CENTRIFUGAL CHILLER

Preventive Maintenance

MITSUBISHI HEAVY INDUSTRIES

Preventive Maintenance for Centrifu

Preventive Maintenance Programs by Mitsubishi Heavy Industries Thermal Systems, Ltd. (MTH) keep your centrifugal chiller running with efficiency and confidence. Offering you maintenance programs to meet your needs with our knowledge and experience from genuine manufacturer.

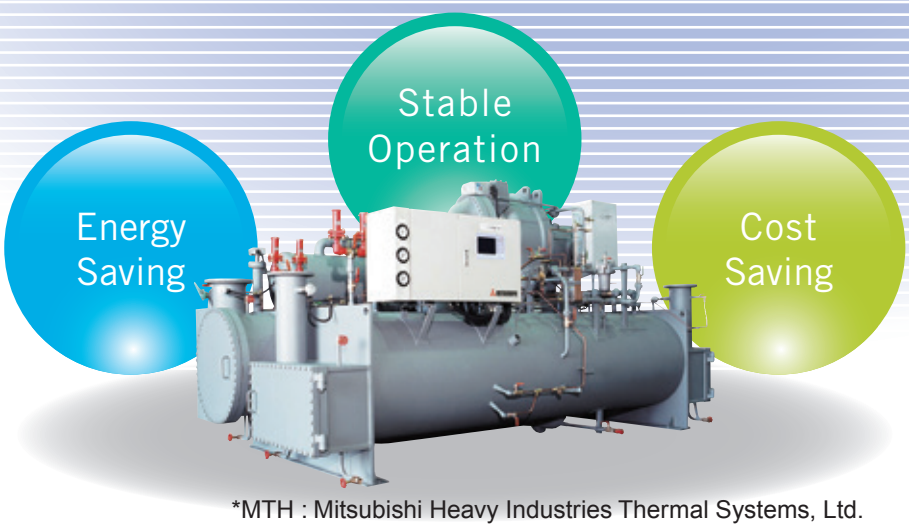
Maintenance Items and Programs

● : Standard △ : Option

No.	Items	Descriptions	Advanced Support Program (Energy Saving / Stable Operation / Cost Saving)
1	Annual Maintenance ※1	Maintenance during a non operating period will be an important opportunity to secure future operations.	●
2	Periodical Maintenance (Compressor, Motor, Overhauling)	Disassembling compressor and recondition or replace consumable parts with new one to ensure stable operations.	△ ※2
3	Periodical Visit for Inspections	Avoid possible technical problem by checking chiller conditions.	●
4	On Call Service	A Customer Service representative will assist you during regular business hours.	●
5	Condenser Tube Cleaning	Maintain maximum operating efficiency by removing foreign debris and scales.	●
6	Periodical Maintenance (Starter Panel or Inverter Panel)	Replace wear and tear parts in the starter panel and the control panel to ensure stable operations.	△
7	Replacement of Control, Electrical Equipment and Parts	Whenever the driving motors or the sensors does not function, it will be replaced per manufacturer's schedule.	△ ※2
8	Eddy Current Testing ECT for Condenser and Evaporator Tube ※1	The tube will be checked for remained thickness or damage.	△ ※2
9	Protective Device Inspection (High Pressure Gas, etc.)	e.g. Inspect operating point of pressure relief valve and make necessary adjustments or replace.	△ ※2
10	5 Years Maintenance ※1	Benefits of preventative maintenance are energy saving, stable operation, and cost saving.	●
11	Performance Guarantee	Chiller cooling capacity and performance will be in a planned range with adequate maintenances.	△
12	Remote Monitoring ※1	Chiller operation data will be available to monitor through internet in real-time.	●

※1: Refer to P4-P5 ※2: The customer must enter into a new contract at the 6th year to extend the service period. ※3: Must order together with

gal Chiller



*MTH : Mitsubishi Heavy Industries Thermal Systems, Ltd.

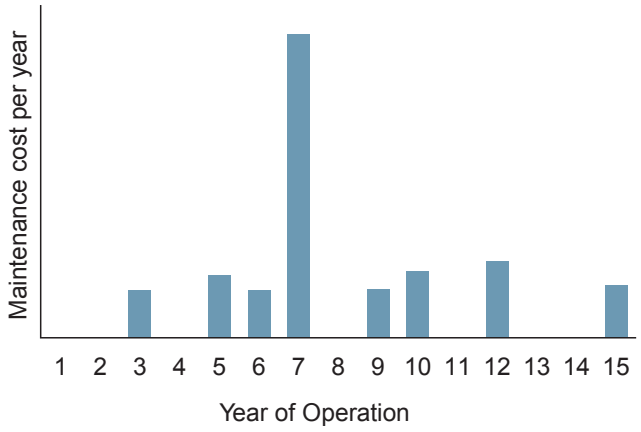
Basic Support program (Stable Operation / Cost Saving)	Indivisual Support (Cost Saving)	Interval	Notes
●	△	Every year	Please contact a MTH* representatives for more details.
△	△	Every 50,000 hours or 7 years which ever comes first Every 5 years recommended for annual operation chillers which is continuously operated	Please contact a MTH* representatives for more details.
●	△	Every 3 months	Obtain operating data and diagnose it, then make necessary adjustments or advices.
●	△ *3	Ocationally	Please contact a MTH* representatives for more details.
●	△	Every year (during annual maintenance) or whenever necessary	Using a brush with water to cleaning inside of tubes is regular. Chemical cleaning may be required for heavy conditions.The water box will be repainted and the gaskets will be replaced. The heat exchanger will be checked based on the heat transfer performance, and if it is judged to be necessary, the tube cleaning will be performed. Chemical cleaning will be changed separately.
△	△	Starter Panel : Every 7 years Inverter Panel : Every 4 years	In case of the inverter panel, some parts will be replaced every four years and the overhauling will be conducted every eight years.
△	△	Every 5 years	Please contact a MTH* representatives for more details.
△	△	Every 5 years	For an accurate ECT, chemical cleaning will be performed before ECT.
△	△	Every year (during annual maintenance)	It includes, safety valve operation check, display pressure gauge accuracy check and safety device operation check.
—	—	—	One year of warrantee period after turn-over is included. This warranty covers only the equipment supplied by MTH*. Please contact a MTH* representatives for more details.
△	—	—	Please contact a MTH* representatives for more details.
△	△	—	Customers are also able to check the operating status in real-time remotely by using IDs or passwords. For detail about the connection, contact MTH*.

“Periodical Visit for Inspections”.

5 Years Maintenance Program

Performing preventive maintenance and replacing normal wear and tear or damaged parts, it will help you to reduce long term maintenance costs and chiller downtime compare with unscheduled maintenance.

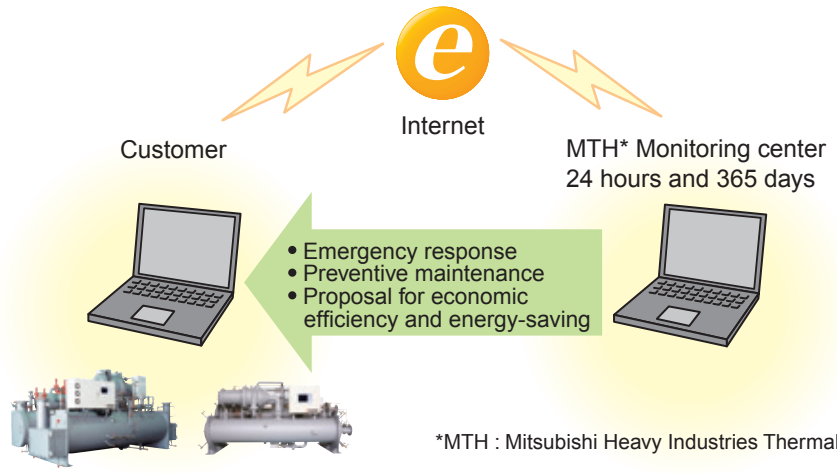
Unscheduled Maintenance



Scheduled Maintenance

Remote Monitoring Program

24-hour and 365-day remote monitoring program is suitable for maintaining the performance and function of the centrifugal chiller.



The remote monitoring program enables various performances.

(1) Monitoring the operation status
(2) Emergency response/treatment and report of the result
(3) Submission of monthly report of data and customer's observation
(4) Proposal for preventive maintenance and economical use based on the result of the analysis of accumulated data

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Condenser and Evaporator Maintenance Program

■Cleaning the tube

Mechanical / Chemical cleaning remove fouling agent and scale composition from the tubes of heat exchangers to keep its efficiency.

■ECT

Insert a probe into the tube to estimate wall thickness by two directions X and Y.

ECT measures remained tube wall thickness and predicts possible refrigerant leak.

Standard Maintenance Schedule for Centrifugal Chiller

● : Standard △ : Option

No.	Maintenance Programs	Years of Operation														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
S-1	Annual Maintenance	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
S-2	Periodical Maintenance (Compressor, Motor, Overhauling)							●							●	
S-3	Periodical Visit for Inspection	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
S-4	Periodical Maintenance (Starter Panel)							●							●	
S-5	Periodical Maintenance (Inverter Panel)				●				●				●			
S-6	Replacement of Control, Electrical Equipment and Parts					●					●					●
S-7	Eddy Current Testing ECT for Condenser and Evaporator Tube					●					●					●
S-8	Protective Device Inspections	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
S-9	5 Years Maintenance			△					△					△		
S-10	Performance Guarantee	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
S-11	Remote Monitoring	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△

Note: This table shows a sample of maintenance plan for unit operates under 4,000 hrs per year.
Required schedule may be different based on accutual condition of the unit.

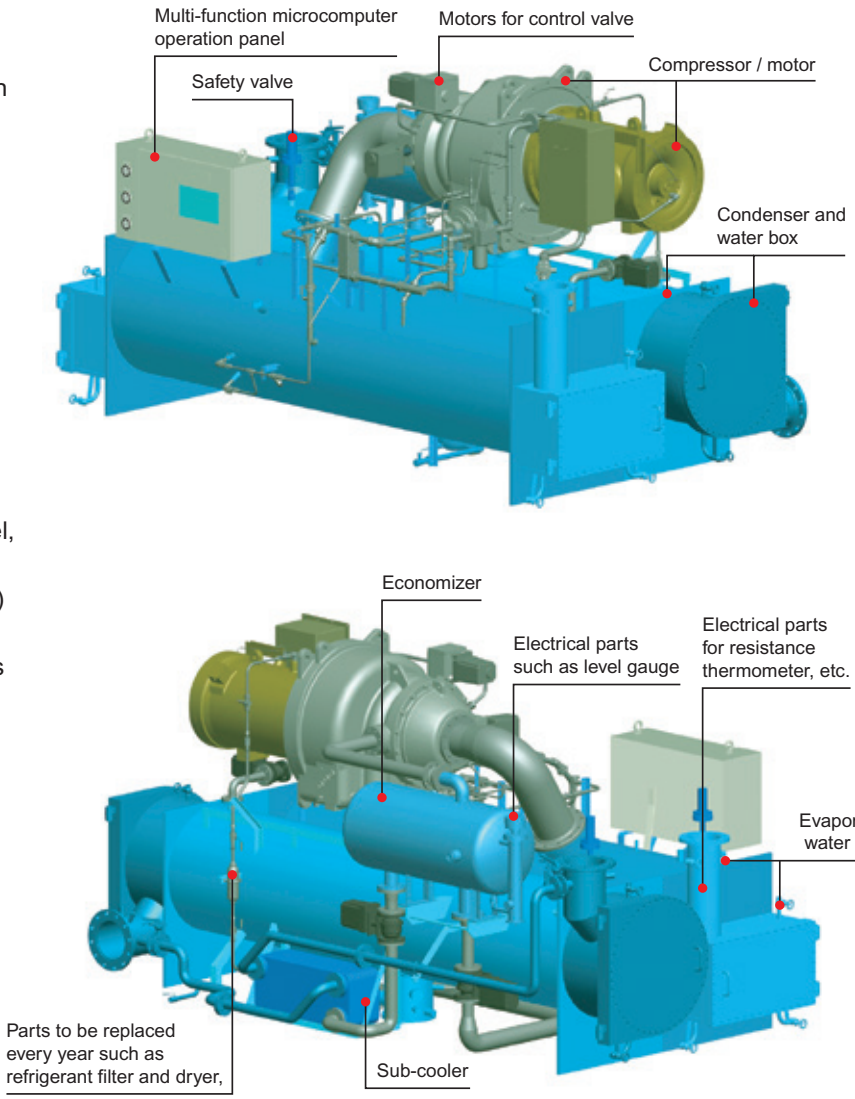
Annual Maintenance Items

No.	Major Maintenance Items	Descriptions
A-1	Inspections for Refrigerant Leak and Oil Leak	Confirm no refrigerant leak by a detector and/or soap water. Confirm no oil leak by visual check.
A-2	Repairing Refrigerant Leak and Oil Leak (if necessary)	If any leak is found, the leak to be repaired. Repair work will be charged separately.
A-3	Replacement of Normal Wear and Tear Parts	Replacement of lubricant oil (or oil analysis), oil filter and refrigerant drier filter.
A-4	Inspection of Control Panel	Inspection and adjustment of temperature / pressure sensors.
A-5	Inspection of Starter Panel	General inspections, tightening nuts.
A-6	Recommissioning	Adjustment of parameter during test run.
A-7	Cleaning of Condenser Tubes	Tube cleaning by brushes. Touch-up painting at damaged point of water box. Apply new gaskets.

Periodical Maintenance [Overhauling]

Every component of the centrifugal chiller plays important role. In an extended use, deterioration continues due to rotation, heating, cooling and vibration at parts that cannot be checked in daily/periodical checks. If the maintenance of the components is ignored, it will cause accident and shorten the service life as well as deterioration of the function and performance of the centrifugal chiller. For the purpose of preventive maintenance, periodical overhaul maintenance is indispensable.
In order to operate the compressor for a long period of time, periodical overhauling is required considering the wear condition of the sealing parts of the high speed rotating object and service life of the bearing, etc.
Concerning other electrical parts (starter panel, inverter panel, multi-function microcomputer operation panel, controllers and safety devices) and mechanical parts (heat exchange tubes, accessories, etc.), this periodical overhauling is also indispensable for maintaining the function and performance.

◆Major Components



Precautions on Water Control

The water control is extremely important for maintaining performance of the centrifugal chiller, economical operation and preventing accidents due to corrosion.

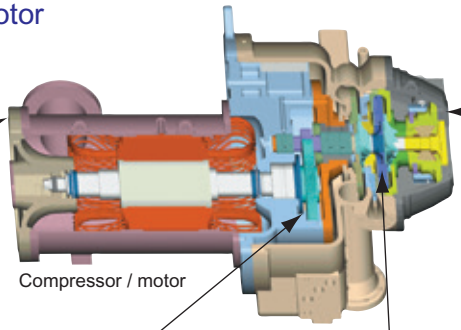
◆Cooling Water

- Heat exchange is performed between the cooling water and atmosphere in the cooling tower, and this causes mixing of components from the atmosphere such as nitrogen oxide and carbon dioxide into the cooling water, deteriorating the water quality. If the cooling water is continuously circulated with the blowing and/or supplying the cooling water insufficient due to splashing of the cooling water and the evaporation loss, it will also deteriorate the water quality.
- By this, the heat exchange rate of the condenser decreases due to adverse conditions inside the tube including slime fouling, existence of some sediment, corrosion tendency resulting from acidified condition and scale adhesion, which may increase power consumption and condenser pressure, thus resulting in some problems such as failure stoppage and tube corrosion.
- For prevention of such problems, follow the instruction manual for water quality control including when to start the operation.
- Periodical cleaning of the tube is necessary as a rule.
  Multi-year maintenance extended course and annual maintenance course include the tube cleaning. Even if you selected other course, the tube cleaning will be optionally available.

◆Maintenance of Compressor and Motor

Check / inspection

Motor stator



Compressor / motor

Disassembling / maintenance / assembling

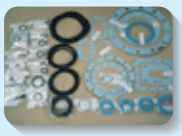
Compressor disassembly

Compressor assembly

Rotor dynamic balance check

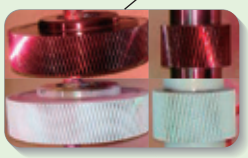
Standard replacement parts

(Bearings)

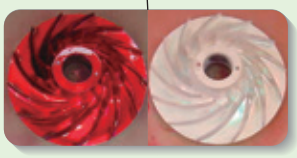


(Gaskets / O-rings)

Inspection



Gear / pinion gear liquid penetrant testing



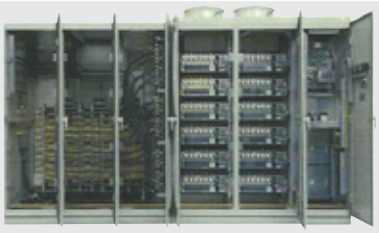
Impeller liquid penetrant testing

◆Major Electrical Parts

■Starter

Starter panel will be used in case of

■Inverter panel



This photo shows an inverter panel of 6.6kW. The opening door is an optional item.

■Multi-function microcomputer operation panel

■Controllers, measuring instruments, valves, etc.

Level gauge, measuring motor valve, pressure switch, resistance thermometer, etc.

(1)Level gauge
(2)Motor for control valve
(3)Pressure switch
(4)Resistance thermometer

- Removing the scales requires chemical cleaning. This service will also be optionally available irrespective of the course.
- What we recommend the most to know the condition inside the tube appropriately is ECT (eddy-current test). This test will also be optionally available irrespective of the course.

◆Chilled Water

- For the chilled water is circulated in the sealed system, the chilled water does not get contact with the atmosphere so much as compared with the cooling water. This makes the quality of the chilled water less deteriorated than the cooling water. From the preventive maintenance perspective; however, we still recommend to conduct ECT every 5 to 7 years as a rule. This test will be optionally available irrespective of the course.
- When the chilled water systems are equipped with thermal storage tanks, carbon dioxide or oxygen could enter into the water due to contact with the atmosphere, which make the circumstance to be corrosion-prone.
  In this case, please analyze the water quality as with the cooling water, and conduct water control in accordance with the instruction manual based on the result of the analysis.

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www.mhi-mth.co.jp/en/

Mitsubishi Heavy Industries Thermal Systems, Ltd.
(Wholly-owned subsidiary of MITSUBISHI HEAVY INDUSTRIES, LTD.)

Chiller & Heat Pump Engineering Department
Service Section
1-1, Wadasaki-cho 1-chome, Hyogo-ku, Kobe, Hyogo, 652-8585, Japan

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