan in operating condition, water supply and overflow checked.
6. Reset all manually resetting safety devices where necessary. Open power circuit to all components: compressor, pumps…
7. Power up the unit with the disconnect switch.
8. On units with air cooled condenser, check for correct operation of the fan and the safety grills are tightly fastened. Ensure that the fan rotation is in correct direction.

3. Unit Startup

1. Ensure that thermometers are installed in the chilled water circuit, pressure switches in the refrigerant circuit.
2. Start the water pump prior to start the chiller.
3. Press the On-Off switch. The compressor will only start if the evaporating pressure (suction) is higher than the cut-in set point of the low pressure switch.
4. Evaporating pressure will drop steadily and the liquid refrigerant accumulated in evaporator during storage will be emptied.
5. Check the current value per phase on each compressor and fan motor.
6. Check compressor discharge temperature.
7. Check suction and discharge pressures.
8. Check compressor suction and discharge temperatures.
9. Check chilled liquid entering and leaving temperatures.
10. Check outdoor air temperature.
11. Check liquid refrigerant temperature at the condenser outlet.

4. Operation

4.1- Function of refrigeration circuit components

1. **Thermostatic Expansion Valve (TEV):**
   The thermostatic expansion valve is fitted on each unit based on given operating range, any replacement should be done by MAM technicians.
2. **Filter Drier:**
   The main function of filter drier is to remove any moisture from the refrigerant which may arise from trapped air due to improper evacuation, system leaks, motor windings, etc.
3. **High & low pressure gauges:**
   Enable instantaneous reading of suction and discharge pressure.
4. **Refrigerant pressure switch:**
   Will be tripped if the discharge pressure is higher or suction pressure is lower than operating limits.
5. **Differential oil pressure switch:**
   a) Reciprocating compressors:
      The pressure switch initiates unconditional unit stoppage when the differential oil pressure drops below a preset minimum value for more than 2 minutes.
   b) Screw compressors:
      The pressure switch initiates unconditional unit stoppage when the differential oil pressure rises above a preset safety value.

4.2- Function of electrical components:

6. **Fan over current protection:**
   The power will be cut off if the fan current rises above the preset limit.
7. **Compressor over current protection:**
   The power will be cut off if the compressor current rises above the preset limit.
8. **Indicator lights:**
   Show us the cause of tripping (pump, compressor, refrigerant low pressure or high pressure trip).

5. Troubleshooting - Repairs

List of the most common problems

Problem	Cause	Solution
5.1-Compressor does not start		
-Motor control circuit established, compressor does not run	-No power supply	-Check main power supply and switch positions
	-Compressor motor burnt out	-Replace compressor motor
-Low voltage reading on voltmeter	-Voltage too low	-Contact power company
-System does not start up	-Breaker tripped or fuses blown	-Check condition of fuses.
	-No water in evaporator	-Measure flow rate, check water pump, water circuit and filter
	-Oil pressure switch tripped	-Check oil pressure switch and determine the cause of the trip out
	-Low pressure safety switch tripped	-Check suction pressure, low pressure safety switch & switch differential
	-High pressure safety switch tripped	-Check discharge pressure and high pressure safety switch
-Normal operation with too frequent starts and stoppages due to action of low pressure safety switch. Occasional presence of bubbles in sightglass.	-Low refrigerant charge	-Check the charge through the sightglass, carry out a leak test, then top up refrigerant charge
-Suction pressure too low, Filter drier frozen up	-Filter drier obstructed	-Check the state of filter drier and replace if necessary
	-Expansion valve closed	-Check bulb, capillaries and operation of valve
5.2-Compressor short cycles on high pressure safety switch trip out		
	-High pressure safety switch trips out	-Check high pressure safety switch differential
	-Low water flow in condenser or dusty condenser coil (poor heat exchange)	-Check water pumps, cleanliness of coils and fan operation
Problem	**Cause**	**Solution**
	-Incondensibles in the refrigeration circuit	-Bleed from circuit and top up refrigerant charge (direct discharge of refrigerant into the atmosphere is **not permitted**)
5.3-Compressor runs in long cycles or run continuously		
	-Faulty control thermostat	-Check operation
-Temperature too low in	-Chilled water thermostat set	-Adjust it

conditioned space	too low	
-Bubbles in sightglass	-Low refrigerant charge	-Check refrigerant charge in sightglass and top up if necessary
	-Filter drier partly obstructed	-Check the drier and replace if necessary
	-Expansion valve partly closed	-Check expansion valve bulb and capillary, measure superheat
	-Liquid line valve not opened far enough	- Open the valve completely
-Noisy compressor or abnormally high suction pressure/low discharge pressure	-Leaky pressure valves	-Check valve gas-tightness, replace valve plate if necessary. Tighten compressor bolts and nuts
5.4-The compressor cuts out on oil pressure safety switch		
	-Oil pressure switch tripped	-Check operation of oil pressure safety switch
-Oil level in sightglass is too low	-Oil pressure too low	-Check oil level in sightglass on the crankcase, check the cleanliness of the oil filter, check the oil pump
-Visible oil leak/ Oil level too low	-Low oil charge	-Check that there is no leakage and add oil
	-Leaky oil sump	-Repair and add oil
-Suction line unusually cold, compressor noisy	-Liquid refrigerant present in the compressor crankcase	-Check appearance of the oil in the sightglass. Measure temperature of oil pump, measure superheat at expansion valve, check that valve bulb is tightly attached

Problem	Cause	Solution
	-Poor heat exchange in the evaporator	-Check water flow. Check fouling by measuring the water pressure drop. Excessive oil migration in the circuit: measure evaporating pressure, superheat and the temperature of the oil pump
5.5- Compressor cuts out through the action of main power fuse		
	-Power supply on two phases only	-Check power supply voltage
	-Faulty motor windings	-Replace the compressor
	-Compressor seized	-Replace the compressor
5.6- Compressor starts with difficulty		
	-Faulty windings	-Replace the compressor
	-Mechanical problem	-Replace the compressor
5.7- The compressor is noisy		
-Compressor knocking	-Broken mechanical parts in compressor	-Replace compressor
-Suction line is unusually cold	-Liquid slugging	Check superheat and that the expansion valve bulb is correctly installed
	-Expansion valve blocked in open position	Repair or replace
	-Broken suction valve	Replace broken valves
-High discharge pressure. The water regulating valve or the pressure operated water valve taps or knocks	-Pressure operated water valve is not working, water pressure is too high or irregular	-Clean the valve. Install an expansion tank upstream of the valve
-Compressor shuts down due to action of oil pressure safety switch	-Low oil charge	-Add oil
5.8- Discharge pressure too high		
-Water is too hot at the condenser outlet	-Water flow too low or water temperature too high in condenser	-Adjust the pressure operated water valve or the thermostat on the cooling tower
-Water is too cold at condenser outlet	-Condenser tubes fouled	-Clean the tubes
-Condenser abnormally hot	-Presence of air or incondensibles in the refrigerant circuit or refrigerant charge too high	-Purge incondensibles and/or air or bleed excess refrigerant.
-Chilled water leaving temperature too high	-Excess cooling load	-Reduce load and reduce water flow if necessary

Problem	Cause	Solution
5.9- Discharge pressure too low		
-Water is too cold at condenser outlet	-Condenser water flow too high or water temperature is too low	-Adjust the pressure operated water valve or thermostat on cooling tower
-Bubbles in sightglass	-Low refrigerant charge	-Carry out a leak test, repair the leak and top up refrigerant charge
5.10- Suction pressure too high		
-The compressor runs continuously	-Too much cooling demand on evaporator	-Check the system
-Suction line is unusually cold, liquid refrigerant returns to compressor	-Expansion valve opened too far	-Adjust superheat and check that the expansion valve bulb is correctly fitted in place
	-Expansion valve blocked in open position	-Repair or replace
5.11- Suction pressure too low		
-Bubbles in sightglass	-Low refrigerant charge	-Carry out a leak test, repair the leak and top up refrigerant charge
-Excessive pressure drop through the filter-drier	-Filter drier obstructed	-Replace filter drier
-No refrigerant passing through the expansion valve	-Expansion valve has lost its charge	-Replace the bulb
-Loss of capacity	-Expansion valve obstructed	-Clean or replace
-Conditioned space too cold	-Control thermostat stucked in closed position	-Repair or replace
-Compressor short-cycling	-Capacity modulation setting too low	-Adjust
-Superheat value too high	-Excessive pressure drop in the evaporator	-Check external equalizing line on the expansion valve
-Low pressure drop in the evaporator	-Low water flow	-Check water flow. Check the condition of the filters, look for obstructions in the chilled water circuit piping

Maintenance contract We recommend you make a contract for maintenance with a MicroAir after-sales service center or dealer capable of professional inspection. For details, contact your dealer. Refrigerant oil Because a special type of refrigerant oil has been used, do not mix any of different type of oil. The refrigerant oil used for the unit:

SH-170/ BSE 170

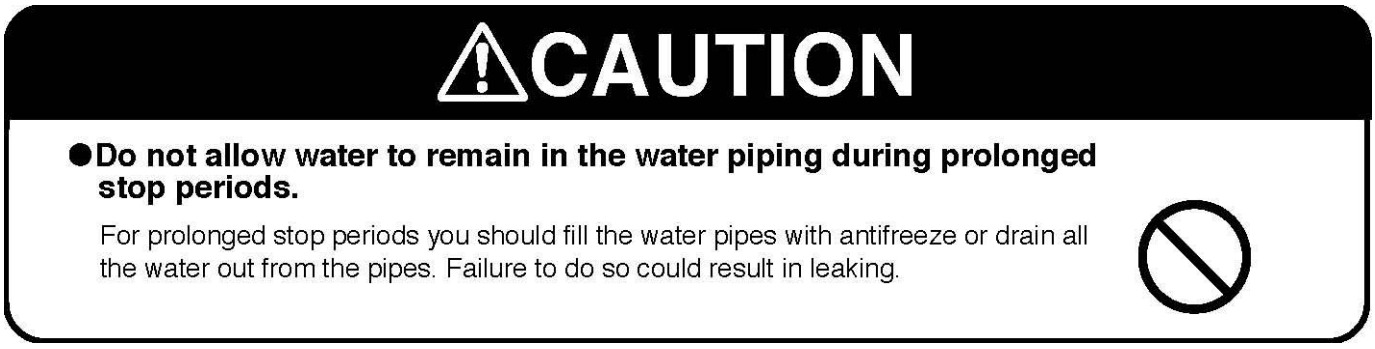
Do not discharge the refrigerants into the atmosphere blindly. It is requited to recover the refrigerant as stipulated by law when disposing the unit. Daily checks

To maintain the unit in prime operating condition, check the following items practically, making adjustments where necessary and keeping a record of all checks. Values under "Passing grade" are indicated for refrigerating machines under typical operating conditions. Any value outside this range cannot be simply regarded as abnormal value.

When to check	Check item	Check method	Passing grade	Results
Daily	1.Dischange pressure	Check the pressure gauge	1.3 ~ 2.4MPa	__MPa
	2.Suction pressure	Check the suction pressure gauge.	~0.35 0.6MPa	__MPa
	3.Power supply	Check using a voltmeter	Within ±10% of the rated voltage.	__V
	4.chilled water temperature at outlet	Check the thermometer.	~5 10℃（cooling）	__℃
	5.vibration and noises	Listen for noises and feel for vibrations.	No abnormal vibrations or noises.	_____
	6.Ambient temperature	Check the thermometer.	For year round cooling operation model, more than -15℃ Max. 43℃. more than -5℃	__℃
Monthly	1.Refrigerant charge	Check the suction and discharge pressure.	Shall be within the above suction and discharge pressure ranges.	__MPa
	2.Refrigerant oil charge	Check the compressor oil gauge.	Refrigerant oil is within range on the gauge.	Oil gauge
	3.Dirt on fins	Inspect visually	No accumulated dirt	_____
	4.water quality	Check the water quality standards which should be in accordance with Micro air or equivalent	See [water quality] . According to the water quality standards provided for by micro air in the chilled water system under JRAGL- 02)	_____

Precautions for Prolonged Stop Period

- Be sure to turn off the power supply switch. If you forget to turn off the power



supply switch, electricity is still supplied to the crank case, consuming several watts of power. In order to conserve electricity, be sure to turn off the power supply switch.

- Drain water out from the water piping. In winter, water in the piping may freeze causing equipment damage. (For details, Microair.)

- After a prolonged stop period, you should turn the power supply switch on at least six hours before running the chiller again. This is done in order to provide electricity to the crank case heater.

CHILLER MAINTENANCE

Following are some of the recommended performance monitoring and maintenance tasks for Chillers & DX
units. The frequency of these tasks should be as indicated below or based on operating experience -

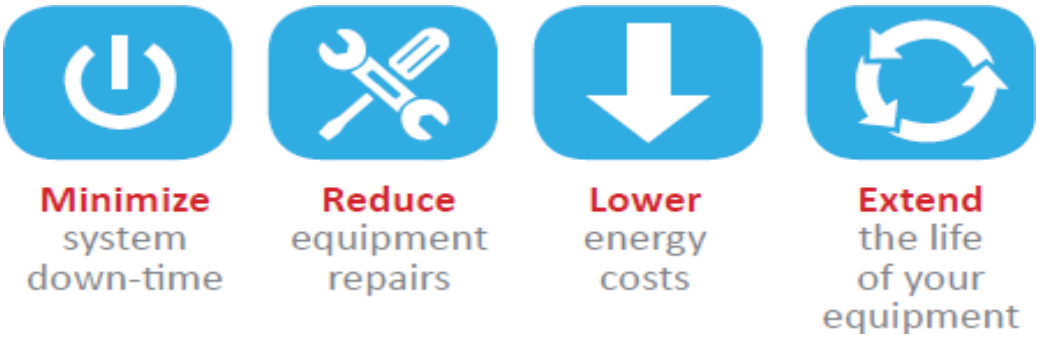
- External visual Inspections - weekly
- Refrigerant Analysis - annual
- Oil Analysis - annual
- Vibration Analysis - annual
- Calibration of controls and instrumentation - annual
- Change Oil and Oil Filter - semi annual
- Change Refrigerant Filter or Filter/Drier - annual
- Clean Condenser Tubes (water cooled) - annual or based on water quality
- Clean Condenser Fins (air cooled) - annual
- Clean Oil Cooler Tubes (water cooled) - annual
- Clean Evaporator Tubes (chillers) - bi annual
- Clean Evaporator Fins (DX units) - annual
- Condenser Tubes Eddy Current Test (raw water cooled) - bi annual or based on water quality
- Internal Inspections & overhaul - Every 5 yrs

The internal inspection/overhaul should include the following -

Compressor Journal &Thrust Bearings, Compressor & Motor Oil Seals, Motor End Bearing , Compressor Motor Megger, Controls/electrical connections, Relief Valve,
Hot gas bypass valve if equipped, thermostatic expansion valves, solenoid valves.
Additional items for Screw machines - Refrigerant Float Valve System, Economizer damper,
Additional items for reciprocating machines - Compressor suction and discharge valves.

Periodic Replacement of vulnerable components - Every 5 yrs

Following components should be considered for periodic replacement -
Oil Heater Thermostat, Capacity Controls, Load Recycle switch, motor bearing and oil temperature
switches, Start/Stop Program Timer, solenoid valves, thermostatic expansion valves.
Additional items for centrifugal machines - Guide vane cycle timer, Guide vane solenoid valve.



What to do When Not Functioning Properly

Symptom	Cause
◆ The chiller is stopped during at nights when the temperature falls to round 0 ℃ , and the pump not runs (chiller is receving electricity).	The chiller is equipped with a pump for preventing water inside the piping from freezing that force-operates.

The following cases are not malfunctions.

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6.Before requesting after-sales service, please check the following items

PREVENTATIVE MAINTENANCE SCHEDULE			
OPERATION	**WEEKLY**	**MONTHLY (Note 1)**	**ANNUAL (Note 2)**
General			
Complete unit log and review (Note 3)	X		
Inspect unit for loose or damaged components and visible leaks		X	
Inspect thermal insulation for integrity			X
Clean and paint as required			X
Electrical (* including the optional VFD)			
Sequence test controls *			X
Check contactors for pitting, replace as required *			X
Check terminals for tightness, tighten as necessary *			X
Clean control panel interior *			X
Clean control box fan filter (Note 7) *	X		
Visually inspect components for signs of overheating *		X	
Verify compressor and oil heater operation		X	
Megger compressor motor			X
Refrigeration/Lubricant			
Leak test		X	
Check liquid line sight glasses for clear flow	X		
Check compressor oil sight glass for correct level (lubricant charge)	X		
Check filter-drier pressure drop (see manual for spec)		X	
Check lubricant filter pressure drop (Note 6)		X	
Perform compressor vibration test			X
Perform oil analysis test on compressor oil			X
Condenser (Water cooled)			
Clean condenser coils or tube			X
Check condenser inlet and outlet			X
Check shell external condition			X
Check flange end for damage and straighten as necessary			X

7.Water Quality

◆ Water quality

The quality of chilled (hot) water when the chiller is running largely affects the chiller's performance and life. It is therefore very important to check the quality of before using, and to monitor the quality of water after installing the chiller. Water quality standard value for water shall be as table. Substances contained water chilling unit condenser water are thickened because water is constantly evaporated in the cooling tower. Water quality of make-up water and circulating water should be checked separately with a certain amount of make-up water and blow, while maintaining circulating water standards. Water should be treated with chemicals as required.

Water quality standards for chilled water, cooling tower water, and make-up water LAP, PBA, Syabas GL-02-1994 Guideline of water Quality for Refrigerators and Air Conditioning Equipment

Note

1. **The circle marks in the columns on the right indicate tendency for corrosion or scale to develop.**
2. **Corrosion has a tendency to occur when water temperature is high (40 ℃or higher), and ifmetals with no protective coating whatever are directly exposed to water, it would be a good idea to take effective measures against corrosion such as adding a corrosion inhibitor or deaeration treatment.**
3. **In a condenser water circuit that uses a closed cooling tower. condenser water and make-up water must satisfy its water quality standards for hot water system and passing water and make-up water must satisfy those for condenser water systems.**
4. **Supply or make-up water should be tap water (from city water) or water for industrial use. Pure water, neutral water or softened water should not be used.**
5. **The 15 items in the table above represent typical causes of corrosion and scale.**

Symptom	Cause
◆ The chiller is stopped during at nights when the temperature falls to round 0 ℃ , and the pump not runs (chiller is receving electricity).	The chiller is equipped with a pump for preventing water inside the piping from freezing that force-operates.

Item(1)(6)		Condenser water system		Chilled water system			Hot water system	
		Circulation system						
		Circulation water	Make-up water	Passing water	Circulation Water(Max.20℃	Make-up water	Circulation Water(Over 20Max.60℃ ℃	Make-up water
Standard item	pH (25℃)	6.5 8.2 ~	6.0 8.0 ~	6.8 8.0 ~	6.8 8.0 ~	6.8 8.0 ~	7.0 8.0 ~	7.0 8.0 ~
	Electrical conductivity (ms/m)	<80	<30	<40	<40	<30	<30	<30
	Chloride ions (mgcl-/l)	<200	<50	<50	<50	<50	<50	<50
	Sulfate ions ($mgSO_4^{2-}$/ l)	<200	<50	<50	<50	<50	<50	<50
	Acid consumption ($_{(pH4.8)}$) ($mgCaCO_3$/ l)	<100	<50	<50	<50	<50	<50	<50
	Total hardness ($mgCaCO_3$/ l)	<200	<70	<70	<70	<70	<70	<70
	Calcium hardness ($mgCaCO_3$/)l	<150	<50	<50	<50	<50	<50	<50
	Ionic-state sillca ($mgSiO_3$/)l	<50	<30	<30	<30	<30	<30	<30
Reference item	Iron (mgFe/) l	<1.0	<0.3	<1.0	<1.0	<0.3	<0.3	<0.3
	Copper (mgCu/) l	<0.3	<0.1	<1.0	<1.0	<0.1	<0.1	<0.1
	Sulfide ion (mgS^{2-}/)l	Shall not be detected	Shall not be detected	Shall not be detected	Shall not be detected	Shall not be detected	Shall not be detected	Shall not be detected
	Ammonium ion ($mgNH_4^+$/)l	<1.0	<0.1	<1.0	<1.0	<0.1	<0.3	<0.1
	Residual chlorine (mgcl-/ l)	<0.3	<0.3	<0.3	<0.3	<0.3	<0.25	<0.3
	l) Free carbon dioxide ($mgCO_2$/	<4.0	<4.0	<4.0	<4.0	<4.0	<0.4	<4.0

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