Cooling Tower Drives

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1. The feature of cooling tower drives

(1)What is a cooling tower?

Cooling towers are used to cool water, which has been heated up during a process. For instance: Large air conditioning systems, process liquids used in crude oil refining , electricity generation systems etc.
There are two main types of cooling tower systems - Open system and Airtight system. In addition, there is the Air Fin Cooler or Air Cooled Condenser.

a) Cooling tower

Cooling Towers are roughly classified into two categories ; Open System (fig 1) and Airtight System (fig 2). The common part of both systems is that warmed-up coolant is cooled down by open air taken in through ventilator. The difference is whether coolant is in direct contact with open air or not. Since the interior of the tower gets very humid, the motor is installed outside the tower.

Open system cooling tower

Cooling efficiency is high because coolant is in direct contact with outside air. This system involves evaporation of some of the coolant. It may be necessary to replace or replenish the coolant after long term running because only pure water is evaporated , allowing impurities and toxic substances to build up in the coolant.

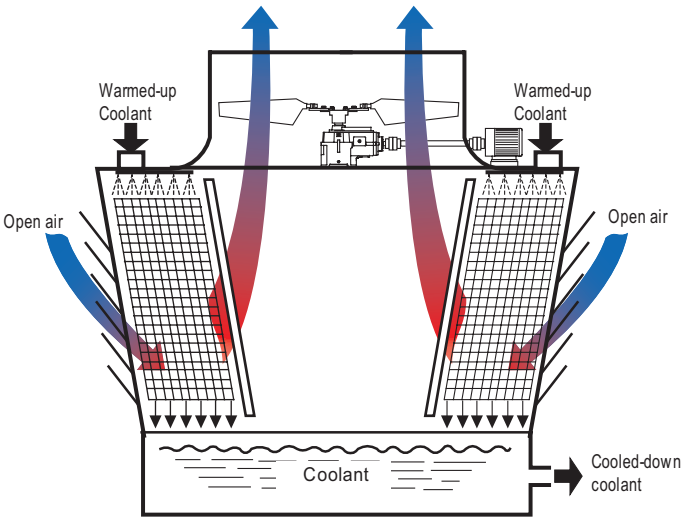


Fig.1 Open system cooling tower
(Coolant is in direct contact with air.)

Airtight system cooling tower

In this system, coolant is contained in a coil shaped radiator so the coolant is not in direct contact with the open air.
The cooling efficiency is about half that of the Open system, however this system is used frequently where problems caused by dirty water are especially to be avoided, such as computer and semi-conductor related places and where the open air is dirty (underground parking lot and volcanic ash areas)

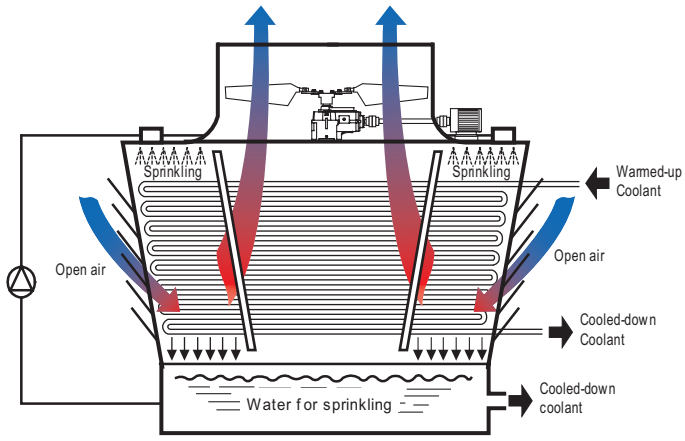


Fig.2 Airtight system cooling tower
(Coolant is not in direct contact with air.)

b) Air Fin Cooler

The Air Fin cooler (or Air Cooled Condenser), as shown in Fig 3 is a dry system where air is used as the cooling medium. The process involves pumping the coolant through finned tubes in the roof of the condenser building and forcing cooling air through the roof. This is a comparatively inefficient system however it is optimum in cases where a large supply of water is not available and environmental considerations make the cooling tower type of system less desirable.

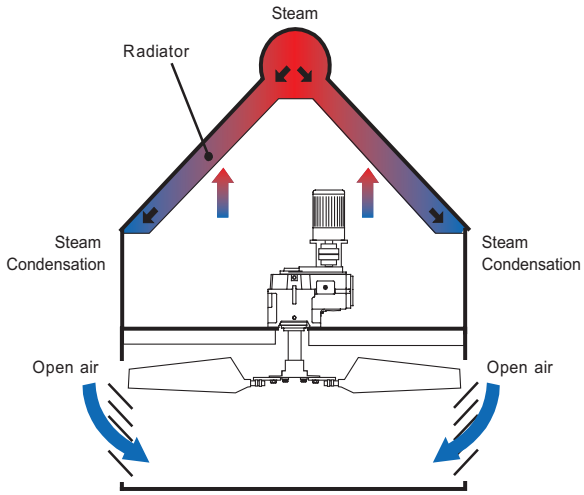


Fig.3 Air fin cooler adopting vertical reducer with parallel shaft
(Coolant is not in direct contact with air.)

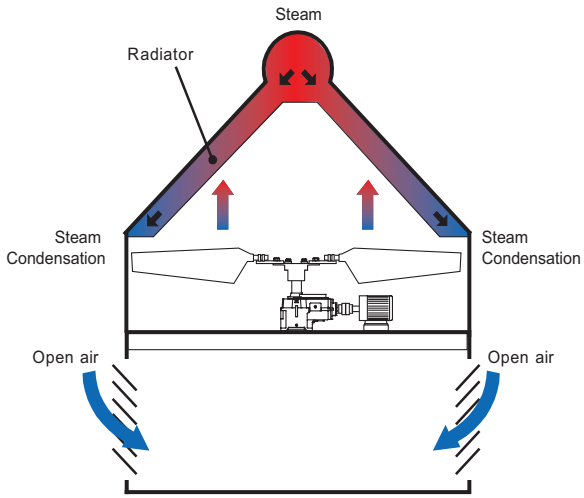


Fig.4 Air-fin cooler adopting vertical reducer with right angle shaft
(Coolant is not in direct contact with air.)

c) Comparison

Method	Advantage	Disadvantage
Cooling tower open system	High efficiency	1.Mixing of impurities into coolant 2.Producing plume in winter 3.Drainage processing is required.
Cooling tower airtight system	1.Coolant is remains clean 2.No condensate plume in winter 3.No problems even with bad atmosphere.	Device is larger than open system's.
Air-fin cooler	No water is required	Inefficient cooling

(2)CTI standard (US Cooling Tower Institute)

COOLING TOWER INSTITUTE standard (CTI-111(98)) "Gear Speed Reducers for application on Industrial Water Cooling Towers," has a description of the design method with regard to gear reducer for cooling tower use. The latest issue was published in March, 1998 and is composed of five sections in total. Major contents are as follows:

1. The gear strength is calculated followed by AGMA6010-F97.
2. Service factors of gear
   Spiral Bevel gear SF=2.0 or more
   Helical gear SF=2.0 or more
3. Life-span of bearing
   Input shaft, intermediate shaft bearings 50,000 hours or more (L10 life**)
   Output shaft bearing 100,000 hours or more (L10 life**)
4. Heat rating
   Generally speaking, the interior temperature of cooling tower is 38C(100 F) and the air velocity around the reducer is 1.27m/sec (250ft/min).
   Under these conditions, the temperature of lubrication must not exceed 93C(200 F).
5. It is important to prevent entry of water and dirt from outside.
6. Synthetic oil may be usable as recommended by reducer maker.

* CTI standard also says that the strength evaluation of Helical gear are followed by AGMA 2001-C95 and Bevel gear by AGMA2003-A86.
** L10 life ...Basic rated life(When 90% of a group of identical bearings will exceed this life when rotated at the same speed and under the same load and operating conditions.)

2. Selection

(1) Required spec

Check allowable thrust load capacity of the low speed shaft.
When the fan is rotating, it exerts a downwards thrust load on the output shaft bearings. Output shaft thrust load capacity must be sufficient.

Hermetic design
Since the inside of a cooling tower is a high humidity area, it is necessary to prevent ingress of moisture and dirt.

Maintenance
It is not possible to regularly re-grease reducer bearings and seals, therefore it will be necessary to lubricate either automatically or by pump.

Adherence to CTI standards is usually requested.

(2) Special attention to selection, regarding thermal rating.

There is a theory that it is not necessary to consider thermal rating of reducer in a cooling tower because there is air movement around the gear case, however as shown in Fig. 5 the air flow is blocked by the mounting structure for the reducer, and there is very little air movement. If, after checking with the cooling tower manufacturer for a specific installation, the actual air velocity around the reducer is 1.4 m/sec or above, the thermal rating can be increased by the air velocity revision factor.

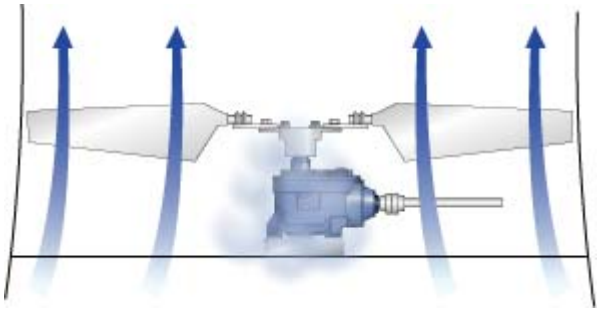
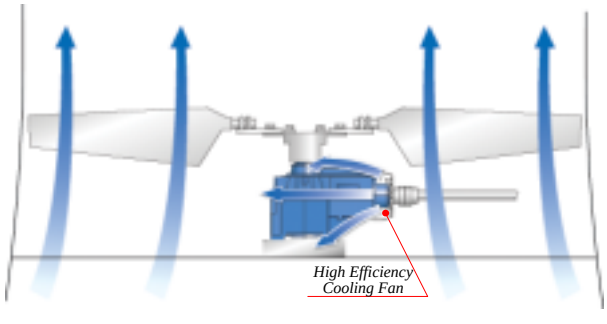


Fig.5 Since gearcase is blocked by the mounting structure of the reducer, wind hardly blows around reducer.

(3) Service factor

SF=2.0 or more is recommended based on cooling tower usage.

New Cooling Tower Drives SFC Series



Air flow of SFC series

Cooling fan forces air around the gearbox leading to lower operating temperature.