RECOMMENDED SPECIFICATION MEE HEAT PUMPS.
(More Energy Efficient) Update 1-6-2018
Also see Warranty Conditions

GENERAL

The Heat Pump is to have enough capacity to maintain the specified pool water temperature at the conditions nominated, and sufficient flexibility to control the pool water temperature at varying ambient temperatures. Generally the system is to be sized at an appropriate low Ambient and at a reduced run time Eg Power available 24 Hours but sized at 20 hours (up to 28C) or 18 Hours for higher temperatures. This allows a reserve in the case of low ambients or recovery from downtime.

The self-contained unit or units are to be specifically designed for Pool Heating applications, factory assembled, evacuated, pressure tested and charged with the correct operating charge of refrigerant and oil. Split systems will be considered provided full details of the design and installation method are provided with the tender.

The heat pump shall consist of all new components and shall be packaged to arrive on site in an unmarked condition.

Refrigerant is to be R-407C.

Heat exchangers and general refrigeration components including the compressors are to be in an insulated cavity.

Under no circumstances are these components to be placed in the same cavity as the fans and evaporators and are not to be in the air stream. The Refrigeration circuit to have fans and coils in a separate designated plenum,

The contractor is to provide a full specification and details of the More Energy Efficient (MEE) heat pump and indicate guaranteed performance for COP at the varying ambient conditions and pool temperatures as required. Unit noise levels shown as sound pressure dB(A) at are to be provided. Sound reduction details required are as per the works specification.

SYSTEM SIZING.

Heat Pumps are to be sized by using internationally recognised and accurate sizing methods. The correct method of sizing a pool heating system and expected running costs is by using the formula below. The contractor will be required to demonstrate the use of this formula for various ambient conditions, specific wind velocities and various relative humidity conditions.

In addition the contractor will be required to provide and adjust for compressor performance at lower ambient conditions as required.

The contractor is required to demonstrate fully the calculations used and the compressor performance at predicted refrigeration parameters as per the design condition.

Sizing pool heating systems by using pool volume only and heat up formulas is inaccurate and unreliable, commercially available pool heating programmes also work on averages. In today's demanding and performance based market these methods are considered unacceptable and are not to be used as the final method of calculation.

The formula below is based on years of research from 'Swimming Pool Heating by Solar Energy' CSIRO Division of Mechanical Engineers and will be the only method of sizing the heat pumps for this project, failure to comply with and provide the required sizing data will render the tender offer as non-conforming.

CALCULATION OF POOL HEATING LOAD

The pool heating load is the total heat loss by the three mechanisms described below, less any heat gain from incident solar radiation. Solarwise has a computer program based on these formulas to quickly calculate heat losses. This coupled with Solarwise's vast experience ensures an accurate outcome.

$Q = A_p (q_e + q_r + q_c - q_s)$

Where

Q = net heat loss rate for the pool (MJ/d)

A_p = pool water surface are (m^2)

q_e = rate of heat loss by evaporation (MJ/m^2.d)—(1)

q_r = rate of heat loss by long wave radiation (MJ/m2.d)—(2)

q_c = rate of heat loss by conduction (MJ/m^2.d). –(3)

q_s = rate of heat gain from solar radiation (MJ/m^2.d)—(4)

(1) EVAPORATION HEAT LOSS – On average evaporation heat loss is the largest loss component and is given by

$q_e = 1.41(3.1 + 4.1V)(P_w - P_a)$

where

q_e = rate of heat loss by evaporation (MJ/m^2.d)

P_w = saturation water vapour pressure at water temperature (t_w) (kPa)

P_a = partial water vapour pressure in the air (kPa)

V = wind velocity at a height of 0.3 m over the pool (m/s).

(2) RADIATION HEAT LOSS Radiation heat loss may be calculated by means of the following simplified equation.

$q_r = 0.082 h_r(t_w - t_s)$

where

q_r = rate of heat loss by long wave radiation (MJ/m2.d)

h_r = radiation – heat transfer coefficient (W/m2.K)

t_w = water temperature (ºC)

t_s = sky temperature (ºC)

(3) CONVECTION HEAT LOSS Heat loss due to convection to the ambient air (for an enclosed pool the room air) is given by:

$q_c = 0.086(3.1 + 4.1\ V)(t_w - t_a)$

where

q_c = rate of heat transfer by convection (MJ/m².d)

V = wind velocity at a height of 0.3 m over the pool (m/s).

t_w = water temperature (ºC)

t_a = air temperature (ºC)

(4) SOLAR RADIATION HEAT GAIN Heat gain due to the absorption of solar radiation by the pool is given by

$q_s = \alpha\ q_{solar}$

where

q_s = rate of heat gain by the pool (MJ/m².d)

α = absorption factor

= 0.85 for light coloured pools

= 0.90 for dark coloured pools.

q_{solar} = rate of incidence of solar radiation (MJ/m².d)

1.1 CONSTRUCTION.

1.1.1 CABINET

The external case, the top and the base shall be 304 Stainless Steel The internal frame and compressor supports shall be 304 grade stainless steel R.H.S. To facilitate rigging and to maintain clearance above the concrete slab, the base shall be supported on 50mm stainless steel feet. This is also to ensure the casing is not in direct contact with the ground or supports. The frame and feet shall be welded or suitably fixed to the frame. All sheet metal panels, decking, brackets, angles, baffles, etc are to be 304 grade stainless steel. All to be insulated where required to reduce noise and condensation. All fixings for panels, brackets, etc are to be secured by stainless steel screws or rivets. **The Stainless Steel case shall be warranted against defects for a minimum period of five years, if a service contract is entered into before the term of the defects liability period then a 15 Years parts warranty will only apply while the unit continues to be serviced by Solarwise or an approved Solarwise service agent. A labour warranty of 5 years is also to be provided. Warranty document for conditions of service to be made available with the tender.**

316 Stainless Steel case can be provided or will be provided when specified. 316 is generally an unnecessary expense as we have many 304 S/Steel units in the market between 12 to 20 years old.

1.1.2 ACCESS DOORS

For commercial use the access doors to the switchboard and to the body of the unit where components such as heat exchangers and refrigerant lines are contained shall be held in position by stainless steel screws or bolts, for basic security and safety, requiring a screw driver or spanner to open them.
Each door is insulated.

1.1.3 CONDENSATE TRAY

All condensate trays shall be 304 (or 316) Stainless Steel. Drains are to be welded to the unit to allow removal of condensate and rainwater. Suitable waste will need to be installed by the contractor. Great care needs to be taken to ensure the unit drains correctly.

1.1.4 ELECTRICAL SWITCHBOARD

The electrical should be positioned in a specially designated section with a unit with 3 or more compressors to have a separate switchboard. The surrounding panels shall be insulated in such a way as to prevent condensation forming inside the electrical section and adequate ventilation shall be included to prevent condensation.

1.1.5 COMPRESSORS.

The compressors shall be Copeland scroll compressors (or equivalent) suitable for heat pump application. Each compressor shall operate independently of other compressors. Compressors along with liquid receivers and Suction Accumulators and solenoid valves are to be installed in a cabinet separate to the evaporator air stream to minimise corrosion or restriction of the air stream.
Inclusions shall be:

- Suction and discharge service valves on Scroll Compressors and Liquid Receivers..
- Suction accumulator.
- Liquid Receiver. (Twin liquid receivers or one two dip tube receiver will be required for Heat and Chill units.)
- Crank Quality Emerson Case Heaters to be included for each compressor and for Liquid receivers in Heat and Chill units to prevent liquid migration.
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PARTS AND LABOUR ON THE **MEE UNIT)** UNIT COMPRESSOR IS 2 YEARS- The digital defrost method is used further controlling the compressor in the safe envelope of operation the compressor will have a five year parts warranty. A labour warranty of two years will also apply.

Because the MEE Model uses pressure transducers to control the EC (Electronically Commutated) Fan than an extra LABOUR WARRANTY TO THREE (3) YEARS APPLIES ON THE COMPRESSOR AS WELL AS THE 5 YEARS PARTS WARRANTY.
COMPRESSOR WARRANTY – Exclusive to the MEE 5 years Parts- 3 Years Labour.

1.2 HEAT EXCHANGERS

1.2.1 CONDENSERS

The heat exchanger/s shall be a 99% pure Titanium coaxial design inner tube with a Polyethylene Outer Case and Nylon ends. **The Heat exchanger case is required to be able to stand in excess of 300kPa at 30 Celsius. This is only provided by the MEE.**
Cupra- Nickel, Titanium alloy or non coaxial design inner tubes will not be accepted.
PVC cases are not to be used as they will only stand 120Pa at 30 Celsius.
A Binda type fitting shall be fitted on the water inlet and outlet for testing purpose and venting/evacuating air at start-up. The unit shall have a flow switch installed in the unit or external to the unit to override the unit in periods of no flow. **The Condenser heat exchanger shall be warranted for a minimum period of fifteen years for Titanium and exclusively five years on the outer case, a minimum of 5 years labour warranty is to be provided. This warranty is conditional on that a Solarwise approved service contract is entered into before the finalisation of the defects liability period. The warranty on the titanium heat exchanger and outer heat exchange case are covered under a full range of chemical conditions outlined in the Australian Standard AS3633—1989" Private Swimming Pools Water Quality".** The warranty will only apply while the unit continues to be serviced by Solarwise or an approved Solarwise service agent.

The Heat Exchangers are not be installed in the Evaporator Air Stream so heat losses, corrosion and air restriction are avoided. The Heat Exchangers should be installed in a separate insulated cabinet to the Evaporator Air Stream.

All water plumbing pipe work for the heat exchangers is to be plumbed in a reverse return manner. **All water plumbing pipe work is to be warranted for six years parts and labour.**
The Heat Exchangers are to be set-up so that the outer case can be removed if failure of the filtration laterals causes fowling of the Heat Exchangers. This is only provided by the MEE,

1.2.2 EVAPORATORS

Mechanically bonded aluminium fins on copper tube. **Evaporators shall have an epoxy coated coil for superior protection to preserve fins and prevent oxidizing.** Proprietary paints are unacceptable. Full conditions of the treatment are to be provided. Evaporator coils shall be four rows deep and 12 fins per inch using internally enhanced tubing and purpose designed for the application and duty requirement. Evaporator de-icing will be by direct digital sensing Hot gas defrost, being activated according to de-ice controller requirements. The Evaporator Air Stream should be left unrestricted expect for Electronic TX Valves that are installed close to the evaporator in good refrigeration practice.

Compressors along with Liquid Receivers, Heat Exchanger, Suction Accumulators and reversing valves are to be installed in a cabinet separate to the evaporator air stream to minimise corrosion or restriction of the air stream. **Evaporator Coils are to be warranted for a minimum of five years parts and 3 years labour.** The warranty will only apply while the unit continues to be serviced by Solarwise or an approved Solarwise service agent. The Evaporator coils are to be installed in a separate plenum with the fans for each refrigeration circuit. **With top discharge fans the coil height is to be no more than a one metre** to ensure reliable air flow across the coil to reduce premature icing and to maximize performance.
Coil guards can be provided as an optional extra.

1.3 REFRIGERANT CONTROLS/PIPING

A Special Emmerson digital thermostat constant test hot gas defrost system is to be used so as to allow the compressor to operate within a safe working envelope, the use of basic hot gas by-pass or other defrost methods are unacceptable and will render the submitted tender as non-compliant. The Defrost Thermostat is a Dixell XR60CX. The Thermostat checks for defrost every 4 hours and if the coil is below -5 degrees Celsius it will initiate a defrost. All refrigerant piping shall be silver/alloy brazed and evacuated to a minimum of 500mu vacuum. Hot gas by-pass can be used in warmer or tropical climates as defrost is intermittent or unlikely. In Heat and Chill units twin liquid receivers, crank case heaters and reversing valves are use for de-icing and balancing the refrigerant from heating to chilling and vice versa.

Piping shall be bracketed to prevent vibration and damage. All pipe work to be insulated where necessary, particularly suction and discharge piping to enhance the heat pump performance and avoid condensation.

1.4 EVAPORATOR FANS

EC (Electronically Commutated) fans with brushless DC motors **and pressure transducers** to control the fans at varying evaporating pressure levels are to be used. An EC fan is a brushless, permanent magnet, synchronous motor with electronic commutation. Fans and motors shall be selected specifically for the duty required with due regard to vibration and noise. Provide fan guards to prevent personal injury. Fans are to be corrosive resistant made from pressed aluminium sheet. The fans are to be axial external rotar type with 5 sickle blades. All materials shall be selected for the corrosive environments and be suitably treated to resist any deterioration. **Evaporator fans and motors are to be warranted for parts for a period of five 5 years and Labour two (2) years.** The warranty will only apply while the unit continues to be serviced by Solarwise or an approved Solarwise service agent.

1.5 ELECTRICAL AND CONTROLS

All controls to be 240 volt. The control system shall include as a minimum:

- Manual reset HP/Circuit.
- Auto reset LP/Circuit
- Electronic thermostat mounted on the cabinet exterior, with a readily viewable Dixell XR30CX digital read-out and with touch-pad type temperature adjustments. A high limit setting on the thermostat shall avoid unauthorized high water temperatures. Thermostat to have decimal point readout and adjustment for temperature and differentials.
- Pressure Transducer on the suction side of each compressor to controls its own fans.
- Sporlan Kelvin 11 controller and pressure Transducer on each Compressor suction to control the Sporlan Electronic TX valve Superheat on each refrigeration circuit.
- Compressors shall start at 15 to 60 second intervals by means of adjustable timers. All compressors de-energise simultaneously.
- Each compressor shall have independent lockout.
- Flow switch (Pressure switch in smaller units), located in either the leaving water pipe to prevent compressors operating due to lack of flow. As an option a flow meter can be chosen for this purpose.

- **The Three Phase units will be fitted as standard with Phase Failure relays.**
- Indicator lights shall be provided, mounted on the cabinet exterior and in clear view, for:

⇒ Power on
⇒ Recommended Commercially:-
⇒ Water flow
⇒ Compressor fault (per compressor)
⇒ Compressor circuit breakers.

Electrical (INCLUDING CAPACITORS-Not used in 3 Phase units) and controls are to be warranted for parts and labour for a period of 1 year.
The units can be set up with Modbus controls to control turndown of each unit and provide lead/Lag control on each compressor. Further controls can be added to measure water flow and temperature rise and calculate kW output.

1.7. INSTALLATION DETAILS

1.7.1. UNIT POSITIONING

The Unit will need to be positioned giving due consideration to required airflow:

- Units installed indoors will need adequate ventilation and separation of intake and exhaust air. Exhaust duct will need to be designed to ensure that airflow is not restricted so as to reduce the performance of the unit. All ductwork may need to be insulated to reduce air noise and/or condensation. Generally the clearances need to be top 2 metres and 1 metre on all sides. Refer to Solarwise for specific applications.

1.7.2. NOISE AND VIBRATION

- Use equipment, which operates within the required noise and vibration limits. Prevent the transmission of vibration from rotating or reciprocating equipment to other building elements using static and dynamic balancing and anti-vibration mounting supports and hangers.
- Use Vibration eliminators on each circuit,
- Use composite small tube for LP and HP controls to prevent cracking of small diameter tubes.
- Position equipment or select, supply and install sound attenuators to achieve the required noise criteria (if specified) as per the Environmental Protection Regulation 1998.
- Method of measurement. The resulting noise levels shall be checked in accordance with AS2107-1987, Clause 5, for internal building measurements and AS1055.1 for external measurements. Correction to background noise to Table B1 of AS2107-1987.

1.7.3. PIPEWORKS FITTINGS, TYPE SIZES:

- All pipework to be minimum Class 9 UPVC pressure pipe to AS1477 up to 125mm and Class 6 UPVC for 150mm or greater.
- All fittings to be minimum Class 12 UPVC.
- Exterior Pipe size flow and return to the heat pump to ensure water velocity through pipes no greater than 1.80m to 2.00m per second in order to reduce possible pipe noise and pipe erosion. Full details of calculated flow rates will need to be provided.

1.7.4. EXTERNAL PIPEWORK BREAK-IN ISOLATION (return to pool line):

Break-in to the return to pool line is to be by replacement of section of pipe work with UPVC pipe. Alternatively stainless steel tapping saddles can be used. All existing services are to be restored intact. Isolation of the system is to be by two appropriately sized (flow and return pipe size) butterfly valves for pipes sizes of 80mm or greater. Ball valves (straight through variety) can be used for 50mm pipe work or

smaller. Valves to be PVC or PVC coated to reduce corrosion. Suitable pump to have barrel unions or flanges to easily allow removal and service the pump.
All wall pipe work and surface pipe work 80mm or greater to be fixed with Unistrut clamps and channels. Galvanised saddles can be used on pipe work 50mm or smaller. In-Line strainers that are able to be cleaned are recommended to prevent fowling of the water circuits.

1.7.5. SUITABLE PUMP SIZE.

Provide a recommendation for a suitable circulating pump based on desirable flow rate through heat pump relative to calculations of head loss. Pump manufacturer pump flow data to be provided to verify suitability.

1.7.6. CORROSION

a) Ensure that all metal to metal surfaces are sealed with silicon or a similar product.
b) Ensure only corrosion resistant materials are used.
c) Significant use of combinations of different metals will not be acceptable.

1.8. LICENCING.

1.8.1. The contractor has to have the appropriate licence for the State. In Queensland the appropriate License is Refrigeration, Air-conditioning and Mechanical Services **Unlimited Design** via the QBCC. In New South Wales the appropriate Licence is Refrigeration, Air-conditioning and Mechanical Services via the Department of Fair Trading.

1.9. TESTING.

1.9.1. The unit is to be tested and commissioned in the factory and such demonstrations can be witnessed by the client if required. The contractor is to adequately demonstrate on site to ensure the correct water flow, air flow and site positioning allows the unit to perform to specified expectations. The contractor must also demonstrate water flow, temperature rise and unit output on commissioning.
It is recommended that a flow meter be installed to allow suitable calculation of water flow.