IWC COUNTERFLOW

INDUCED DRAUGHT COOLING TOWER

OPERATING & MAINTENANCE

MANUAL

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FOREWORD

Although the cooling tower is manufactured from extremely durable materials, it is also subjected to extreme operating conditions. Recognition of this fact emphasizes the need for regular, periodic, inspection and maintenance. Most companies enforce specific inspection and maintenance schedules for all their major pieces of equipment and it is recommended that a program be initiated for the cooling tower on the completion of installation.

These operating and maintenance instructions have therefore been prepared to assist the operator of the cooling tower in obtaining the best results and long life from his cooling tower equipment.

ESSENTIAL OPERATING TERMS

The following are some of the common expressions used in connection with cooling towers:

Approach:	is the difference between the temperature of the cold water leaving the cooling tower and the wet bulb temperature of the surrounding air.
Cooling range:	is the difference in temperature between hot water entering the cooling tower and cold water leaving.
Wet bulb temperature:	is the temperature at which air would normally become saturated, with no change in heat content. It is theoretically the minimum cold water temperature attainable when cooled through evaporation at atmospheric pressure.
Evaporation loss:	is the water vaporised in the cooling process. This can be estimated at approximately 1 % of the flow rate per 6 °C of temperature cooling range.
Distribution system:	is the piping and nozzle arrangement in the top of the tower which distributes the hot water evenly over the tower working area.
Drift:	is water lost as fine droplets carried from the tower by air passing through the tower. Drift is reduced to a minimum by good engineering design. The drift loss in our counterflow cooling tower is guaranteed not to exceed 0.1 % of the water circulated, although the actual loss will generally be below this figure.
Drift eliminator:	is the assembly placed between the distribution system and the fan for the purpose of minimising drift loss.
Fill:	is the packing inside the tower, used to break up and retard the flow of water and thus provide for better contact between air and water. In this way the contact surface area between air and water is maximized, inside the cooling tower fill, thus promoting evaporation and inturn cooling.

IMPORTANT INSTRUCTIONS FOR INSTALLATION AND MAINTENANCE

HANDLE WITH CARE - FIBREGLASS

HANDLING

- DO NOT LIFT COOLING TOWER FROM HEADER OR PIPES.
- LIFT CAREFULLY FROM UNDERNEATH WITH EXTENDED FORKS.
- TOWER CAN BE LIFTED, BY LIFTING LUGS (IF LUGS ARE PROVIDED) BUT SPREADER BAR MUST BE USED.
- INSTALL ON FLAT AREA (CONCRETE PLINTH).
- CHECK ROTATION OF FAN; ENSURE AIR FLOW EXITING THE COOLING TOWER OUT THE TOP.

MAINTENANCE

- DO NOT OPERATE COOLING TOWER WITHOUT AN AUTOMATIC BLEEDING SYSTEM.
- ADEQUATE AND SUITABLE WATER TREATMENT CHEMICALS MUST BE USED.
- REGULAR CHECKING OF THE INTERNALS, FAN AND MOTOR ASSEMBLY MUST BE CARRIED OUT.
- REFER TO OPERATING AND MAINTENANCE MANUAL.

SPECIFICATION OF IWC INDUCED DRAUGHT COOLING TOWER

Fill

The tower fill (or packing) is available in three different standard options.

PVC Film Pack

High quality, rigid PVC material in a cross flute configuration. The film pack exhibits great strength and good chemical resistance properties. The heat transfer characteristics are such that this is the most efficient cooling tower fill, per unit volume, of any fill on the market.

> **Warning:**
>
> The softening temperature of PVC fill material is 60 °C, and we therefore advise that the maximum temperature of water entering the tower should not exceed 55 °C and the continuous operating temperature should be less than 45 °C.

HDPE Tubular Trickle Pack

Tubular trickle pack is manufactured from high density polyethylene and consists of open tubes packed horizontally into the cooling tower. This fill is recommended for use in very aggressive cooling water with a high solid content where film pack would be easily clogged. The individual tubes can be easily removed for cleaning and re-installed without fear of damage. This fill is also recommended where continuous operating temperatures are in the range 45 °C to 60 °C with occasional temperatures not exceeding 80 °C.

X-Grid Splash Pack

X-Grid is a South African patented metallic splash pack, manufactured in 3CR12, 304 or 316 stainless steel. The fill is non-clogging with a high resistance to impact and can be steam cleaned. The fill is also resistant to erosion and friction, and there is no aging effect as found on plastic fill types. X-Grid is also recommended to be used on cooling towers where temperatures consistently exceed 60 °C.

Chemical resistance tables applicable to the fill material are available on request.

Drift Eliminators

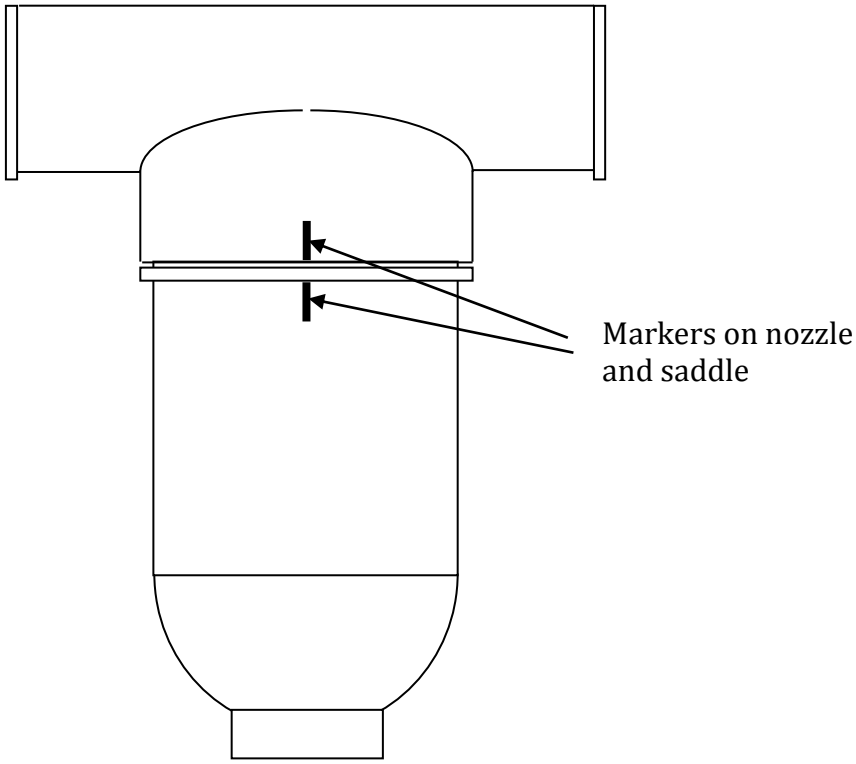
The drift eliminators are made of rigid PVC panels having a flute type configuration.

Alternative types manufactured from PVC and stainless steel waves are also available.

Distribution System

The distribution system is manufactured from PVC pipes fitted with down spray, square pattern, nozzles of ABS plastic, making the whole distribution system completely non-corrosive. Nozzles are properly spaced to give uniform distribution of water over the entire area of the tower. Industrial Water Cooling nozzles are easily removed for cleaning by unscrewing the nozzle from the saddles. The swirler is on a taper fit and can be knocked out using a piece of wood.

When replacing the parts firmly press the swirler back into he nozzle and screw it back into the saddle tightening it against the rubber O-ring until the markers on the nozzle line up with those on the saddle. Ensure that the index mark on the sprayer is in line with the centre line of the pipe. This is essential to ensure correct orientation of the square spray pattern.

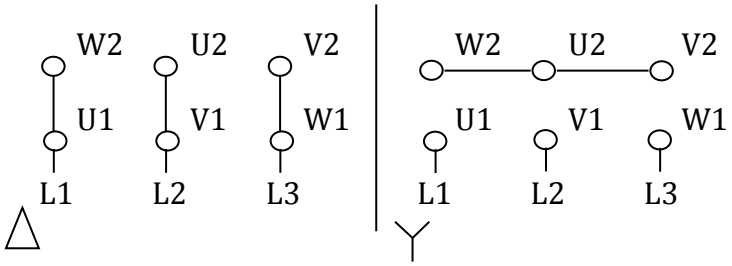


Fan Stack

The fan stack is of glass fibre construction, designed to give trouble free, vibrationless operation. Warm air is exhausted from the fan stack at a high velocity and recirculation is minimised.

Mechanical Equipment

Each fan stack is equipped with a variable pitch axial flow fan directly driven by a pad mounted electric motor. The motor electrical termination wiring detail is shown below.



INSTALLATION INSTRUCTIONS

General

1. If the tower is installed complete with basin, it should be placed in a level position on solid flat foundations.

2. IWC fibreglass cooling towers can be supplied:

   - with standard basin
   - without basin for draining into a pond or catchment area provided by the user.

3. Hot water, cold water, make-up water, overflow and drain connections as well suction screen are provided when a standard basin is supplied. The drain is despatched with a fitted plug but the user may find it necessary to pipe the overflow and drain water to a waste pipe, in which case a suitable shut-off valve should be fitted by the user. If the cooling tower is supplied without basin, only hot water connections are provided. The cold water connection, the make-up ball valve and connection, the drain and overflow connections and suction screen are to be supplied in this case by the user unless otherwise specified.

4. Fan motor and starter should be wired up to an A.C. supply of the same frequency and voltage as that shown on the motor nameplate. The motor must be checked for the correct rotation. The starter must be fitted with thermal overload protection set at a level no higher than the maximum rated current.

   The fan must be fitted for correct direction of air flow, i.e. in the normal fan arrangement, vertically upwards. All wiring should be done to suit outdoor conditions and the conduit or cable connection to the terminal box must be weather and water-proofed to prevent any ingress of moisture into the terminal box of the fan motor.

Location of tower

1. The cooling tower must be located outside. All details are to be specified to Industrial Water Cooling before any cooling towers are supplied for inside installations. Careful consideration should be given to location with respect to surrounding structures or other obstructions. Sufficient clearance should be allowed for the free flow of air to the inlet of the tower and for its discharge from the tower. A reduction of the normal air requirement to the tower by obstructions, as well as recirculation of air from the tower discharge, reduces its performance.

2. Cooling towers should be located so that noise created by either air or water will not be a source of annoyance. The preferred location is either remote from or above a place requiring low sound levels. Furthermore, the tower should be located away from windows and vents through which air or water noise would be transmitted. The tower site should be such that the air discharge will not cause condensation or wetting of nearby areas or buildings due to normal drift and plume discharge by the fan. The tower should not be located near contaminated air.

3. The hot air discharge from a cooling tower located indoors must be ducted to atmosphere. As the added air friction may affect the fan performance, all such ducting should only be installed after consultation with the supplier. The duct should always be self supporting and equipped with an access door to facilitate fan/motor maintenance.

Piping

1. A valve should always be inserted in the tower inlet pipeline. This can be used to adjust the water flow requirements and to isolate the piping system.

2. On multiple tower applications using a single pump, balancing valves should be inserted in each tower inlet pipe. Furthermore, equaliser lines equivalent in diameter to or larger than suction pipe connections should be installed between the basins of each tower to maintain the same water level throughout. With this arrangement only one make-up water ball valve is required to feed the entire system and this should therefore be sized for the total quantity of make-up water. Ensure in all cases that ball valve used is correct type (high or low pressure) and size to ensure that water level is always maintained. The size of the ball valve depends on the required make-up and on the available mains pressure.

3. The make-up line should be sized larger than the ball valve to facilitate quick-filling of the system.

4. It is usually necessary to route piping from overflow and drain connections to the nearest sewer. If this is done a valve should be inserted in the drain piping and this valve should remain open when the system is drained during extended periods of shut-down.

5. Bleed-off piping could be routed either to the nearest sewer or the basin overflow pipe. An automatic bleed-off system must be installed to control the level of the total dissolved solids contained in the circulating water through the cooling tower.

6. A pipe-line strainer should always be fitted in the hot water inlet pipe. The mesh of this strainer should be of size to hold any matter suspended which may lodge in the nozzle.

7. A pressure gauge should be installed in the inlet pipe close to the cooling tower. The checking of the pressure at start up and monthly intervals will give an indication of possible clogging up of spray nozzles inside the cooling tower.

PRE-START UP INSTRUCTIONS

Prior to start up, the cooling tower should be checked to ensure that:

1. The piping system to the cooling tower is cleaned and flushed of foreign matter prior to start up.

2. The basin is clean and free of any debris.

3. The float valve for the basin make-up water is operating freely.

4. All bolts are tight, especially those of the fan assembly and mechanical equipment supports.

5. The fan turns freely in the correct direction such that the air discharges from the cooling tower in an upward direction.

6. The electrical connections are safe for operating conditions.

7. The motor/fan units run without excessive noise, heating and vibration. Run the motor/fan units for at least one hour to check this. Carefully inspect all mechanical equipment after start up run.

When all items have been checked and are satisfactory, commissioning of the cooling tower may be carried out.

SHUT DOWN INSTRUCTIONS

The procedure to follow during shut-down is dependent upon the duration of the run and the length of the shut-down. The maintenance schedule should be checked and items requiring attention taken care of. Regardless of the length of the shut-down, the fan and motor assembly should be visually inspected. Each cell which is out of operation for a period in excess of one week should be started and run each week for at least ten minutes to reduce the danger of rust forming in the bearings. The distribution system must be inspected and cleaned and the basin drained and cleaned. During extended shut-down periods and as a regular maintenance procedure during operation, all external bolts, including stairway or ladder bolts, etc, should be checked and tightened if loose.

IMPORTANT

MAKE SURE POWER IS OFF BEFORE WORKING ON MOTOR.

NEVER ENTER A COOLING TOWER TO INSPECT FAN WITHOUT FIRST MAKING SURE THAT ALL ELECTRICAL POWER TO THE FAN HAS BEEN LOCKED OUT.

WATER TREATMENT

Water treatment is an important part of your entire cooling plant and it is very important that the process be carried out efficiently. It is generally recommend that an automatic bleed-off system and an automatic dosing system be installed, as this allows you to have a problem free water management program.

We would like to emphasise that a bleed-off system is a necessary component of an effective water treatment program, along with the dosing of the various water treatment chemicals. It is of utmost importance in the prevention of scale build up in the cooling system.

If the cooling tower is situated in a dusty environment or if solid particles can enter into the cooling system, then it is recommended that a side stream filter be installed to prevent build-up of this dust and/or these particles in the cooling tower system.

The recommended components are detailed below:

Bleed-off system complete with

- automatic solenoid valve
- conductivity controller
- conductivity probe – inline or dip-type

- The conductivity bleed-off system works on the following principle. The conductivity of the water in the system is constantly monitored. When the conductivity level reaches the pre-set upper limit, a solenoid valve is triggered. This leads to the release of a quantity of water from the system allowing for the water in the system to be "diluted", by the fact that a greater volume of water is added into the system by the make-up valve.

- A conductivity bleed-off system will keep the concentration of total dissolved solids (TDS) at an acceptable level of below 800 ppm. At this level scale build up will be minimised. The control of anti-scaling will also be complimented by the dosing of anti-scaling chemicals.

Side stream filtration system

Manual, fibreglass side stream filter complete with:

- multi-port valve
- dual media (Hydro-anthrasite and Silica sand)

- The side stream filter will remove the solid particles and dust from the water in the cooling system. In this way it will prevent build-up of this dust in the cooling tower and in any heat exchangers served by the cooling tower. It is recommended to limit the side stream filtration to approximately 10 % of the mainstream flow rate.

Automatic dosing systems

Automatic anti-scaling dosing system complete with:

- chemical storage tank
- water meter or a timer control
- dosing pump

Automatic Biocide dosing system complete with:

- chemical storage tank
- dosing pump
- timer control

- The dosing system for both biocide and anti-scaling chemicals, will give you problem free control over the growth of algae and microbes as well as scale build-up and corrosion respectively. The dosing system will be set at about 90-120 ppm for the biocide dosing and 150-200 ppm for the anti-scaling dosing. It must be mentioned that these figures are general guides and each system must be set for its own particular requirements.

- The combination of these chemicals will allow for the control of both the scale build-up and the microbial growth (algae and bacteria). The price of these chemicals can vary depending on the quantity and source of the make-up water. Once the system is up and running efficiently and the water meter is installed, the ratio of chemicals to make-up water can be accurately established.

TROUBLE SHOOTING GUIDE

FAULT	INSPECT FOR	CORRECTIVE MAINTENANCE
Poor water distribution	-Broken nozzles.	-Replace or repair all defective parts.
	-Blocked nozzles or distribution piping	-Clean nozzles or distribution pipes.
	-Damaged or clogged fill	-Replace fill.
	-Damaged distribution	-Replace or repair all defective parts. piping.
	-Low water flow	-Inspect and clean pump suction screens.
	-Excessive water flow	-Reduce water flow to design quantity. above design quantity
Excessive drift Loss	-Water hitting drift eliminators due to excessive water flow above design quantity.	-Check pump flow. Restore water flow to design conditions.
	-Broken nozzles	-Replace or clean nozzles.
	-Broken or missing drift	-Replace with new packs. eliminators
	-Fan pitched above design	-Pitch fan to design conditions.
	-Damaged distribution piping	-Repair broken header or lateral piping.

FAULT	INSPECT FOR	CORRECTIVE MAINTENANCE
Unbalanced fan	-Pitch angle varies on each fan blade	-Set pitch angle of each blade to same angle. Check all fixing bolts.
	-Damaged blades	-Replace with new units.
Motor		
Noisy motor	-Worn bearings	-Replace bearings and grease seals.
Motor shuts down after short duration run.	-Faulty or incorrect motor starting equipment.	-Check overload protective devices.
	-Overload or incorrect line voltage.	-Check voltage available to all phases at motor terminal.
Motor vibration	-Bent motor shaft.	-Replace.
	-Unbalanced fan.	-(See above).
	-Worn bearings.	-Replace.
	-Loose mounting bolts.	-Tighten mounting bolts.

RECOMMENDED SPARES

A list of recommended spares, with up-to-date prices, will be forwarded to you under separate cover if requested.

PERIODIC MAINTENANCE CHECK LIST

Once per week:	Inspect pump suction screens and clean if necessary.
Once every sixty (60) days:	Motor bearings should be checked and lubricated if necessary.
Once every six (6) months:	Check distribution system and clean if necessary. The nozzles must be removed, cleaned and replaced. Check the condition of the packing for damage or clogging.
Once a year:	The tower should be shut-down and a complete inspection carried out.