0713P EVAPCO COOLING TOWERS

Branded worksection

This branded worksection *Template* has been developed by NATSPEC in conjunction with EVAPCO Australia (the Product Partner) and may be used whilst the Product Partner is licensed to distribute it. The copyright remains with NATSPEC. As with all NATSPEC worksections, it is the responsibility of the user to make sure it is completed appropriately for the project. The user should also review its applicability for local conditions and regulations. Check www.natspec.com.au for the latest updated version.

Worksection abstract

This worksection *Template* is applicable to EVAPCO cooling towers normally used in commercial buildings. It is not intended for large, specialised towers for heavy industrial plant. Closed circuit fluid coolers, hybrid coolers and evaporative condensers are included in this worksection and fall within the meaning of cooling tower as defined in AS/NZS 3666.1.

Background

AS/NZS 3666.1, called up in *0171 General requirements*, addresses design and installation of cooling towers (AS/NZS 3666.1 Section 4). Maintenance is addressed in AS/NZS 3666.2 and AS/NZS 3666.3. On microbial control, see also SA/SNZ HB 32.

For design information of cooling towers see AIRAH DA17 on cooling towers, AIRAH DA18 on water treatment and AIRAH DA19 on HVAC&R maintenance.

How to use this worksection

This worksection *Template* must be customised for each project. See A guide to NATSPEC worksections (www.natspec.com.au) for information on *Template* structure, word styles, and completing a worksection.

Related material located elsewhere in NATSPEC

If a listed worksection is not part of your subscription package and you wish to purchase it, contact NATSPEC.

Related material may be found in other worksections. See for example:

- *0753 Water treatment*.
- *0784 Motors and starters*.
- *0791 Mechanical commissioning*.

Material not provided by EVAPCO Australia

This branded worksection *Template* includes generic material which may not be provided by the Product Partner including:

- CTI certified evaporative condensers.

Documenting this and related work

You may document this and related work as follows:

- Number of towers, number of cells and cell arrangement e.g. single, double.
- Water treatment – see *0753 Water treatment* and AS/NZS 3666.1 Section 4.
- Show access for inspection maintenance and removal of components on the drawings. Make sure heavy items located at high level such as fan motors can be safely removed.
- Detail noise and vibration isolation.
- Lifting mass (including mass of largest part) and operating mass of the tower may be critical. If so, include in the **SELECTIONS**.
- Consider cooling air arrangements including the risk of recirculation and the effect on air flow of sound attenuation or louvres, if present. Show the cooling tower configuration on the drawings.
- Detail the piping arrangements at the towers to achieve even water distribution and to prevent loss of water when the tower shuts down. Do not rely on check valves to prevent water loss.
- Location of the cooling tower discharge in relation to air intake louvres and habitable areas. Minimise the risk of people coming into contact with potentially contaminated air.
- For Class 2 to 9 buildings, BCA J5.12 defines maximum energy consumption for cooling tower fans. Conforming values should be included in the schedules.
- Water supply (especially in relation to backflow prevention) must conform to AS/NZS 3500.1 and the Plumbing Code of Australia (PCA). State or territory regulations may also apply.
- Lightning protection may be required in some locations. See *0979 Lightning protection*.
- Fire protection (e.g. sprinklers) may be required for some cooling tower types.
- This worksection contains text, including *Optional* text, which may be adapted for use in design and construct projects. See NATSPEC TECHreport TR 03 on specifying Design and Construct for mechanical services.

The *Normal* style text of this worksection may refer to items as being documented elsewhere in the contract documentation. Make sure they are documented.

Specifying ESD

The following may be specified by retaining default text:

- Provisions for environmental noise levels.
- Durable components and materials, particularly for corrosion resistance, to enhance material life cycle.
- Closed circuit coolers as an option to cooling towers.
- NCC energy efficiency requirements for fans and pumps.
- Microbial controls.
- Hybrid coolers.

The following may be specified using included options:

- Material selection to enhance material life cycle.
- Provisions for reducing transmitted noise and vibration.

The following may be specified by including additional text:

- High energy efficiency cooling towers for further reduced operating costs and greenhouse gas emissions.

Refer to the NATSPEC TECHreport TR 01 on specifying ESD.

1 GENERAL

1.1 RESPONSIBILITIES

General

Requirement: Provide EVAPCO cooling towers, as documented.

Documented is defined in *0171 General requirements* as meaning contained in the contract documents.

Add closed circuit coolers and/or evaporative condensers if applicable.

1.2 DESIGN

If the contractor is to undertake some of the design, detail the extent here. For example, you may wish to specify only the chiller performance and leave selection of the size and type of cooling towers to the contractor. If the contractor is to undertake part of the design consider including submissions of for example, design, calculations selections.

Requirements

General: To *0171 General requirements*, **DESIGN**.

Location and de-rating

Location: Assess proposed locations of cooling towers and apply appropriate de-rating.

Typical factors bearing on the need to de-rate a tower's performance would be as follows:

- Internal to the building: Additional air pressure loss may be imposed on both the suction and discharge side of the fan(s). Also, wind pressures may sometimes have a positive, and at other times a negative, effect on the wall louvres.
- External to the building: Parapets, adjoining structures such as lift motor rooms or even adjoining buildings may cause discharge air to be recirculated into the tower intake with serious consequences as far as performance is concerned.
- Elevation above sea level.

Consult EVAPCO if necessary.

Structure

Requirement: Conform to *0171 General requirements* and the following:

- Fixed accessways: To AS 1657.
- Structural design actions: To the AS/NZS 1170 series.

0171 General requirements includes relevant design parameters.

The above are statutory requirements in Australia. EVAPCO cooling towers also conform to:

- Wind and Seismic: To International Building Code (IBC).
- FM approval to FM 4930 to mitigate property loss in the event of exposure wind, seismic or fire events. They feature an FM approved mark affixed to the equipment.
- PVC fill, eliminators and inlet louvres: Tested to ASTM E84.

Pressure vessels
Standard: To AS 1210 or AS 2971, as appropriate.

Cooling towers
Requirement: Design cooling towers, as documented.

Change this *Optional* style text to *Normal* style text when the contractor is to design and select the cooling towers. Use *0701 Mechanical systems* to describe design parameters for mechanical systems, as a whole, including the basis for calculating the total chiller capacity from which the heat rejection will be determined.

Selection parameters included in the **SELECTIONS** schedules should not be repeated here**.** The schedules' *Guidance* text includes suggestions for modifying them to suit design and construct projects.

General: Select cooling towers with heat rejection capacity under the documented conditions and not less than the heat rejection requirements of the connected chillers.

Modify to suit other equipment included in this worksection, e.g. closed circuit coolers.

Number and connection: Provide one cooling tower per chiller with each chiller-cooling tower combination on a separate condenser water circuit.

This is a reasonable design solution that avoids the complications of interconnected cooling tower basins.

Cooling tower design, application and calculations
Standards: Conform to the recommendations of one or more of the following:
- AIRAH Design Application Manuals.
- ASHRAE Handbooks.
- CIBSE Guides.

Method of calculation: Manual or software that employs the data and methods in the applicable standard.

Design documentation

This is a partial list of items only. Edit to suit the project. Drawings relating to whole systems should be included in *0701 Mechanical systems*.

General: To *0171 General requirements*, **DESIGN DOCUMENTS**.

Drawings: Show the following on the drawings:
- Number of towers, cells and cell arrangement.
- Access for inspection, maintenance and removal of components.
- Water treatment, dosing and sampling facilities.
- Detail noise and vibration isolation.
- Cooling tower configuration.
- Detail piping arrangements at the towers.
- Location of cooling tower discharge.
- Lifting mass (including mass of largest part) and operating mass of the tower.
- Cooling air arrangements and measures to prevent recirculation.
- Sound attenuation or louvres.
- Piping arrangements at the towers to achieve even water distribution and to prevent loss of water when the tower shuts down.
- Location of the cooling tower discharge in relation to air intake louvres and habitable areas. Minimise the risk of people coming into contact with potentially contaminated air.
- Water supply arrangements including backflow prevention to the PCA and local regulations.
- Lightning protection if required for the location.
- Fire protection (e.g. sprinklers) if required.
- [complete/delete]

1.3 COMPANY CONTACTS

EVAPCO technical contacts
Website: www.evapco.com.au.

1.4 CROSS REFERENCES

General

Requirement: Conform to the following:

- *0171 General requirements*.

0171 General requirements contains umbrella requirements for all building and services worksections.

- *0701 Mechanical systems*.

0701 Mechanical systems deals with matters common to more than one Mechanical worksection.

- *0714 Mechanical pumps*.
- *0731 Fans*.
- *0733 Air coils*.
- *0741 Ductwork*.
- *0745 Attenuators and acoustic louvres*.
- *0753 Water treatment*.

List the worksections cross referenced by this worksection. *0171 General requirements* references the *018 Common requirements* subgroup of worksections. It is not necessary to repeat them here. However, you may also wish to direct the contractor to other worksections where there may be work that is closely associated with this work.

NATSPEC uses generic worksection titles, whether or not there are branded equivalents. If you use a branded worksection, change the cross reference here.

1.5 STANDARDS

Microbial control

General: To AS/NZS 3666.1 as required by the NCC and the recommendations of SA/SNZ HB 32.

See NATSPEC TECHnote DES 022 for more information on requirements for microbial control in buildings.

Refrigeration systems: To AS/NZS 5149.1, AS/NZS 5149.2, AS/NZS 5149.3 and AS/NZS 5149.4.

AS/NZS 5149.1, AS/NZS 5149.2, AS/NZS 5149.3 and AS/NZS 5149.4 deal with safety and environmental aspects of refrigeration systems. They are based on the corresponding ISO 5149 series standards but with Australian amendments including a performance option in Appendix ZZ of each part of the standard.

See NATSPEC TECHnote PRO 007 on refrigerant options.

1.6 INTERPRETATION

Definition

General: For the purposes of this worksection the following definitions apply:

- Capability: The percentage of design water flow rate that the cooling tower is capable of cooling through the design temperature range at the design approach temperature with air entering at the design wet bulb temperature.
- Cooling tower: As defined in AS/NZS 3666.1 and including hybrid coolers.

Edit the **Definitions** subclause to suit the project or delete, if not required. List alphabetically.

1.7 SUBMISSIONS

Certification

Requirement: Submit certification of the following:

- Conformity to the provisions of AS/NZS 3666.1, including certification of drift loss and drift loss test method.
- Thermal performance: Tested to either of the following:

  . CTI STD-201 RS.
  . CTI ATC-105.
- Sound level tested to CTI ATC-128.

Warranty

Cooling towers: Submit EVAPCO standard warranty.

2 PRODUCTS

2.1 GENERAL

Product substitution

Other products: Conform to PRODUCTS, **GENERAL**, **Substitutions** in *0171 General requirements*.

The *0171 General requirements* clause sets out the submissions required if the contractor proposes alternative products. Refer also to NATSPEC TECHnote GEN 006 for more information on proprietary specification.

Marking

Name plates: Provide metal labels fixed to casings using a marking method that will remain legible for the life of the tower. Locate in an easily visible position. Include the following data:

- Make or name of manufacturer.
- Model.
- Serial number.
- Rated water flow.

2.2 WARRANTY

Warranty

Requirement: Provide EVAPCO standard warranty on the motor and drive.

Extent of warranty: Warrant fans, bearings, pulleys, shafts, belts, gear reducers, drive shafts, drive couplings, electric fan motors, and mechanical equipment supports on both belt and gear drive units.

Period: 5 years.

2.3 PRE-COMPLETION TESTS

Type tests/production tests

Drift loss: Tested and certified to be less than 0.002%.

This is the maximum permitted drift loss toAS/NZS 3666.1 clause 4.4.

AS/NZS 3666.1 does not prescribe a test standard for drift loss. In a note it refers to AS 4180.1 or AS 4180.2 but also says other methods established in other countries such as the heated bead isokinetic (HBIK) test are also acceptable. CTI ATC-140 is an isokinetic test method.

Thermal performance: Including the effects of accessories and noise reduction to either of the following:

- Tested and certified to CTI ATC-105.
- Certification of the evaporative heat rejection equipment model line to CTI STD-201 RS.

CTI STD-201 RS sets forth a program whereby CTI will certify that all models of a line of evaporative heat rejection equipment offered for sale by a specific manufacturer will perform thermally in accordance with the manufacturer's published ratings.

CTI certification is for type testing.

Consider evaluation and other additional measurements, e.g. entry and leaving air velocity, water meter device readings, water temperature in the cold water basin, system static pressures, pump motor amperage.

Sound levels: Tested and certified to CTI ATC-128 at 100% fan speed and 100% water flow at 1.5 m horizontally at any point around tower (in free field).

Pressure test: Leak test coils for at least 1 hour by either of the following:

- Submerging in warm water and applying air or other gas under pressure.
- Hydrostatic test.

Equipment incorporating coils: Pressure test coils to the greater of 2 MPa or 1.5 times the working pressure.

Equipment incorporating refrigerant coils: After testing, dehydrate, charge with dry nitrogen to 7 kPa minimum, and seal.

Certification: FM Approved to FM 4930. Affix FM approved mark to equipment.

See FM Approval Guide for conditions and limitations.

2.4 MATERIALS GENERAL

General

Standard: To AS/NZS 4020 and AS/NZS 3666.1.

In the absence of a suitable standard for materials in cooling towers, AS/NZS 4020 is referenced. This standard deals with products for use in contact with drinking water. AS/NZS 3666.1 also contains requirements relating to materials.

Pipe connections

General: For pipe connections other than refrigerant:

- ≤ DN 50: Screwed to AS ISO 7.1.
- > DN 50: Flanged to AS 2129 Table E.

Nozzles

Material: ABS or polypropylene.

Gravity hot water basin and covers

Material: Stainless steel or PVC-U formed and/or welded.

Galvanized steel is also available.

Hardware for wetted parts

Material: Type 304 or 316 stainless steel to ASTM A240/A240M.

Nails: Helical or spiral.

Hardware for non-wetted parts

Material: Galvanized steel or stainless steel.

Fill and drift eliminators

General: Decay and ultraviolet light resistant rigid PVC-u with a minimum temperature rating of 50°C.

Galvanized steel components

Sheet metal: Zinc coated steel, with minimum Z600 coating to AS 1397.

EVAPCO galvanized steel towers use grade G-235 galvanizing. This code refers to 2.35 oz/ft^2, equivalent to 717 g/m^2, which is greater than the 600 g/m^2 provided by Z600.

Hot-dip galvanized components: Hot-dip galvanize after fabrication. Minimum coating mass 600 g/m^2 to AS/NZS 4680.

Stainless steel components

Stainless steel: Provide stainless steel components as follows:

- Atmospheric corrosivity categories C1, C2 and C3 to AS 4312: Type 304 to ASTM A240/A240M.
- Atmospheric corrosivity category C4 to AS 4312: Type 316 to ASTM A240/A240M.

For atmospheric corrosivity categories C5 and CX seek specialist advice and include text here.

The atmospheric corrosivity category for the project is given in *0171 General requirements* and depends on site conditions. Refer to NATSPEC TECHnote DES 010 for guidance on specifying atmospheric corrosivity in NATSPEC.

Type 304 is generally cheaper but construction in Type 316 stainless steel may be required for a project where long life is required or in a marine environment such as near breaking surf. An alternative in Type 304 stainless steel may be sufficient but consideration must be given to anticipated chloride levels in the condenser water when considering which grade of stainless steel to use. *0753 Water treatment* requires chemicals to be compatible with materials, not the other way around. In extreme cases more corrosion resistant materials may be required, in which case replace stainless steel with an alternative, e.g. Monel.

2.5 COOLING TOWERS

The combinations of materials in the following tower types represent common practice. Adjust to suit specific proprietary towers and project conditions. Include the required construction combination in this clause; delete non-preferred alternatives and insert the required choice or alternatives in the **COOLING TOWER SCHEDULE**.

General

Selection: Provide EVAPCO products as follows:

- Cooling towers: AT, UT, USS, AXS, LSTE, LPT.

Galvanized steel towers

Consider galvanized steel construction when low capital cost is a priority and reduced service life acceptable. Manufacturers may offer a protective coating such as ‘an electrostatically sprayed thermosetting hybrid polymer fuse-bonded to the hot-dipped galvanized substrate’. Other combinations are also possible such as stainless steel for wetted parts with galvanized steel for the remainder of the tower.

Casing material: Galvanized steel.

Cold water basin: Galvanized steel or stainless steel.

Material may be documented in **Cooling tower schedule**.

Fan cowl and guard: Galvanized steel or stainless steel.

Mechanical equipment support: Hot-dip galvanized steel or stainless steel.

May be made from rolled hollow sections or folded sheet. For additional corrosion protection hot dip galvanized components can be epoxy finished but this may be only marginally cheaper than stainless steel.

Non-wetted structure: Galvanized steel.

Hardware for non-wetted parts: Galvanized steel.

Galvanized steel: Steel, hot-dip galvanised after fabrication or factory coated with coating mass at least 700 g/m². Paint edges cut or damaged surfaces with zinc-rich primer to AS/NZS 3750.9.

Stainless steel towers

Casing material: Stainless steel.

Cold water basin: Stainless steel.

Mechanical equipment support: Stainless steel.

Non-wetted structure: Stainless steel.

Alternatively mild steel hot dip galvanized.

Hardware for non-wetted parts: Stainless steel.

Access for maintenance

Requirement: Conform to **ACCESS FOR MAINTENANCE** in *0171 General requirements*.

Cold water basins

Construction: Provide basins capable of supporting the weight of service personnel and the rated water content.

Materials are listed for the respective tower types**.** Alternative materials include concrete.

Sheet metal cold water basins: Double break flanges for maximum strength and rigidity and fully weld all seams in factory.

Basin capacity: Sufficient to contain the water overflow from the water suspended in the water distribution system and the fill without the loss to overflow pipes when the water distribution system is stopped.

Careful detailing of piping may be needed to minimise water loss. A check valve may assist but should not be relied on. Alternatively, document basin capacity to accept the required quantity of water.

In certain (rare) climatic conditions, a sump heater may be needed to prevent the sump contents from freezing. If heaters are required, specify a heater of the nickel alloy electric element sheath type, complete with factory installed sump thermostat and low water level cut-out. Consider capacity.

Filling facilities: Provide a copper alloy ball float valve to AS 1910, with plastic float or EVAPCO electronic water level control system.

Position: To AS/NZS 3500.1 Table 4.6.3.2.

AS/NZS 3500.1 Table 4.6.3.2 lists minimum air gap which varies with outlet size. The Network Utility Operator may require larger air gaps.

Separate quick fill facilities: Required, with back flow prevention to AS/NZS 3500.1.

The Network Utility Operator (normally the local water authority) will usually require an air gap over the basin or tundish to AS/NZS 3500.1 Table 4.6.3.2. Consult the Network Utility Operator.

Overflows: ≥ DN 50.

Sumps

General: Provide the following:

- A lift-out Type 304 stainless steel strainer with 3 mm perforations at the outlet, large enough to prevent vortices forming at the water outlet.
- Anti-vortex plate, if necessary.
- Drain outlet: ≥ DN 50.

AS/NZS 3666.1 clause 4.1.5 specifies a minimum drain size of 50 mm which may be too small for many towers and require long drain times.

- Provision for equaliser connections for multiple tower operation.

Sump material: Same as basin.

Alternatively, specify stainless steel for sumps and fittings.

Louvres and splash guards

General: Provide readily removable air inlet louvres and splash guards.

Air inlet louvres: To AS/NZS 3666.1.

Air inlet screens: Prevent the entry of birds by the use of removable hot-dip galvanized, stainless steel or plastic air inlet screens or equivalent configuration of inlet louvres. Provide hot-dip galvanized screens with two coats of factory applied compatible topcoat.

Consider louvre and screen material and bird mesh. Louvres may be integral or separate – check with manufacturer.

Fill

See **Fill and drift eliminators** for materials.

Film-type fill: Wave formed sheets designed for even water distribution to give maximum wetted surface area.

Drift eliminators

Location: Provide EVAPCO EDE001 drift eliminators located in the air flow above the fill and water distribution system, so that full air flow passes through the eliminator.

Drift eliminators have a significant effect on water consumption. Low drift loss means lower water consumption. See *Guidance* on **Type tests/production tests** for more information on drift loss. See **Fill and drift eliminators** for materials.

Distribution system

Counterflow towers: Distribute water through non-clog nozzles fitted to a spray tree arranged for complete wetting of the fill. Fabricate spray tree from PVC-U with branch pipes readily removable from pipe headers.

Spray nozzles: EVAPCO zero-maintenance precision moulded ABS with 32 mm diameter orifice threaded into branch piping. Provide an internal sludge ring to prevent clogging.

Crossflow towers: Provide either a gravity type perforated hot water basin with anti-splash devices or balancing valves with nozzle distribution system. Provide removable covers with stainless steel hardware for exposed hot water basins.

2.6 CLOSED CIRCUIT COOLERS

Delete this clause if, as is normally the case, there are no closed circuit coolers.

Induced draft closed circuit coolers are prohibited by BCA Table J5.12.

General

Selection: Provide EVAPCO products as follows:

- Closed circuit coolers: ATWB, eco-ATWB, eco-ATWB-H, ESW4.

Coil sections

General: Design for low pressure drop. Provide headers and pipe connection stubs of the same material as the coil. Extend stubs at least 100 mm outside the enclosure through openings grommeted airtight around the stubs.

Closed circuit coolers: Provide air vent. Arrange coils and headers with sloping tubes to drain water fully. Pressure test to 2.7 MPa under water.

Heat transfer coil: Provide elliptical tubes with internal tube surface enhanced for greater heat transfer.

Coil materials:

- Steel coil: Pipe to EN 10216-1, hot-dip galvanized after fabrication.
- Copper coil: Pipe to AS 1571 or ASTM B68/B68M, with brazed joints.
- Stainless steel coil: Type 304 or 316.

Water system

General: Distribute water evenly through non-clog nozzles fitted to a spray tree arranged for complete wetting of the coil. Fabricate spray tree from PVC-U with branch pipes readily removable from pipe headers. Make sure pipe bends are covered by the spray. Connect pump discharge to spray tree

headers by pipes grommeted and electrolytically insulated at casing penetrations. Electrolytically insulate joints in dissimilar pipe materials.

Arrangement: Arrange nozzles and spray system so they are not exposed to sunlight. Screw nozzles directly into the spray system. Do not use rubber grommets to hold them in place.

Spray pumps

General: Conform to *0714 Mechanical pumps*.

If sold as a package, it is usually not necessary to specify the pump performance. If a schedule is required, refer to **Schedules** in *0714 Mechanical pumps* for guidance.

Energy efficiency: Conform to BCA J5.7.

Construction: Close-coupled centrifugal pump fitted with mechanical seal and piped to the suction strainer and the water distribution system.

Materials: Cast iron or bronze casing with zinc-free bronze impeller keyed to a stainless steel shaft.

Motor: Totally enclosed.

- Degree of protection: IP55.

Mounting: Vertically mounted with flooded suction and free draining into the basin.

EVAPORATIVE CONDENSORS

General

Requirement: Conform to **CLOSED CIRCUIT COOLERS** and the following:

- Coils: Copper to AS 1571 or ASTM B68/B68M, with brazed joints.

Subcooling coils: Provide a subcooling coil, with surface area at least 10% of that of the condensing coil. Locate the subcooling coil in the entering side of the condensing coil.

If evaporative condensers are required include this *Optional* style text by changing to *Normal* style text.

Include the degree of subcooling required at the coil outlet in **SELECTIONS**.

2.7 HYBRID COOLERS

General

This clause deals with hybrid devices that reduce the temperature of water through a combination of non-wetted finned coils and evaporative pre-cooling. During low ambient and part load operation, the cooler operates by sensible cooling only but at higher loads and ambient pre-cooling by evaporation reduces the temperature of the air entering the coil.

Hybrid coolers reduce water consumption compared to conventional cooling towers because no water is used at low load and part load.

Selection: Provide EVAPCO products as follows:

- Hybrid coolers: eco-Air V-series Adiabatic.

Requirement: Conform to **COOLING TOWERS** and the following.

Type: Condenser water cooler consisting of an extended surface plate fin coil with automatically controlled evaporative pre-cooler on the coil air entering side, induced draft fans and casing.

Access: Arrange coils and casing so that both sides of coils, pre-cooler and fans are readily accessible for inspection and cleaning.

Coils

Requirement: Conform to *0733 Air coils*, except as follows:

- Dry heat transfer coil: Construct of 16 mm diameter round copper tubing with carbon steel connections and aluminium alloy 5005 fins spaced 2.5 mm apart. Hydraulically expand tubes into the fin plate for consistent contact. Pressure test coil to 1.2 MPa. Conform to the strength requirements of ASME/ANSI B31.5.
- Evaporative heat transfer coil: Provide prime surface steel elliptical tubes with internal tube surface enhanced for greater heat transfer. Encase in a steel framework and hot-dip galvanise entire assembly after fabrication. Provide all coil rows with extended surface fins and sloping tubes for liquid drainage. Pressure test to 2.7 MPa using air under water. Conform to the strength requirements of ASME/ANSI B31.5.

Circuiting: Pipe dry heat transfer coil in series with the evaporative heat transfer coil and design both to carry the full unit flow.

Pre-cooler

General: Provide a pre-cooler consisting of non-metallic evaporative cooling pads, with stainless steel or plastic water distribution system and water circulation pump. Conform to **WATER DISTRIBUTION SYSTEM.**

Pre-cooling pads: Conform to **Fill and drift eliminators**.

Pump

General: Conform to *0714 Mechanical pumps*.

If sold as a package, it is usually not necessary to specify the pump performance. If a schedule is required, refer to **Schedules** in *0714 Mechanical pumps* for guidance.

Construction: Close-coupled centrifugal pump fitted with mechanical seal and piped to the suction strainer and the water distribution system.

Materials: Cast iron or bronze casing with zinc-free bronze impeller keyed to a stainless steel shaft.

Motor: Totally enclosed.

- Degree of protection: IP55.

Mounting: Vertically mounted with flooded suction and free draining into the basin.

Controls

General: Provide automatic controls to perform the following functions:

- Control the pump to maintain condenser water leaving temperature.

More detailed control requirements may need to be specified to meet chiller manufacturer's recommendations.

- Dump water from the system daily or to meet water quality requirements.

2.8 FANS

Construction and installation

Refer to *0731 Fans* for more information. Fan materials may be documented in the **Cooling tower schedule**.

Requirement: Conform to *0731 Fans* except as varied by this clause.

Energy efficiency: Conform to BCA J5.12.

Centrifugal fans: Conform to **CENTRIFUGAL FANS - GENERAL PURPOSE** in *0731 Fans* with forward curved impellers hot-dip galvanized after construction.

Axial flow fans: Conform to **AXIAL FLOW FANS** in *0731 Fans*, high efficiency aerofoil type with aluminium wide chord blade construction.

Balancing

General: Static and dynamically balance rotating equipment.

Shaft

Material: Mild steel shaft protected by factory applied zinc rich coating to shaft and bushings.

Guards

Axial flow fans: Provide a mesh guard over the fan discharge. Allow for tachometer insertion.

Centrifugal fans: Provide a mesh guard over the fan inlet.

Guard material:

- Stainless steel towers: Stainless steel guards.
- Galvanized steel towers: Provide hot-dip galvanized steel guards.

Drive

Belt drive: V-belt belt drive consisting of a matched set of at least 2 belts, capable of transmitting 150% of the motor starting torque. Provide pulleys with machined grooves and shaft keys or taper lock bushes. Permanently mark belt size in a prominent location next to the drive.

Horizontal belt drives should be avoided as they sometimes throw belts.

Belt tensioning equipment: Provide adjustment of belt drive tension by movement of the motor on slide rails or by pivoting support. Do not use the weight of the motor to provide belt tension. Restrain the motor with locknuts on bolts used to clamp the motor in place.

Drive guards: Provide demountable guards to external drives to completely enclose the drive and exposed shafts. Allow for tachometer insertion.

Pulleys: Aluminium, steel or cast iron with epoxy paint finish, taper-lock bush and stainless steel hardware.

Pulleys may also be nylon or cast aluminium.

Fan bearings

General: Sealed type or grease-lubricated, as applicable, self-aligning, ball or roller bearings. For lubricated bearings, make provision for grease relief and extend lubrication lines to outside of tower.

Contractor to select or specify required type, e.g. sealed for smaller units or units in damp hot air streams.

Design life: Minimum L-10 life of 100,000 hours.

Fan stacks

General: Smoothly contoured with minimum fan blade tip clearance.

Motors

Requirement: Conform to the following:

- Degree of protection: IP55 minimum.
- Shaft: Mild steel protected by factory applied zinc rich coating.
- Cable entry: Into conduit box from below.
- External finish: Epoxy paint.

Motors exposed to moist air stream are vulnerable to corrosion, particularly end covers so additional corrosion protection is required. Aluminium casings are not immune to this problem.

Consider specifying motors mounted outside the airstream.

- Efficiency: High efficiency to IEC 60034-30-1 efficiency class IE3 and suitable for variable speed drive.
- Motor insulation: Thermal class 155 (F) to IEC 60085.

2.9 ACCESS AND CLEANING PROVISIONS

General

Consider requirement for stand-by units. Also consider field erected tower options, e.g. plenum walkway, handrail system, ladder, stair, fan stack, fan deck.

AS/NZS 3666.1 includes many provisions that bear on cleaning and maintenance. See, for example, clause 4.2 which requires that the start sequence of duty/stand-by pumps alternate automatically. The recommended frequency is twice weekly.

Make sure drawings show reasonable means for safe access, for example, to remove a large fan motor from the top of the tower. Note also that statutory restrictions may exist on the use of vertical ladders.

Requirement: Provide smooth easily cleaned surfaces on the inside of the casing. Provide facilities for inspection, cleaning and removal of the fill, drift eliminators, water distribution system and other wetted components. Arrange the position of the cooling tower and piping to permit this.

Multi-cell towers: Do not provide cooling towers that depend on passage through active cells to access other cells.

Equipment requiring routine service and maintenance includes:

- Control equipment.
- Drift eliminators and fill.
- Fans, motors, bearings and drive including belts.
- Internal spray nozzles.
- Hot decks.
- Valves for flow adjustment.
- Pump/line strainer.
- Ball float valves.
- Basins.

Access doors and panels

General: Provide watertight and airtight access doors or panels in each cell above the highest water level in the cold water basin. For multiple cell towers, provide doors between cells which are opening from each side.

Consider specifying minimum size.

Ladders
General: If cooling plant equipment requiring services and maintenance is located 2400 mm or higher above the floor level, provide access ladders and platforms to AS 1657.

Internal walkways
Crossflow cooling towers: Provide a slip-resistant internal walkway to AS 1657 above the maximum water level in the cold water basin, extending the full length of the tower between end walls. Provide access to the basin from the walkway.

Dead legs
General: Arrange the cooling towers and piping so that all parts can be drained and flushed. Provide additional full way drain valves and flushing facilities so that balance/equalising lines between towers can be drained and flushed.

2.10 CAPACITY CONTROL

Check with manufacturer for available methods.

Method
Requirement: Provide capacity control as documented.

Motor control: Two-speed or variable speed drive.

Fan cycling: Temperature controlled or as documented.

Fan discharge dampers: If documented, provide dampers as follows:

These apply to forced draft towers with centrifugal fans.

- Requirement: Provide dampers for fan capacity control of forced draft towers with centrifugal fans. Locate dampers in the discharge of the fan housing.

Fan dampers, located where noted, are out of the wet air stream. Specify the type of damper control required.

- Damper type: Single aerofoil blade.
- Materials: Use the same material as the casing, securely clamped to a type 316 stainless steel shaft supported by sintered bronze bearings.

3 EXECUTION

3.1 GENERAL

Piping
Connections: Support connected piping independently of the cooling tower, so it does not exert load on the cooling tower connections.

Piping layout: Arrange piping so the cooling tower can be fully drained, and piping cannot become air locked. If piping serves multiple cells or cooling towers, arrange symmetrically to make sure water flow rate to each is equal.

Airflow
Clearances: Locate the cooling tower no closer than manufacturer's recommended clearances from adjacent objects including walls, other cooling towers and equipment, and so that turbulence caused by wind flowing over adjacent objects does not affect air flow into or out of the cooling tower. Make sure discharge is clear and adjacent objects do not cause air to recirculate to air intakes.

Provisions: If necessary to achieve the above, provide discharge hoods or raise cooling towers.

Water treatment
Requirement: To *0753 Water treatment*.

0753 Water treatment contains related execution requirements including passivation of galvanized steel cooling towers.

Bleed control: Provide an automated conductivity controller to control bleed.

3.2 MOUNTING BASES AND FRAMES

General
Requirement: Mount equipment on bases or frames designed to support the assembly under starting and operating conditions without incurring undue distortion, stress or fatigue. Provide holding down bolts.

Steel components: Hot-dip galvanize after fabrication.

Vibration isolating mountings

General: Prevent vibration from cooling towers from being transmitted to the structure. Provide either:

- Vibration isolation for the fans and motors. Level the tower, shim or grout and fix to the structure.
- Provide a rigid supporting frame under the tower and vibration isolating mountings between the frame and structure.

If the tower is mounted directly on the anti-vibration mounts the tower may flex over time causing seams to split and the tower to leak or crack.

Corrosion protection: As for **Hardware for non-wetted parts** for the respective tower type and corrosion class.

See **Hardware for non-wetted parts** in the respective tower type in **Cooling tower construction**.

Access for maintenance

Requirement: Conform to **ACCESS FOR MAINTENANCE** in *0171 General requirements*.

3.3 DISCHARGE PLENUM

General

Location: Provide a discharge plenum on the top of the unit for the connection of ductwork as documented.

Construction: Conform to *0741 Ductwork*.

3.4 SOUND ATTENUATORS

General

Requirement: To *0745 Attenuators and acoustic louvres* except as follows.

Selection: Provide EVAPCO supplied sound attenuators.

Infill: Seal water-tight to *0745 Attenuators and acoustic louvres* **Infill sealing.**

Casing and infill facing:

- Galvanised steel cooling towers: Galvanised steel.
- Stainless steel cooling towers: Stainless steel.

3.5 COMPLETION

General

Distribution system: Make sure of the spread of water is even over the fill.

Sump water level: Adjust to manufacturer's recommendations and so that no water is lost when the tower shuts down.

4 SELECTIONS

Schedules are a way of documenting a selection of proprietary or generic products or systems by their properties. Indicate their locations here and/or on the drawings. Refer to NATSPEC TECHnote GEN 024 for guidance on using and editing schedules.

4.1 COOLING TOWERS

EVAPCO cooling tower schedule

Property	CT1	CT2	CT3
EVAPCO model series			
Type			
Flow type			
Cooling tower construction			
Minimum heat rejection (kW)			
Number of cells			
Entering water (°C)			
Leaving water (°C)			
Entering air wet bulb (°C)			

Property	CT1	CT2	CT3
Maximum water flow rate (all cells combined) (L/s)			
Minimum water flow rate (% maximum flow)			
Minimum air flow (L/s)			
External fan static pressure (Pa) at minimum air flow			
Maximum water side pressure drop including static lift (kPa)			
Mechanical draft type			
Fan type			
Fan construction			
Number of fans per cell			
Fan motor minimum (kW)			
High efficiency motor required			
Maximum sound pressure level measured to CTI ATC-128 with 100% fan speed and 100% water flow at 1.5 m horizontally at any point around tower (in free field):			
- 63 Hz			
- 125 Hz			
- 250 Hz			
- 500 Hz			
- 1000 Hz			
- 2000 Hz			
- 4000 Hz			
- 8000 Hz			
Vibration mounting type			
Minimum static deflection			

CT1, CT2, CT3: These designate each instance or type or location of the item scheduled.

Edit codes in the **Schedule** to match those on drawings.

Prefabricated cooling towers are, by definition, of standard proprietary design and manufacture. Therefore much of the detailed information required for preparing this schedule will normally be supplied by the manufacturer in the precontract period.

Type: e.g. Cooling tower; Evaporative condenser; Closed circuit cooler.

Flow type: e.g. counterflow, crossflow or parallel flow (the latter is a non-mechanical tower).

Cooling tower construction: As construction of EVAPCO towers is determined by the EVAPCO model this row may be deleted except when options are required. e.g. EVAPCO AT towers have galvanised constriction while USS towers are the same towers in stainless steel. EVAPCO offer stainless steel basins with galvanised steel in which case list in this row. Louvres and splash guards are available in PVC-U, type 304 or 316 stainless steel.

Minimum heat rejection: Make sure circulating water flow and temperature requirements match those of interconnected equipment, e.g. chiller condenser water heat rejection, and pump kW input energy.

Entering air wet bulb (°C): Take account of wind effects, other equipment, adjacent buildings and the like. These will tend to elevate the cooling tower entering air wet-bulb above that used for space cooling load calculations. The increase in entering air

wet bulb should be estimated but as a guide might be taken as air conditioning load design wet bulb plus 1°C. For example, if the air conditioning load has been calculated on 23ºC wet bulb specify 24ºC wet bulb for the tower. This will produce a larger tower but will lower the energy consumption of the refrigeration plant and reduce the risk of high head pressure shut down on extreme days. A high wet-bulb temperature may mean that test conditions can be achieved on only a few occasions during the year, as a variation of only ± 5°C is allowed.

External fan static pressure (Pa) at minimum air flow: If the cooling tower has a ducted inlet or discharge or if there is another source of external resistance (e.g. noise attenuation) include the fan external static pressure at an assumed air flow rate. External resistance may necessitate non-standard fans and motors or de-rating of the tower.

Mechanical draft type: e.g. forced or induced.

Fan type: e.g. centrifugal, axial flow.

Fan materials: Include relevant materials e.g.:

- For centrifugal fans: Scroll material (e.g. stainless steel, galvanized), Impeller material (e.g. stainless steel or galvanized steel) and shaft material (usually stainless steel).
- Axial flow fans: See *0731 Fans* for options.

Fan motor minimum (kW): Make sure of conformity to BCA J5.12.

High efficiency motor required: Yes or no. See also *0784 Motors and starters*. Check availability with cooling tower manufacturers before specifying.

For Class 2 to 9 buildings, BCA J5.12 sets maximum energy consumption for cooling tower fans.

Maximum sound pressure level measured to CTI ATC-128 with 100% fan speed and 100% water flow at 1.5 m horizontally at any point around tower (in free field): See AS/NZS 2107 for recommended design sound levels for building interiors. Note that the schedule provides for one commonly used format for specifying noise levels and may require adjustment to suit available data and site conditions. Other data available includes sound level in dB(A) from top and/or side. Consider including requirements for sound attenuator insertion loss (if used) but the values scheduled are usually more effective.

Adapting the Cooling tower schedule for design and construct projects

If the contractor is to calculate the required performance and to select the equipment, the **SELECTIONS** schedules can be used to set generic selection parameters. Note that the documents should include sufficient information for items to be determined by the contractor, for example from documented performance parameters and drawing information. For these items, insert suitable text such as *To the documented requirements*. The **Cooling tower schedule** can then form the basis of the contractor's submissions with the text replaced by design values:

- Minimum heat rejection (kW).
- Number of cells.
- Maximum water flow rate (all cells combined) (L/s).
- Minimum air flow (L/s).
- External fan static pressure (Pa) at minimum air flow.
- Maximum water side pressure drop including static lift (kPa).
- Number of fans per cell.
- Fan motor minimum (kW).
- Maximum sound pressure level measured at 1.5 m horizontally at any point around tower (in free field) and following rows.
- Vibration mounting type.
- Minimum static deflection.

REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS ISO 7		Pipe threads where pressure-tight joints are made on the threads
AS ISO 7.1	2008	Dimensions, tolerances and designation
AS/NZS 1170		Structural design actions
AS 1210	2010	Pressure vessels
AS 1397	2021	Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium
AS 1571	2020	Copper - Seamless tubes for air-conditioning and refrigeration
AS 1657	2018	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 1910	2004	Water supply - Float control valves for use in hot and cold water
AS 2129	2000	Flanges for pipes, valves and fittings
AS 2971	2007	Serially produced pressure vessels
AS/NZS 3500		Plumbing and drainage
AS/NZS 3500.1	2018	Water services
AS/NZS 3666		Air-handling and water systems of buildings - Microbial control
AS/NZS 3666.1	2011	Design, installation and commissioning
AS/NZS 3750		Paints for steel structures
AS/NZS 3750.9	2009	Organic zinc-rich primer

AS/NZS 4020	2018	Testing of products for use in contact with drinking water
AS 4312	2019	Atmospheric corrosivity zones in Australia
AS/NZS 4680	2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS 5149		Refrigerating systems and heat pumps - Safety and environmental requirements
AS/NZS 5149.1	2016	Definitions, classification and selection criteria (ISO 5149-1:2014, MOD)
AS/NZS 5149.2	2016	Design, construction, testing, marking and documentation (ISO 5149-2:2014, MOD)
AS/NZS 5149.3	2016	Installation site (ISO 5149-3:2014)
AS/NZS 5149.4	2016	Operations, maintenance, repair and recovery (ISO 5149-4:2014, MOD)
SA/SNZ HB 32	1995	Control of microbial growth in air-handling and water systems of buildings
BCA J5.7	2019	Energy efficiency - Air-conditioning and ventilation systems - Pump systems
BCA J5.12	2019	Energy efficiency - Air-conditioning and ventilation systems - Heat rejection equipment
ASME/ANSI B31.5	2019	Refrigeration Piping and Heat Transfer Components
ASTM A240/A240M	2020	Standard specification for chromium and chromium-nickel stainless steel plate, sheet and strip for pressure vessels and for general applications
ASTM B68/B68M	2019	Standard Specification for Seamless Copper Tube, Bright Annealed
CTI ATC-105	2019	Acceptance Test Code for Water Cooling Towers
CTI ATC-128	2014	Code for the measurement of sound from water cooling towers
CTI STD-201 RS	2017	Performance rating of evaporative heat rejection equipment
FM 4930	2013	Approval Standard for Cooling Towers
EN 10216		Seamless steel tubes for pressure purposes. Technical delivery conditions.
EN 10216-1	2013	Non-alloy steel tubes with specified room temperature properties
IEC 60034-30-1	2014	Rotating electrical machines - Efficiency classes of line operated AC motors (IE code)
IEC 60085	2007	Electrical insulation - Thermal evaluation and designation
The following documents are mentioned only in the *Guidance* text:		
AS/NZS 2107	2016	Acoustics - Recommended design sound levels and reverberation times for building interiors
AS/NZS 3666		Air-handling and water systems of buildings - Microbial control
AS/NZS 3666.2	2011	Operation and maintenance
AS/NZS 3666.3	2011	Performance-based maintenance of cooling water systems
AS 4180		Measurement of drift loss from cooling towers
AS 4180.1	2008	Chloride balance method
AS 4180.2	2008	Lost chloride method
AIRAH DA17	2014	Cooling towers
AIRAH DA18	1998	Water treatment
AIRAH DA19	2019	HVAC&R maintenance
BCA Table J5.12	2019	Energy efficiency - Air-conditioning and ventilation systems - Heat rejection equipment - Maximum fan motor power - Cooling towers, closed circuit coolers and evaporative condensers
NATSPEC DES 010	2020	Atmospheric corrosivity categories for ferrous products
NATSPEC DES 022	2014	Microbial control
NATSPEC GEN 006	2015	Product specifying and substitution
NATSPEC GEN 024	2019	Using NATSPEC selections schedules
NATSPEC PRO 007	2017	Refrigerant options
NATSPEC TR 01	2019	Specifying ESD
NATSPEC TR 03	2018	Specifying design and construct for mechanical services
PCA	2019	National Construction Code Series Volume 3 - Plumbing Code of Australia
ASTM E84	2021	Standard Test Method for Surface Burning Characteristics of Building Materials
CTI ATC-140	2011	Isokinetic drift test code
ISO 5149 series		Refrigeration systems and heat pumps - Safety and environmental requirements