# 廷 亚 冷 却 塔
# TYACHT COOLING TOWER

## 型式(SERIES):TCT&TCC

（开放式、引风横流密闭式冷却塔）
(OPEN & CLOSED TYPE COOLING TOWER)

## 安装、维护说明书
**Rigging and Maintenance Procedures**

首先感谢贵公司购买廷亚冷却塔。

本说明书以标准型冷却塔为对象，针对安装、运行、操作、检修时的安全，及维持性能等方面进行具体说明。请在使用前先详细阅读本说明。请保存好本说明书，以便随时阅读。

Thank you very much for purchasing TYACHT cooling tower.
This manual covers all the basic information necessary for the cooling tower including installtion, operation, and maintenance. Keep this manual handy for your daily inspection.

上 海 廷 亚 冷 却 设 备 有 限 公 司
SHANGHAI TYACHT COOLING EQUIPMENT CO.,LTD.

# CONTENTS



Precaution in safety

Prior to operation, read this operation manual for your safety.

Please keep the manual handy.

SIGN INDICATION:

⚠ : CAUTION
⃠ : DON'T EVER DO
: DON'T TOUCH, ENTER
: DON'T BREAK APART
: CARRY THIS OUT
: REQIRES EARTHING

"CAUTION" indicates there is a possibility of serious wounding and death in consequence of improper usage (handling).

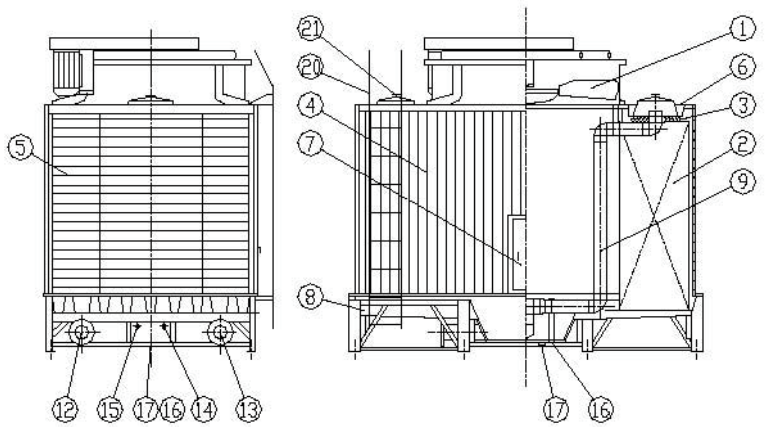
"PRECAUTION" indicates there is a possibility of serious damage of equipments and physical properties in consequence of improper usage (handling).

## 1. Structure

Cooling tower Sketch, Fig 1. Fig 2.

Fig 1. Cooling tower Structure

Open type, Model TCT (Internal piping type)




1. Fan
2. Heat exchanger
3. Spray filling
4. Outside panel
5. Louver
6. Upper basin
7. Inspection door
8. Lower basin
9. Internal pipe
10. Spray pipe
11. Spray pump
12. Inlet pipe
13. Outlet pipe
14. Make up pipe (Auto)
15. Make up pipe (Manual)
16. Over flow
17. Drain
18. Drain (Circulate water)
19. Air purge bleeder
20. Ladder
21. Control handle

Closed type, Model TCC

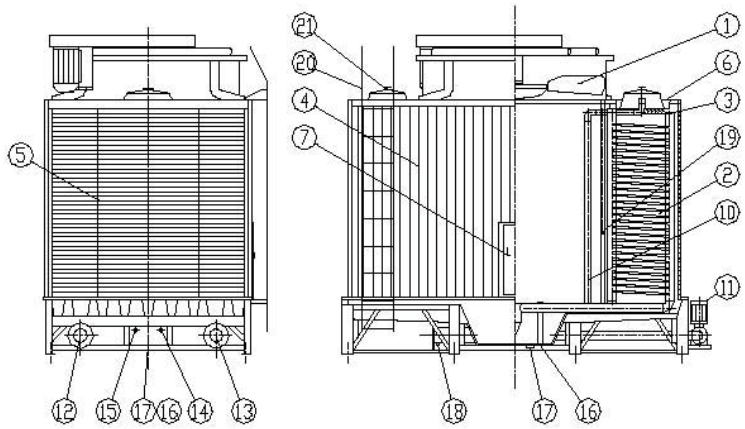
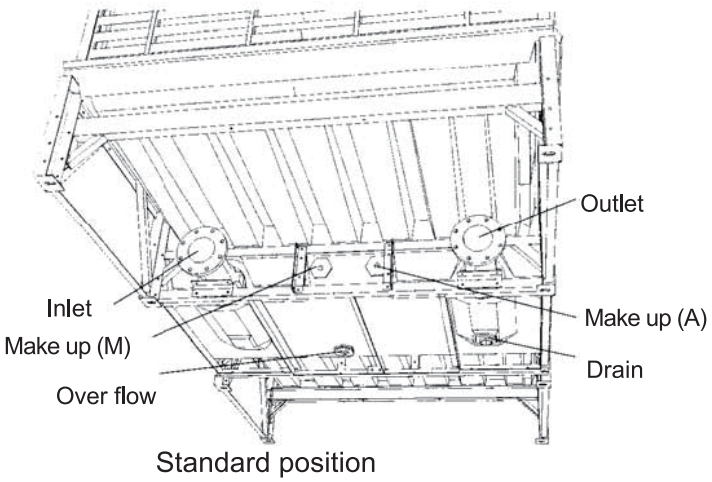



Fig 2. Piping

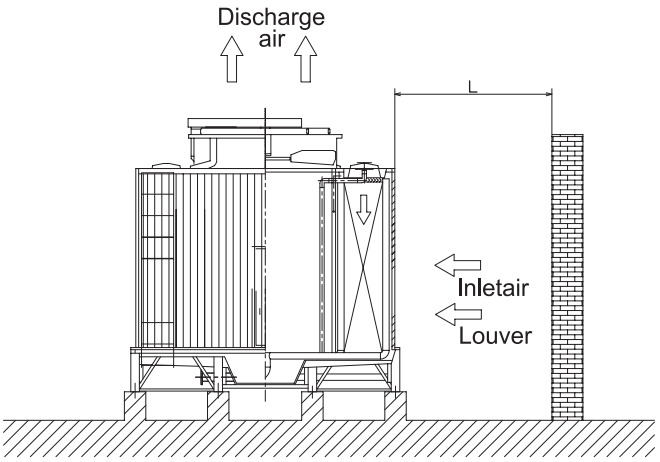


## 2. Precaution in design & installation

Instruction in erection:

- Select well-ventilated and clean area for the erection.
- Avoid a dusty or acidic location.
- Also avoid any location close to a chimney or exposed to radiant heat from any other heat source.
- Erect the tower vertically to the ground level and fix it with anchor bolts.
- Keep distance between the tower and the obstacle as per the table below. Air volume to the cooling tower may be insufficient if the distance is not secured. (Ref. to Fig. 3.)
- Exercise care to prevent discharged air from being re-circulated and sucked into the tower (Short-circuit).

Fig. 3 Distance between the tower and obstacle




| DISTANCE (L) | |
|---|---|
| 5RT～15RT | 0.5m or above |
| 20RT～70RT | 1.0m or above |
| 80RT～100RT | 2.0m or above |
| 110RT～175RT | 2.5m or above |
| 200RT～400RT | 3.0m or above |
| 500RT or above | 3.5m or above |

Obstacle should not exceed the height of fan discharge port. The Tower might face "short circuit" if obstacle is taller than tower (fan discharge port) depending on the surrounding condition (wind direction and speed).

Please take the following points into account to design plumbing layout and periphery.
Refer to Fig.4 for piping layout for tower and chiller.

- Check the direction of the piping as per the approval drawing.
- Check the tower foot-layout in accordance with the position, foundation of the vibration isolator and anchor bolt.
- Minimize "UP & DOWN" of piping to avoid excessive pressure loss.
- Though flow control valves are provided for internal piping version, additional valves are recommended for inlet pipe for each tower cell so that inlet water flow for every cell could be balanced.
- Valves are also recommended for external piping version to regulate water flow for each upper basin.
- Pipe size should be equivalent (or above) to the size of connecting flange of circulating water.
- Make-up water pressure should be within the range of 0.05～0.3MPa.
- Make drainage pipe as short as possible. Select up-sized diameter pipe for long drainage for smooth drain-out.
- Take some countermeasure for drainpipe to avoid clogging.
- If heater is adopted in lower basin for winter use, level tank and float switch are also recommended.

Pay attention to the followings for closed type cooling tower.

Fig. 5 is a reference for piping system.

- Pressure for coil and circulating water pipe should be 0.49MPa or below. Consult us for the application of higher

pressure (above 0.49MPa).

- Prepare expansion tank in between circulating water outlet and pump. The tank should be located higher than tower. It should be in service whenever water inside totally closed pipe expands or contracts in consequence with temperature change or leakage from pump gland packing.
- In winter season, Take countermeasure against water freezing by applying heater for spray-water and circulating water, or by applying aux.pump or by-pass circuit in the water flow system.

Fig. 4 Open type piping reference

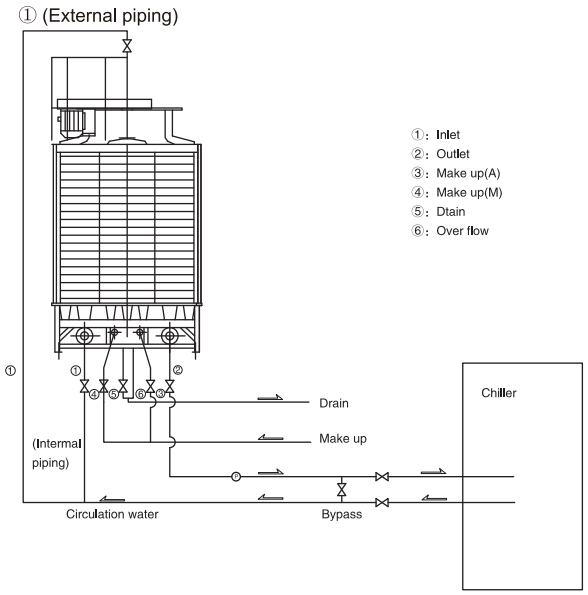
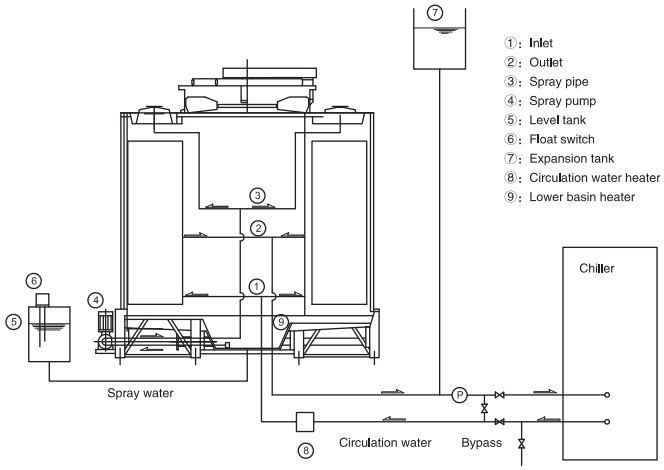



Fig. 5 Closed type piping reference




## 3.Precaution in inspection

: Other than the purpose of inspection, do not enter (or climb up on) tower.
: More than 2 persons are required on duty for safety reason.
: Make sure that fan motor, pump and heater are turned off.
: Do not touch heater even after being turned off.
: Do not enter (climb up on) tower while fan is in operation.
: Do not stick hand or foreign substance into fan while in operation.
: On the top of cooling tower, keep yourself supported safely by having something you can fall back on.
: Electrical wiring should be done by an expert possessing license.
: Make sure that capacity of power supply, control panel, and switching device be appropriate.
: Make sure to carry out earth-wiring first when doing wiring.
: Do proper wiring to avoid leaking and short-circuit of electricity.
: Run for trial after wiring.
: Products should not be broken apart or dismantled unless done by an expert possessing license.
: Take precaution against unexpected swallowing (of circulating water) or inhaling (of droplets of circulating water).

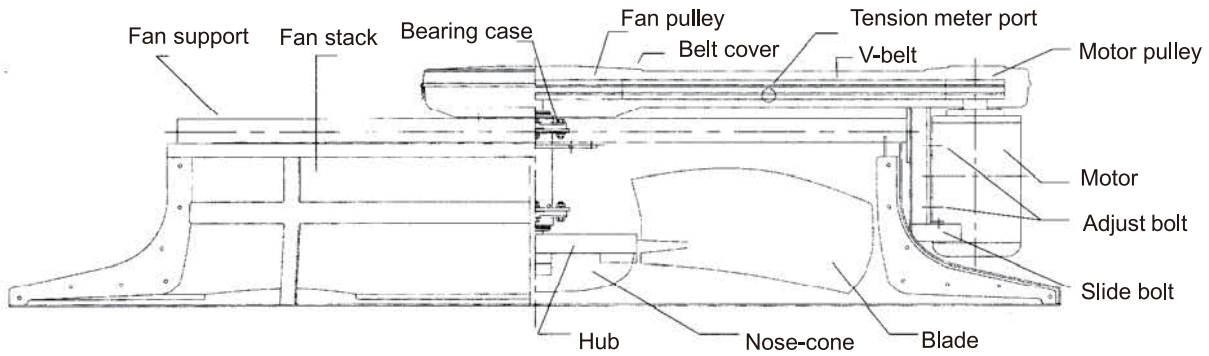
## 4. Precaution in trial operation

The work such as the early period adjustment of the cooling tower becomes necessaryat the time of the trial run. Please confirm the following point without fail.

①Confirm that bolt is securely fastened comming every single tower parts.

②Do the inspection of the fan. (Structure of the fan is shown in Fig. 6.)

Fig. 6 Structure of the fan .

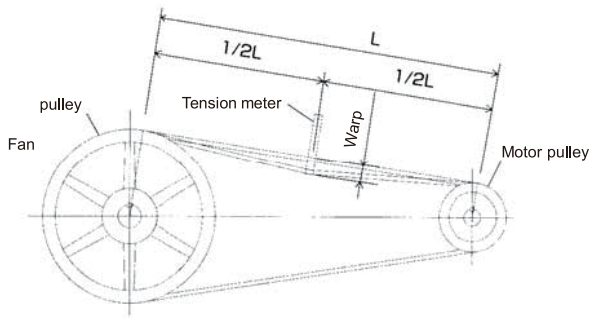



Check whether not some obstacle is located nearby to disturb smooth airflow or not.

- Blade tip should not contact fan casing internal.
- No loosening of bolt should be found at any connecting portion.
- Blade-fixing bolt should be re-tightened every 100hrs of operation.
- Open belt-cover to check type, quantity, and length of V-belt in accordance with specification.
- Surface of Pulleys (of fan and motor) should be at the same height without having inclination.
- Check V-belt tension.

Proper tension can be secured at 1.6mm deflection per 100mm(span-L) when the specified load is given at right angle to the center of span-L (ex. 8mm deflection is appropriate for 500mm span-L).

Fig. 7 Appropriate way of stretching V-belt




| Type | Prescription load | |
|---|---|---|
| SPZ | 7～10N | 0.7～1.0kg |
| SPA | 15～18N | 1.5～1.8kg |

- Remove oil, grease, etc. sticking on V-belt and V-pulley.
- Remove foreign substance such as bird nest from belt-cover.

- ⚠ Check electricity system: switch, fuse, wiring are suitable for motor capacity., ground wiring has been done, and avoid single-phase operation.
- To avoid single-phase operation, application of breaker is recommended.
- Confirm that insulation has been done.
- Revolution direction of fan-blade should be in conformity with direction of arrow indicated on fan casing.
- For belt-driven type, power supply is reverse-phased.

**Electricity wiring**

**Please refer to the wiring diagram inside the motor wiring box.**

- Operate fan to check abnormality in noise and vibration, and electric current.

① Clean upper & lower basin, strainer of circulating water & float valve, and tower internal.

② Introduce water through make-up water pipe to fill basin until water starts running through overflow pipe. Remove air from strainer. (Let air out from strainer gradually by operating circulating pump intermittently for open-type tower). For closed-type tower, open air-purge bleeder to let air out from pipe internal by operating water-spray pump intermittently.

③ Water level in lower basin gradually goes down as pump is operated continually. This water level is going to be the operating water level for the tower. Adjust float valve to stop feeding water at this level.

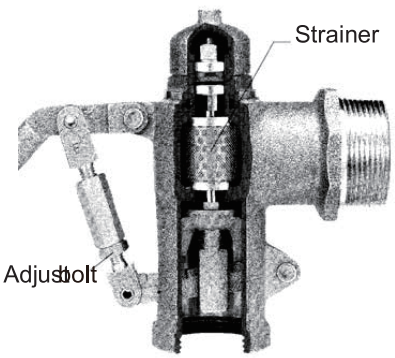
④ Make sure to have no leakage from lower basin, piping connection.

⑤ No abnormal noise from fan acceptable.

⑥ Do the inspection for the confirmation on item (P8) at the time of everyday operation.

**Note the followings for closed-type cooling tower.**

- Open cock of air-purge bleeder and fill internal of coil and pipe with water.
- Operate circulating pump intermittently to let air out completely.
- Once air is completely out, close the cock of bleeder.
- Do correct wiring on water-spray pump to secure revolution direction in conformity with that of arrow mark.
- If spray-water pump goes in reverse-revolution, pumped-water amount decreases dramatically and abnormal noise comes out.
- Spray-water pipe internal should be free from air, and external free from water-leakage.
- Cover should be applied for pump, if it is supplied with tower.
- ❗ Connect ground-wire (earth) first when working on electrical wiring for water-spray pump.




Float-valve supplied with TYACHT cooling tower is double-action, pressure-balance type (except for smaller models). It is equipped with strainer toprotect valve-seat against clogging. Strainer can bepulled out with cylinder by loosening bolt on the top. As it is very easy to clean, daily maintenance is highly recommendable.

Check the followings:

- Remove foreign substance in strainer.
- Does the float do the up-and-down motion lightly?
- Pole responds properly to wave motion of water.

## 5. Precaution in stating operation

**It is very important to confirm that nothing serious has happened to the not-in-use tower prior to operation after long-term intermission.**
**Especially fan unit should be inspected following the inspection procedure on "4. Precaution in trial operation".**

**Also note the followings:**

- Re-tighten blade-fixing bolt after the first 100 hour operation, then once every 3 years periodically (tower operated throughout a year requires once a year).
- Check V-belt tension and remove foreign substance in belt-cover.
- Grease should not be leaked from bearing.
- Check bolt connecting fan unit to tower body is securely fastened.
- Confirm that water is filled in lower basin up to overflow level prior to operation.
- Confirm that no reverse-revolution, abnormal noise and vibration are found before pump start.
- Confirm that amperage marked is below the rated amperage of motor.
- Keep in mind that the excess of electric current may be caused by low voltage.
- Coming back from the non-use period, check v-belt tension after the first 100-hour operation. Tighten or loosen adjust bolt if necessary.
- Confirm required amount of water flows into every single upper basin. Flow meter is recommendable for accuracy.
- Check performance of float valve every time to secure proper water level. If lower basin water is lower in level, tower cannot ensure proper operation in consequence of having air sucked in from strainer.
- Coming back from the non-use period, clean lower basin and drain (replenish) circulating water after 1 week of operation to remove foreign substance.

⚠ **Note the followings for closed-type cooling tower.**

- Again, make sure to let air out of copper coil.
- Water in lower basin should be at proper level prior to operation of spray-water pump.
- Though water might not contact coil surface uniformly in the beginning, 2 or 3 days of operation could solve the problem naturally.

⚠ **Watch for noise, vibration, electric current, water temp., water volume Refer to "14. Trouble shooting" to take action accordingly.**

For towers for stand-by and emergency use, operate fan and spray-water pump once a month to check operation (avoid operating pump without water).

**To be continued to the next page for some more detail of inspection to follow.**

## 6. Daily inspection

Item to be inspected.

| Location | Item to be Checked |
|---|---|
| Surrounding of Cooling tower | Is condition of ambient air nearby normal?<br>Is there any obstacle nearby disturbing airflow?<br>Is there any place nearby happened to have higher ambient temp?<br>Is abnormal noise or excessive vibration found on tower body or pipes?<br>Is there any water-pool nearby? |
| Cooling tower inside | Is level of circulating water in lower basin appropriate?<br>Is there foreign substance such as leaves, plastic bag, etc. in lower basin?<br>Is there foreign substance stuck in strainer net?<br>Is water circulating up above strainer?<br>Is circulating water changed extremely in color?<br>Is there any extreme change in circulating water temp.?<br>Is strainer of float valve clogged? (Ref. P6)<br>Is float valve working properly?<br>Is make-up water replenished properly? |
| Cooling tower top | Is water-distribution hole of upper basin clogged?<br>Is any foreign substance sticking around fan blade? |
| Current | Is amperage of fan motor and pump motor appropriate? |

## 7. Freeze Protection

If the cooler are installed in cold climate,freeze protection must be provided for the heat exchanger coil in the unit as well as for the recirculating water system.

### Recirculating Water

The general and effective way of keeping the recirculated water from freezing is to use a pan heater. Electric heater is recommended to install with the water level switch, temperature controller and other auxiliary equipment. An automatic control is good plus which shall prevent the electric heaters in dry-heating or over-heating.

The recirculated pipe of spray water should be packed with insulation materials, so that pipings outside water pan can be protect from freezing.

All spray water should be drained immediately whenever the units shut down for long term or flow stops. Please keep the drain valves open of water pan and spray water pump.

### Closed Circuit Water Cooler Coils

The simplest and most effective way of protecting the heat exchanger coil from freezingis to use an inhibited ethylene or propylene glycol anti-freeze. If this is not possible, an auxiliary heat load must be maintained on the coil at all times so that the water temperature does not drop below 7˚C when the cooler is shut down.

If an anti-freeze solution is not used, the coil must be drained immediately whenever the pumps are shut down or flow stops.This is accomplished by automatic drain valves and airvents in the piping to and from the cooler.Care must be taken to ensure that the piping is adequately insulated and sized to allow the water to flow quickly from the coil.Coils should not be drained for an extended period of time.Please keep the drain valves and air vents open.

An automatic control system also can be applied to antifreeze when the units operating above 0˚C ambient temperature. Spray water pump and fan can be controlled to open or not according to the water outlet temperature.

All above freezing measures can be used separately, or do several design at same times. Please contact our local representatives or Aftersale Service Department for details.

## 8. Maintenance & parts replacement

⚠ **For longer lifetime of cooling tower, exercise the following inspection in addition to the daily inspection. Replace parts or do touch-up if necessary.**

- Motor and fan adopt non-lubricating type bearing. Replace bearing every 3 years (life time of bearing is 20,000 hrs). Also replace immediately if abnormal noise starts coming out.
- A total set of V-belt should be replaced after 8,000 hrs of operation or every year. Damaged piece proper can be replaced if it is cut or worn heavily.
- Water-spray pump for closed-type tower adopts mechanical seal. Replace immediately if water starts leaking from the seal. Replace once a year even if no water leakage is found.
- Touch-up paint should be applied to painted parts or equipment (motor, pump) once every 3 to 5 years.
- Remove foreign substance from upper basin water-distribution holes and strainer to avoid clogging. It surely affects tower performance negatively if clogging occurs on upper basin. Clogging of strainer could lead to breakage.

Corrosion-resistance for standard tower. (Steel parts only)

Table A. Anti-corrosion specification table. (Steel parts only)

| Parts name | Application |
|---|---|
| Frameworks | H.D.G. (Hot Dipped Galvanized) |
| Lower basin frame | Ditto (Including legs) |
| Fan | Ditto (Excluding bearing & pulley) |
| Header for closed cooling tower | Ditto |

Note) Following parts are NOT subject to painting:

1. Hot dipped galvanized steel.
2. Resin-synthetic.
3. Stainless steel.
4. Bronze.

Standard color of paint is Munsel N-5. Dirt can be removed by applying thinner and wipe with clothe. Rusted portion of steel should be removed by scratching with sand paper or wire-brush prior to applying touch-up paint.

⚠ **Feel free to contact us if any other abnormality is found in daily inspection.**

## 9. Long term out of-operation

**To keep tower out of operation for long time, proper inspection and maintenance should be carried out periodically even during the not-in-use period to be ready for upcoming operation.**

- Loosen tension of v-belt to avoid deformation, and keep fan under a cover.
- Keep foreign substance, small animal, etc. out of tower internal and pipes.
- Make sure to drain water out of pipes, coil, and tower basin in winter. Freezing may give damage to pipes and coil. Special preparation against freezing should be taken for closed-type tower such as opening cock and drain valve of air purge bleeder, lower basin, and water-spray pump.
- ⚠ Make sure that electric power is completely switched off and not susceptible to unexpected switch-on.
- Those who are not concerned should not enter nor climb up on tower.

**⚠ To re-start operation after long-time non-use period, follow the instruction below as well as item 3, 4,5, and 7.**

- Prior to operation, make sure that no loosening of bolt on each connecting portion and rust appearing on steel parts. Replace or repair if necessary.
- Check insulation of fan motor, spray water pump, and circulating water pump. The resistance should be 1MΩ or more at 500v megger.

## 10. Retaining cooling tower performance

Performance of cooling tower is totally dependant on mutual interrelationship of factors such as circulating water flow, inlet and outlet temp., ambient wet bulb temp., air volume, etc. It is not appropriate to evaluate a tower performance simply based on temp. difference of inlet and outlet. The ideal way of evaluating performance of cooling tower is to focus on outlet temp. by comparing with that of design condition having rest of the factors(water flow, inlet temp, wet bulb, and air flow) completely fixed to be exactly same in figure.

Generally, tower performance tends to fluctuate as per the table below.
Table B.

| Large temp. difference inlet and outlet | Small temp. difference inlet and outlet |
|---|---|
| High heat load | Low heat load. |
| Small water volume | Large water volume |
| Large temp. difference between inlet and wet bulb | Small temp. difference between inlet and wet bulb |
| High inlet temp. | Low inlet temp. |

## 11. Calculation of make up water

Volume of circulating or spraying water decreases in due course because of the following reasons:

1) Cooling tower is designed to cool water taking advantage of principle of evaporation.
2) Water droplets are carried away in open air by strong wind generated by fan (carry-over).
3) To keep proper water quality in tower, a part of circulating water must be drained out (to be replenished with fresh water as much).

To calculate make-up water volume, follow the equation below:

1) Evaporation loss (WE) kg/h
   WE = (tw1— tw2)×L×Cp÷2520
   tw1 : Inlet water temperature(°C), tw2 : Outlet water temperature(°C),
   L : Flow rate (kg/h), Cp : Specific heat of water (Kcal/kg°C),
   2520 : Latent heat incidental to water evaporation (kJ/kg°C)
   If the difference between inlet and outlet temp. is 5°C, evaporation is going to be 0.84% based on the above equation.

2) Drift loss (WD) kg/h
   It varies depending on tower structure and air-flow velocity, normally it is about 0.05% .

3) Blow down (WB) kg/h
   It varies depending on amount of pollutant in the air, quality and multiples of concentration of make-up water, normally it is about 0.08% .

   Make-up water (ΔL)
   ΔL = WE + WD + WB = 0.84% + 0.05% + 0.08% = 0.97%

Make-up water will be approximately 0.97% of flow rate by equations mentioned above, but, Make-up of 1.2~1.5% is recommended in actual operation.

## 12. Water quality control

It is well known that negative effect caused by corrosion, scale, and slime in consequence of having tower operated with highly-concentrated chloride Ca, chloride Mg is expected. This fact is considered applicable only to open-type cooling tower but it is the same with closed-type tower in the sense that water sprayed on cupper coil also evaporates to be high in concentration. Also, under the same capacity, both open and closed type tower require the same amount of make-up water due to the fact that same amount of water evaporation occurs in both. To avoid the water qualityrelated troubles, water-quality control is required for circulating water (open-type), and for spray water (closed-type).
The water suitable for cooling tower application is shown below for reference.

Standard for Water quality control

Table 1. For circulating water *1

| | Items *3,*4 | Criteria | Tendency *2 | |
|---|---|---|---|---|
| | | | Corrosion | Scale |
| Standard | pH (at 25°C) | 6.5 ~ 8.2 | ○ | ○ |
| | Conductivity (mS/m) | 80 or less | ○ | ○ |
| | Chloride Cl (mg $Cl^-$ /l) | 200 or less | ○ | |
| | Sulfate ion $SO_4^{2-}$ (mg $SO_4^{2-}$ /l) | 200 or less | ○ | |
| | Acid consumption {pH 4.8}(mg$CaCO_3$/l) | 100 or less | | ○ |
| | Total hardness (mg $CaCO_3$/l) | 200 or less | | ○ |
| | Calcium hardness (mg $CaCO_3$/l) | 150 or less | | ○ |
| | Silica (mg $CaCO_3$/l) | 50 or less | | ○ |
| Reference | Iron Fe (mg Fe/l) | 1.0 or less | ○ | ○ |
| | Copper (mg Cu/l) | 0.3 or less | ○ | |
| | Sulfide $S^2$ (mg $S^{2-}$/l) | Shall not be detected | ○ | |
| | Ammonium ion $NH_4^+$ (mg $NH_4^+$ /l) | 1.0 or less | ○ | |
| | Residual chlorine (mg Cl/l) | 0.3 or less | ○ | |
| | Isolation carbon (mg $CO_2$/l) | 4.0 or less | ○ | |
| | Stability exponent | 6.0~7.0 | ○ | ○ |

Table 2. For make-up water (reference) *5

| | Items *3,*4 | Criteria |
|---|---|---|
| Standard | pH (at 25°C) | 6.0 ~ 8.0 |
| | Conductivity (mS/m) | 30 or less |
| | Chloride Cl (mg $Cl^-$ /l) | 50 or less |
| | Sulfate ion $SO_4^{2}$ (mg $SO_4^{2-}$ /l) | 50 or less |
| | Acid consumption {pH 4.8} (mg $CaCO_3$/l) | 50 or less |
| | Total hardness (mg $CaCO_3$/l) | 70 or less |
| | Calcium hardness (mg $CaCO_3$/l) | 50 or less |
| | Silica (mg $CaCO_3$/l) | 30 or less |

| | Items *3,*4 | Cristeria |
|---|---|---|
| Reference | Iron Fe (mg Fe/l) | 0.3 or less |
| | Copper (mg Cu/l) | 0.1 or less |
| | Sulfide $S^2$ (mg $S^{2-}$/l) | Shall not be detected |
| | Ammoniumion $NH_4^+$ (mg $NH_4^+$/l) | 0.1 or less |
| | Residual chlorine (mg Cl/l) | 0.3 or less |
| | Isolation carbon (mg $CO_2$/l) | 4.0 or less |

Note

*1 Standard for cooling water (circulating water).

*2 "○" indicates the item marked is a strong influential factor to from corrosion or scale.

*3 The 15 items listed are the major factors having tendency for forming corrosion or scale.

*4 Name and unit of each item is in conformity of that of JIS code K0101.
Acid-consumption is also referred to as Total alkalinity, or M-alkalinity.

*5 Make-up water is referred to be as the water supplied to cooling tower, not including transitory water.

## Calculation of multiple of concentration and blow-down

Heat-exchange is done by having part of circulating (spray) water evaporated. Thus, the leftover portion of the remaining water is quite concentrated. The ratio between fresh, original make-up water and the remaining water after having some portion evaporated is called "Multiple of concentration".

To keep favorable multiples of concentration during tower operation in order to secure proper performance of cooling tower, blow-down is required as per the amount calculated based on the equation below.

$\Delta L = WE + WD + WB$

$N = (WE + WD + WB) / (WD + WB)$

Description

N : Concentration multiple, ΔL : Make-up water amount (l/h), WE : Evaporation loss (l/h)

WD : Drift loss (l/h), WB : Blow down amount (l/h)

From the above, following equation is applicable:

WB = {WE / (N – 1)} – WD ……(1)

ΔL = WE × N / (N – 1) ……(2)

Now that evaporation loss is 0.84% of circulating water amount, relationship of Multiples of concentration (N) and Makeup water (ΔL) is going to be:

Table C. Multiple of concentration and Make-up water amount

| Concentration multiple (N) | 2 | 3 | 4 | 5 | ∞ |
|---|---|---|---|---|---|
| Make-up water amount (ΔL) l/h per RT | 12 | 9 | 8 | 7.5 | 6 |

**To check Multiples of concentration of circulating and make-up water, lab analysis is required. Periodical water sampling is recommended.**

Generally, Multiples of concentration is obtained from the following equation applying sodium ion concentration value obtained from lab. Analysis.

N = CR / CM

CR : Sodium ion concentration of circulating (spray) water ( mg $Cl^-$ /l)

CM : Sodium ion concentration of make-up water (mg $Cl^-$ /l)

If sodium ion concentration in ambient air is high, it could affect the calculated value.

In general, Multiple of concentration is set 2～3. However, it could vary depending on make-up water quality and operating facility.

There are some ways to apply blow-down:

- Prepare valve somewhere along circulating or make-up water pipe and have the valve kept slightly open to let some portion of water go out.
- Let a little bit of water overflow through overflow pipe entirely through tower operation.
- In addition to regular cleaning of lower basin, throw concentrated water and apply fresh water in.

Chemical is also one of the ways to control water quality (consult chemical supplier for father reference).

## 13. Emergency and parts replacement

Let us know the followings:

SERIAL No. (Very important)

- Serial number.
- What kind of trouble at which parts?
- Name & phone number of the person in charge.

## 14. Trouble shooting

There could be a slight difference between open and closed type in terms of troubled position and contents.

Table D. Countermeasure against possible trouble-related subject.

| Trouble details | Type | | Cause | Measure | Reference |
|---|---|---|---|---|---|
| | Open | Closed | | | |
| Abnormal sound & vibration | ○ | ○ | Bolts loosening. | Check bolts for looseness and tighten loosened ones. | |
| | ○ | ○ | Inadequate tension of V-belts. | Adjust the tension. | P18 |
| | ○ | ○ | Contact of fan blade tips & fan casing. | Contact the distributor. | |
| | ○ | ○ | Defective shaft or bearings. | Contact the distributor. | |
| | ○ | ○ | Defective motor. | Contact the distributor. | |
| | | ○ | Reveres rotation of spraying water pump. | Wire correctly. | |
| Electric overcorrect | ○ | ○ | Voltage drop. | Check & measure the voltage and contact power supplier. | |
| | ○ | ○ | Incorrect setting of fan blade angle | Contact the distributor. | |
| | ○ | ○ | Defective motor. | Contact the distributor. | |
| | ○ | ○ | Defective shaft or bearings. | Contact the distributor. | |
| | | ○ | Defective spraying water pump. | Check strainer & spraying pomp. | |
| Abnormal increase of outlet water temperature | ○ | ○ | Excessive flow rate. | Adjust flow rate in specified value. | |
| | ○ | ○ | Imbalanced water. | Clean upper basin. Adjust valves. | |
| | | ○ | Imbalanced water into cooling coils. | Adjust valves. | |
| | | ○ | Insufficient air purge out of cooling coils. | Purge air out completely out of coils from purge valve on header. | P19 |
| | ○ | ○ | Insufficient air volume. | Remove obstacles for air intake. Check V-belts. | P16,P18 |
| | ○ | ○ | Deflected air intake into cooling tower. | Improve the remove obstacle for ventilation. | P16 |
| | ○ | ○ | Recalculation of discharge air. | Improve the remove obstacle for ventilation. Contact the distributor. | |
| | ○ | ○ | Loosened or slip off of V-belts. | Adjust the tension. | P18 |
| Decrease of circulating water | ○ | ○ | Clogged strainers. | Clean strainers. | P19 |
| | ○ | ○ | Decrease of water level in lower basin. | Check and adjust make-up water float valve. | |
| | ○ | ○ | Defective drain valve. | Check drain valve. | |
| | ○ | ○ | Insufficient capacity of circulating water pump. | Replace sufficient capacity pump. | |
| Excessive drift loss | ○ | ○ | Excessive flow rate. | Adjust flow rate specified value. | |
| | ○ | ○ | Imbalanced water. | Clean upper basin. Adjust valves. | |
| | ○ | ○ | Excessive air volume into cooling tower. | Contact the distributor. | |
| Damage to cooling coils | | ○ | Insufficient draining in cold season. | Contact the distributor. Install heater or inject anti-freeze fluid. Make sure to open drain valves and purge valves. | |

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Note: Please read operation manualpre pared for each TYACHT product for proper usage including safety inspection and cleaning.The content of this manual may be changed without notice for product improvement.