E CLASS
EVAPORATIVELY COOLED
Oil-Free Centrifugal Chiller

SMARDT

CONTENTS

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DOCUMENT PURPOSE

This catalogue provides a general overview of Smardt's E Class chiller range, including the key features and options available. It is intended as a general guide for the appropriate selection and application of E Class chiller units.

For specific application information, contact your nearest Smardt sales representative.

The information provided is general in nature, and is subject to change as part of Smardt's commitment to continuous product improvement.

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SMARDT CHILLER GROUP

Smardt is "Global Number One" in oil-free centrifugal chillers, with production facilities in Stuttgart, Germany; Melbourne, Australia; Plattsburgh, New York; Guangzhou, Guangdong and Montreal, Canada. Smardt service networks extend across the globe; they monitor and support the world's largest installed base of oil-free high-efficiency chillers (well over 5000 by the end of 2015). Smardt started a global reputation with the first oil-free centrifugal prototype built in 2002 to help refine Turbocor's compressor technology before its launch in 2003.

Smardt's lowest lifecycle costs make such a major contribution to an owner's long term values that they make chiller first cost differences largely irrelevant.

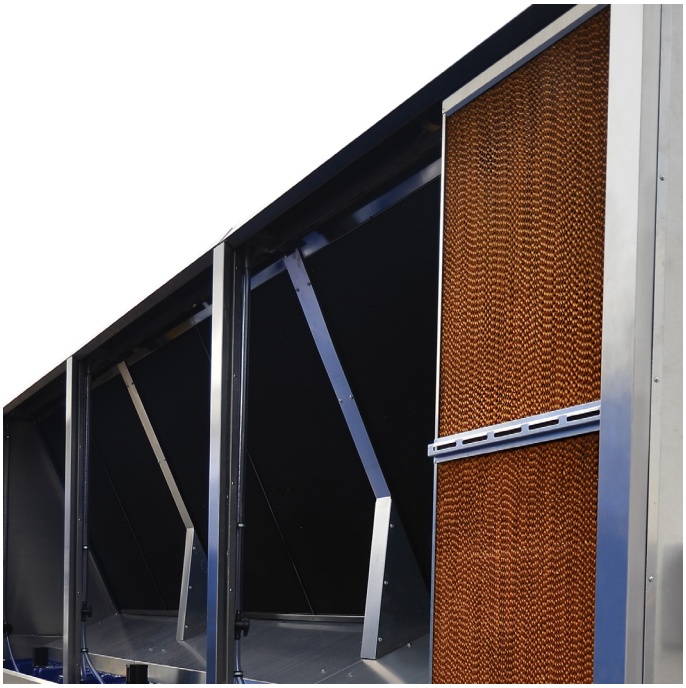
Since 2002, Smardt has built, tested and continually refined the world's widest oil-free chiller range. Water cooled high-efficiency chillers from 200 kW up to over 8 MW, air cooled chillers from 200 kW to 2 MW, adiabatic chillers to over 1 MW, modular, split, condenserless and other variations match a wide range of specific applications. Free cooling (standard coil or thermosyphon) and heat recovery applications are increasingly specified. The Smardt range covers a wide range of non-standard conditions, e.g. in fluids (glycols, brines and others). Increasing focus on low-GWP refrigerants is reflected in installed Smardt chillers in Switzerland and other countries. Smardt innovations have resulted in a number of patents and patent applications.

Unlike all other global chiller brands, Smardt's global innovation programs are wholly dedicated to Smardt customers and the value they earn from their Smardt chillers. In compressors, Smardt has been working closely with Turbocor since 2002 (Smardt founder Roger Richmond-Smith is also a founder of Turbocor), and the two companies continue to share detailed test programs. In heat exchangers, Smardt's research work on metallurgy, corrosion resistance, flow and heat transfer management has led to several patents and patent applications. In systems integration and controls, Smardt software innovations mean major advances in operating efficiencies, effective redundancy and responsiveness. In service support, training, monitoring and continuous commissioning, Smardt programs continue to develop. Seamless optimisation of whole variable speed chiller plants using Smardt chillers shows further major gains in energy efficiency.

SMARDT MARKETS ACHIEVING MAJOR ENERGY REDUCTIONS

- DATA CENTERS (ESPECIALLY BANKING & OTHER FINANCIAL INSTITUTIONS)
- HOSPITALS & HEALTHCARE
- HOTELS
- PROCESS COOLING
- EDUCATIONAL & INSTITUTIONAL CAMPUSES
- CONCERT HALLS & OPERA HOUSES
- MARINE
- LARGE COMMERCIAL BUILDINGS
- DISTRICT COOLING SYSTEMS

E CLASS OVERVIEW



Smardt's range of E Class evaporative chillers is designed to reliably and responsibly deliver high operating efficiencies across extended operating conditions. It features a purpose-built high-efficiency evaporative condenser that, unlike "wet-pad" alternatives, is designed with harsh environmental conditions in-mind.

Smardt, as the global pioneer in evaporatively-cooled chillers, have brought their extensive experience in chiller development, sales and service into designing the E Class – a range of evaporative chillers that deliver the highest level of reliability, outstanding efficiency, and the lowest total cost of ownership.

All Smardt chillers are designed to optimize the superior performance of oil-free compressors from Danfoss Turbocor, and the E Class is no exception.These compressors, coupled with our purpose built evaporative condenser design, high efficiency evaporator, and industry-leading fan technology result in the highest efficiency evaporative chiller.

Our class leading performance and quality design ensures the best results for total equipment lifecycle operation and reliability.

The E Class range comes with the same benefits as all Smardt chillers, such as ease of installation, simplicity of operation and maintenance, and lower installation and maintenance costs as compared to systems using water-cooled chillers and cooling towers.

HIGHLIGHTS

- Attain watercooled chiller system efficiency with only a fraction of capital cost outlay and water usage.
- Integrated heat rejection, no chemical dosing, significantly reduced maintenance costs and no legionella reporting requirements.
- Chiller is fully assembled in the factory. There is no requirement for installation contractors to fit wet pads, sumps or framing in situ. Sustained evaporative operation and reliability is assured.
- Designed for ease of maintenance and serviceability.
- Advanced corrosion protection on critical operating surface areas.
- Accurately designed and integrated evaporative operation that is designed specifically for trouble-free and sustained operation across the entire chiller load range.
- Australian manufactured, acceptance tested and pre-commissioned prior to delivery ensuring trouble-free commissioning and startup on every project.

The E Class features a high quality purpose-built evaporative condenser, with unrivalled redundancy of serviceable components

OIL-FREE COMPRESSOR TECHNOLOGY

At the core of all Smardt chillers is an oil-free Danfoss Turbocor compressor, featuring magnetic bearing technology. With no oil to compromise heat exchanger performance, and no friction losses associated with conventional compressor bearings, Smardt chillers are able to achieve exceptional full- and part-load efficiencies.

This ultra high speed technology eliminates up to 99% of compressor induced vibrations, and dramatically reduces the sound levels emitted by the chiller.

HIGH EFFICIENCY

In addition to its compressor technology, the E Class utilizes high performance aluminum/copper coils and industry-leading EC fan technology to deliver a highly-efficient refrigeration circuit.

All Smardt chillers use a premium flooded shell and tube heat exchanger which has superior efficiency and reliability to plate and frame or DX heat exchangers.

PURPOSE-BUILT CONSTRUCTION

All Smardt chillers are factory assembled and tested, ensuring chillers have trouble free start up and commissioning by the installation contractor. E Class chillers are delivered to site as a completely assembled, single-piece unit, so there is no requirement for installation contractors to fit evaporative pads, sumps or framing in situ.

CORROSION PROTECTION

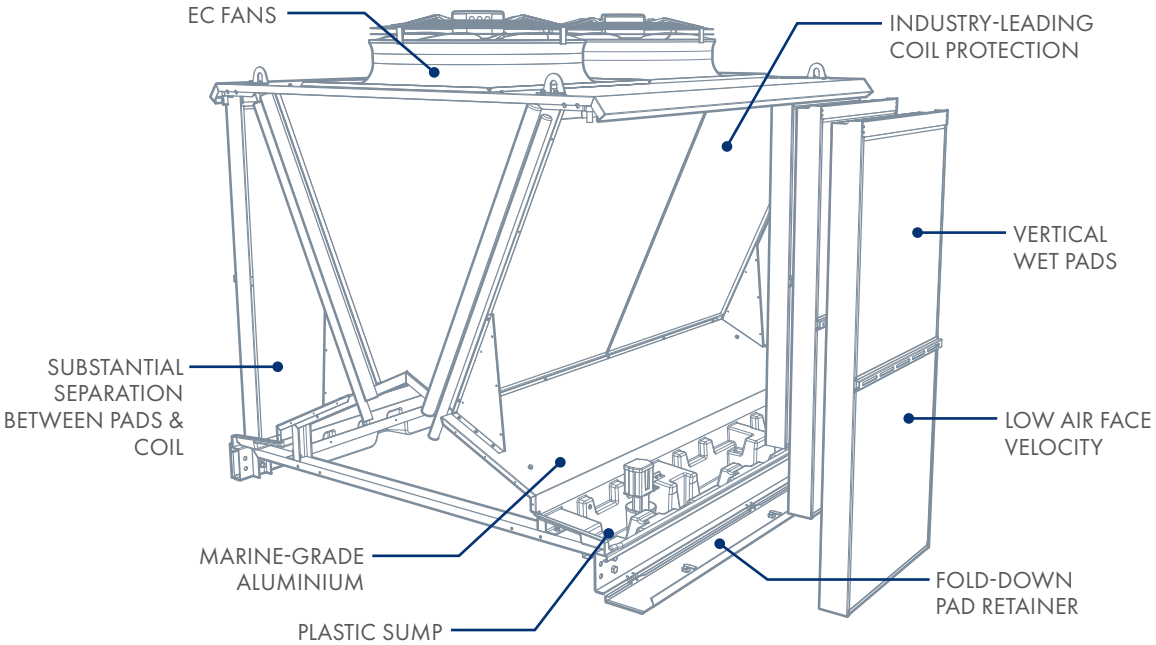
The E Class condenser has been designed with highly corrosive conditions in mind, utilizing ABS plastic and marine-grade aluminum components as standard.

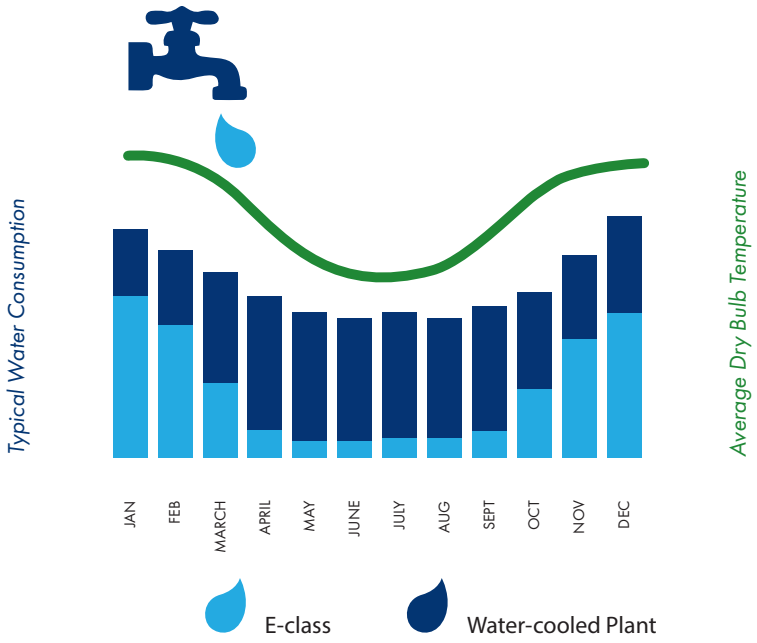
The standard SBS condenser coils are electrophoretically dipped with proven salt spray resistance exceeding 6000 hours to ASTM B117.

In addition, the wet pads have been sized specifically to limit the face velocity of incoming air to prevent water droplet carry-over – a major risk for potential corrosion.

HIGH AMBIENT OPERATION

The integrated adiabatic cooling system increases the condenser's effectiveness, reducing the power required by the compressor. This allows the compressor to operate at previously limiting ambient conditions. In some cases, full load design and capacity selections are available for ambient air temperatures exceeding 50°C, whilst maintaining comparitively high efficiency.





LOW WATER CONSUMPTION

Unlike a cooling tower, which must evaporate water year round to shed its entire heat load, an E Class chiller will only use its evaporative system when required.

This allows the E Class condenser to automatically switch off its evaporative system during low ambient conditions, while a cooling tower continues to consume water.

ENVIRONMENTALLY RESPONSIBLE

All E Class chillers use R134a refrigerant, which has no ozone-depletion potential, is non-toxic, non-harmful and has no phase-out schedule per the Montreal protocol.

Additionally, the vertical wet pad works with gravity to ensure maximum humidification efficiency while preventing water wastage via spray drift or carry-over.

Unlike cooling towers, no chemical treatment of condenser water is required, allowing for its safe disposal.

CONTROL SYSTEM

Proven across years of industry experience in evaporative chiller operation, Smardt's controller is designed to optimize the performance & capabilities of the E Class chiller range. Capacity can be reduced to as little as 10% of full-load capacity.

SERVICEABILITY

All Smardt chillers include refrigerant isolation valves on both sides of all serviceable components as standard. This facilitates servicing without the need to pump down the entire unit, and in most cases can be undertaken while the chiller remains operational.

Service and maintenance access to E Class chillers is provided without the need to remove wet pads every time.

RELIABILITY & REDUNDANCY

The E class features a sectional condenser design which offers unrivalled redundancy of serviceable components, and allows routine maintenance tasks to be performed on individual modules while the chiller remains operational.

The sectional condenser design allows for a range of efficiency options based on job location, application and critical operating environment.

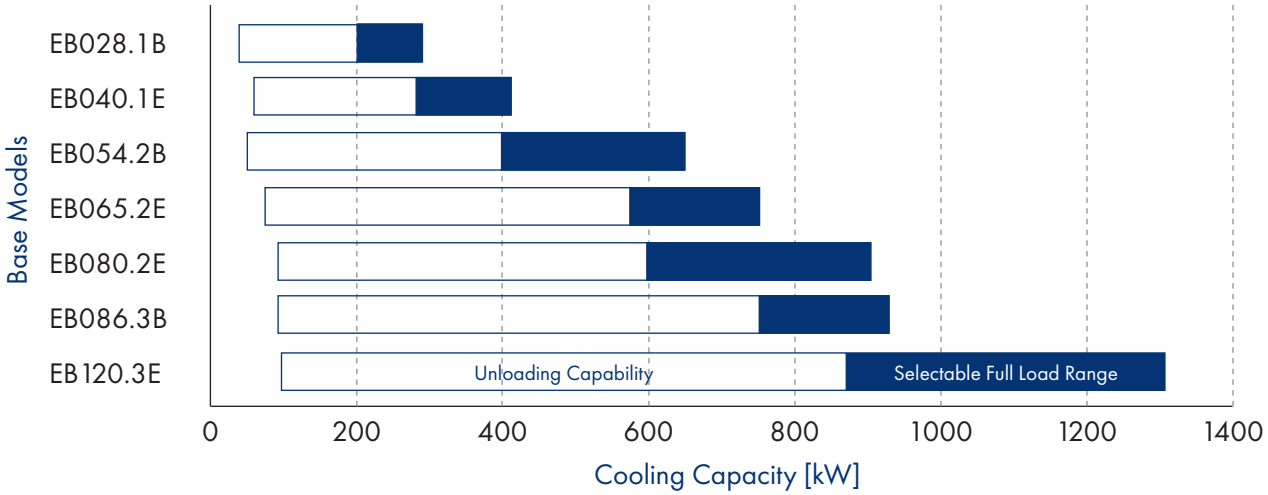
On multiple-compressor models, mechanical and electrical isolation provides significant redundancy and failsafes. In the event of a compressor outage, Smardt's controller will automatically adjust its logic to continue serving the chilled water load with the remaining available compressors.

Should a compressor require servicing, it can be quickly & easily isolated, even removed, without stopping the chiller.

Electrical terminals, compressors, valves and critical system items are not exposed to humid, pre-cooled condenser airflow.

CAPACITY RANGE

The E Class range has been designed to meet a wide variety of applications, with full load capacities ranging from 200kWR up to 1320kWR.

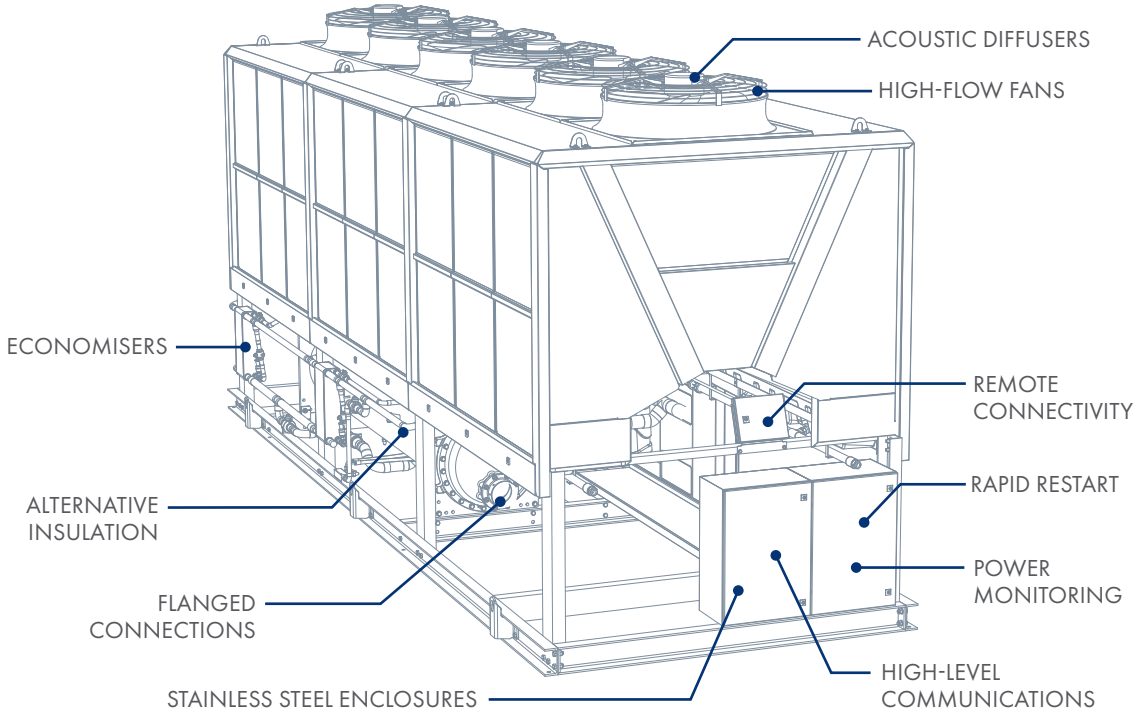


Note: Available cooling capacity will vary with operating conditions and chiller configuration.
Capacities shown are based on 35°C DB, 21°C WB.

STANDARD CONFIGURATIONS

BASE MODEL	EVAP. PASSES			FAN COUNTS					FAN TYPES		CONFIG.
	2	3	4	2	4	6	8	10	P	Q	E
EB028.1B			●	●	●				●	●	●
EB040.1E		●	●		●				●	●	●
EB054.2B	●	●	●		●	●			●	●	●
EB065.2E	●	●	●			●			●	●	●
EB080.2E	●	●	●			●	●		●	●	●
EB086.3B	●	●	●				●	●	●	●	●
EB120.3E	●	●					●	●	●	●	●

AVAILABLE OPTIONS



ECONOMISERS

Economisers are available on all models in the E Class range, which can extend the capacity of the chiller and/or further increase its operating efficiency.

ALTERNATIVE INSULATION

All models are fitted with 19mm [3/4"] closed-cell rubber, wrapped in 3mm thick UV-stabilised insertion rubber, as standard. 38mm rubber, aluminium cladding, 50mm polystyrene and 50mm polyurethane options are also available.

FLANGED CONNECTIONS

Grooved connections are supplied as standard on all models. Flanged options, including AS Table 'E' and ANSI #150, are available on request.

STAINLESS STEEL ENCLOSURES

All E Class electrical enclosures are powder-coated. For additional protection, powder-coated stainless steel cabinets are also available.

REMOTE CONNECTIVITY

Access data trending, or real time feedback on chiller status and performance remotely on all models.

ACOUSTIC DIFFUSERS

Acoustic diffusers are available on all E Class models, offering up to 7dB(A) reduction in fan acoustic pressure, and a 25% reduction in fan energy consumption with unchanged airflow.

HIGH FLOW FANS

High efficiency EC fans are installed as standard on all models. Increased condenser performance can be achieved with the addition of high flow fans.

RAPID RESTART

Designed for critical installations, Rapid Restart allows the chiller to resume operation in as little as 20 seconds following power supply restoration.

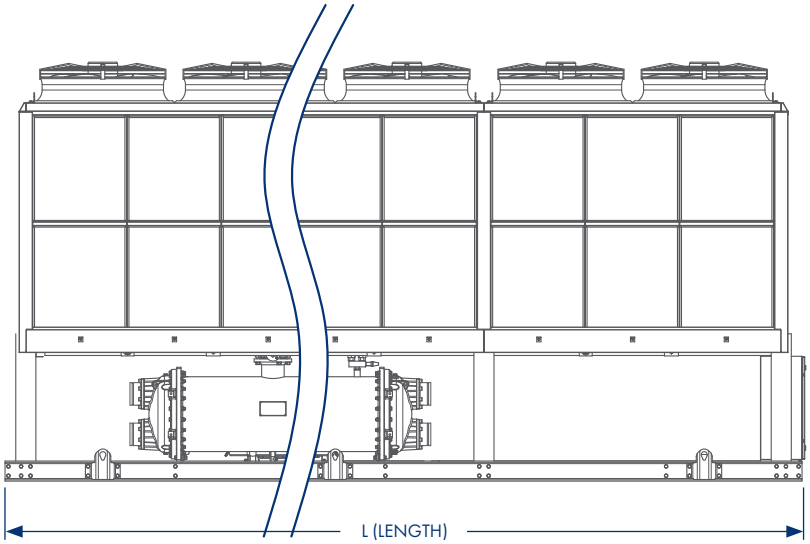
HIGH-LEVEL COMMUNICATIONS

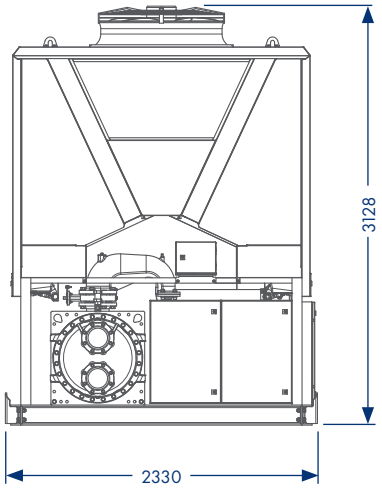
MODBUS high-level communication is installed as standard across all models. BACnet, BACnet IP, MSTP and REMOTE communication options are also available.

POWER MONITORING

An integrated monitoring system, providing absolute power usage & quality in real time over HLI.

PHYSICAL DATA





BASE MODEL	FAN QUANTITY	OVERALL LENGTH 'L' (mm)	OPERATING WEIGHT (kg)	SHIPPING WEIGHT (kg)
EB028.1B	2	2585	3340	3105
EB028.1B	4	4805	4585	4235
EB040.1E	4	4805	5145	4740
EB054.2B	4	4805	5435	5035
EB054.2B	6	7025	6785	6270
EB065.2E	6	7025	7340	6780
EB080.2E	6	7025	7455	6875
EB080.2E	8	9245	8815	8120
EB086.3B	8	9245	8940	8220
EB086.3B	10	11465	10290	9450
EB120.3E	8	9245	9630	8845
EB120.3E	10	11465	10980	10080

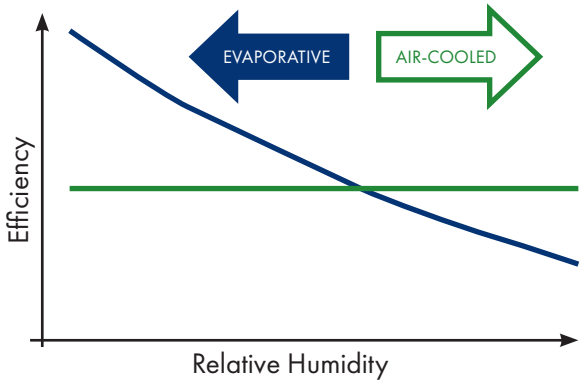
APPLICATION CONSIDERATIONS

APPROPRIATE CLIMATE

Evaporative cooling is most effective in low-humidity environments, where maximum advantage can be gained through adiabatic cooling of ambient air. The E Class is designed for such conditions.

For applications involving very high humidity, we recommend our range of T^A Class high efficiency, oil-free air-cooled chillers.

Appropriate Climate for Adiabatic Chillers



CHILLED WATER REQUIREMENTS

All external pipework must be self-supporting, and aligned to prevent strain and distortion on the chiller's headers and couplings.

EVAPORATOR WATER CIRCUITS

The chiller performance and efficiency can be adversely affected by contaminants in the water circuit. As such, strainers should be located on the inlet side of the evaporator.

The water circuit should be arranged so that the pumps discharge through the evaporator, with the return water to the chiller connected to the lower connection of the evaporator.

CHILLED WATER TEMPERATURE LIMITS

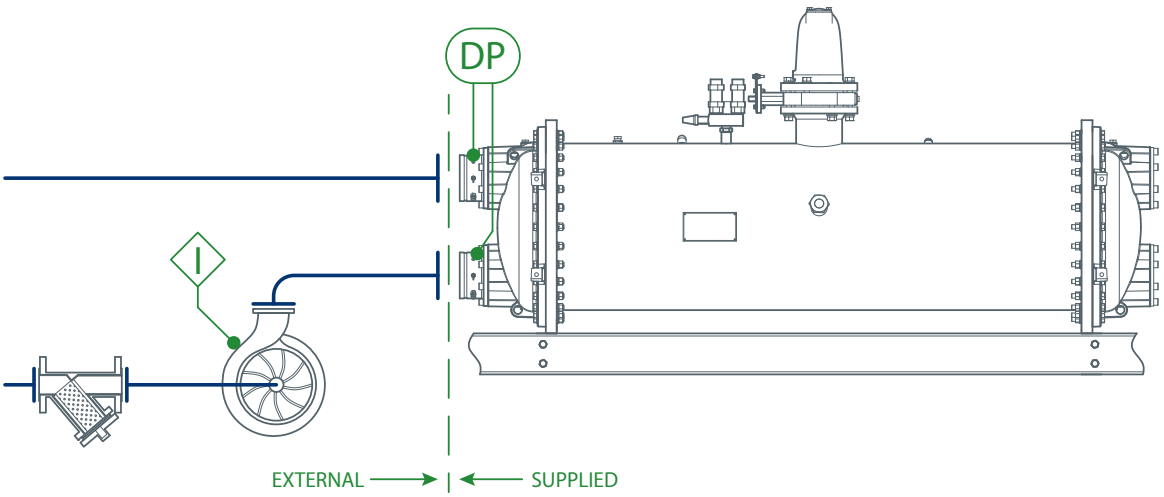
E Class chillers are optimised for chilled water temperatures between 4°C and 22°C. For applications outside this range, please consult your local sales representative.

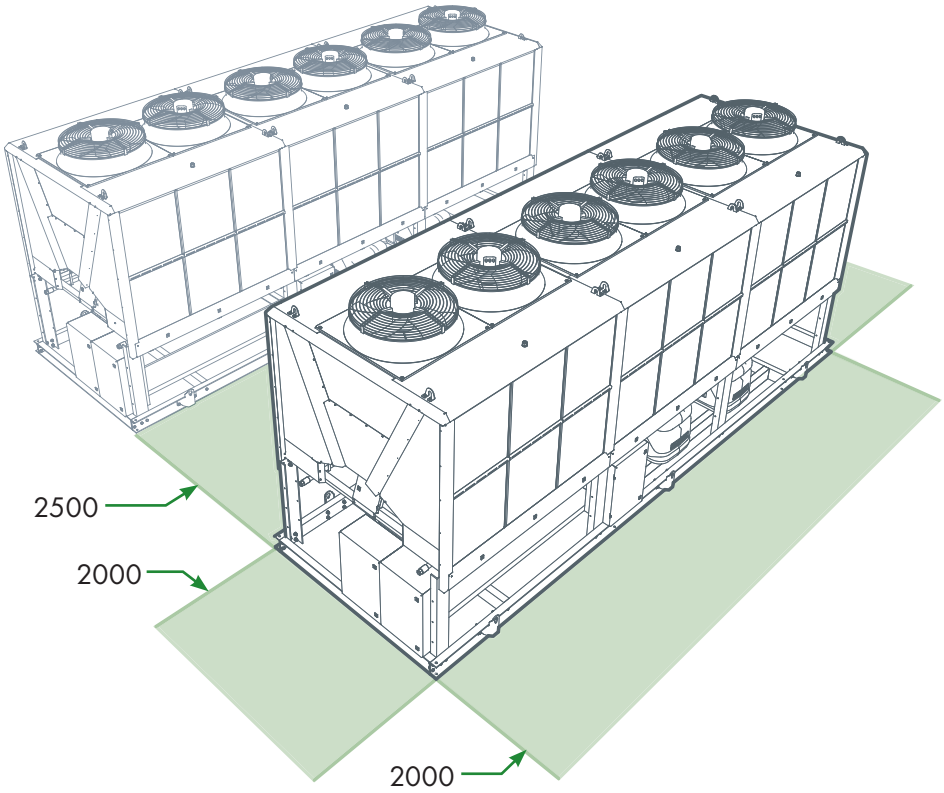
FLOW SAFETY INTERLOCKS

Differential pressure (DP) transmitters are fitted as standard on all Smardt chillers, which enables the chiller to shutdown in the event of low or high flow through the evaporator.

An additional field-supplied chilled water pump interlock, or a VSD interlock signal are required on all installations.

If the chiller is intended for an application using variable chilled water flow, please confirm the appropriate cut off point with Smardt.





SITE CLEARANCES

A nominal clearance of 2000mm is required around all four (4) sides of E Class chillers, and 2500mm between adjacent chillers.

A clearance equal to the length of the evaporator is recommended at either end of the vessel for service access requirements.

Air discharged from the fans should be unimpeded. Adjacent walls should be no higher than 3000mm.

Contact Smardt for advice on restrictive installations.

MOUNTING REQUIREMENTS

The chiller shall be installed on a flat surface, with a minimum of 75mm flange width around the perimeter of the base frame. Refer to individual product information for these dimensions.

Waffle pads can be used in place of spring mounts for most installations requiring structural isolation.

CONDENSER MAKE-UP WATER

The water consumed during operation of the E Class evaporative condenser must be replenished via the 'make-up' connection. This connection must be capable of delivering a pressure of 200kPa, with the appropriate flow rate, as shown in the table below.

MAKE-UP LINE FLOWRATE CAPABILITY OF E CLASS CHILLERS (ALL VALUES IN L/MIN)

FAN QTY	2	4	6	8	10
EB028.1B	8	16			
EB040.1E		16			
EB054.2B		16	24		
EB065.2E			24		
EB080.2E			24	32	
EB086.3B				32	40
EB120.3E				32	40

Note: A minimum of 200kPa supply pressure is required during delivery of the flow rates quoted above. Values in table do not represent water consumption during chiller operation.

DESCRIPTION

Microprocessor controlled, electric water chiller using HFC-134a refrigerant, oil free, two stage centrifugal variable speed compressor and electronic purpose built evaporative condenser.

QUALITY ASSURANCE

Construction shall comply with relevant Australian codes; vessels shall be manufactured in accordance with ASME code or AS1210. Selected units can be run tested at the factory prior to shipment (optional).

EQUIPMENT

Fully integrated, factory assembled, purpose built evaporatively-cooled packaged liquid chiller fitted with all factory wiring, piping, controls and refrigerant. Chiller shall be rated in accordance with AHRI Standard 550/590 (I-P).

COMPRESSOR(S)

The compressor(s) shall be an OIL FREE semi-hermetic two stage direct driven variable speed centrifugal. Compressor(s) shall be equipped with discharge and suction shutoff (isolating) valves for mechanical isolation as standard.

Capacity control shall be provided by variable speed drive and inlet guide vanes, capable of reducing unit capacity to below 15% of full load.

Compressor shall start unloaded and current inrush shall be limited by control to less than 5 amps. Motor cooling shall be provided by an integrated liquid refrigerant injection system controlled by the compressor(s). The compressor(s) shall require no oil lubrication.

EVAPORATOR

Provide shell and tube design evaporator with seamless copper tubes mechanically expanded into boiler quality mild steel tube sheets with mild steel water boxes. Form the evaporator shell from carbon steel plate, designed, tested and stamped in accordance with AS1210 or ASME safety codes for unfired pressure vessels. Rate the water tubes to a pressure to suit the installation but in any case be not less than 1000kPa. Insulate the evaporator with 19mm closed cell PVC nitrile rubber sponge and further wrap with 1.5mm thick insertion rubber. Provide a water drain connection and single bulb well for low temperature cut-out, load limit thermostat, and temperature controller.

CONDENSER

Shall have two vertical finned heat exchanger coils housed in marine grade aluminium frames which shall be of 3mm thick welded construction. A water distribution system for air precooling consisting of a water circulation pump(s), water make up solenoid valve, motorized water dump valve(s), and an overflow with piped drainage.

Fans shall be high efficiency EC variable speed fans. The evaporative cooling pads shall have a surface area exceeding that of the condenser coils, and be fitted with water distribution reservoirs at the top, and ABS plastic sumps at the bottom. Evaporative pads will be spaced from the condenser coils at an average distance of 400 mm. All materials located on the “wet side” between pads and coils shall be constructed of marine grade aluminium, ABS plastic, and Stainless Steel. Precooling is to be activated at an (adjustable) pre-set ambient. Precooling shall be provided by pumps fitted to each water sump. There shall be multiple water pumps and sumps per chiller for redundancy, the number of which will be equal to the number of condenser fans.

The dump valve(s) are to be activated daily, to drain all the water from the unit sumps in order to eliminate any potential risk of bacteria growth.

Condenser coils shall be post-coated with an electrophoretic process to achieve precise and consistent coating across entire coil including fin edge seal. Finished surface includes oven bake curing and UV protective top coating. The coil coating shall be salt spray certified to ASTM B117-97 / DIN 53167 for 6,000hrs.

REFRIGERATION COMPONENTS

Pressure Relief Valves shall be provided on the evaporator in a paired assembly to allow for either to be isolated without the introduction of any safety hazard.

Each compressor shall be fitted with Discharge and Suction isolation valves.

Electronic Expansion valves shall be provided.

Electronic Level Sensors shall be provided to allow for accurate expansion valve control.

Evaporator shall be fitted with a sight glass to allow for visual inspection of the tubes.

There shall be a minimum of 9 isolation valves within the refrigeration pipework to allow for rapid serviceability of individual components. Isolatable componenets shall be accompanied by a service port to allow for localized refrigerant reclaim.

STANDARD CONTROLS, INTERLOCKS & SAFETIES

Provide and mount in the chiller set control cubicle the interlocks, time delays, relays, surge controls, capacity control, safety controls, relays, connections for interlocks with external pumps and flow switches and the like necessary for safe and satisfactory operation and for restarting the chiller set immediately upon restoration of interrupted power supply.

Unit controls shall include the following minimum components:

- Microprocessor control with non-volatile memory.
- Power and control circuit terminal blocks.
- ON/OFF control switch.
- Temperature sensors installed to measure cooler entering and leaving fluid temperatures.
- Sensors for suction and discharge pressures.
- Sensors for suction and discharge temperatures.

Unit controls shall include the following functions as standard:

- Capacity control based on leaving or entering chilled water temperature with set point offset load compensation.
- Rate of change control at start up to prevent overshoot.
- Control of condenser fans and activation of evaporative system to condensing pressure and maximize efficiency.
- Auto restart after power failure.
- Auto evaporative water dump cycle.
- Auto condenser air flush on shut down.
- The control panel shall include a 7 inch, clear backlit, colour LCD touch screen with menu driven user interface for setting of user set points and options, and for providing operating information descriptions.

Unit controls shall include the following display variables as part of the user interface:

- General operational data including; entering and leaving chilled water temperatures, chilled water set point, ambient air temperature, time and date, active timers, system demand, chiller status, active faults and alarms
- Compressor data including; communication integrity, active alarms, actual compressor(s) demand, impeller speed, IGV position, active pressure ratio, suction pressure, discharge pressure, active power input, desired power input, 3 phase Amps, surge RPM, choke RPM.
- Trending Data including; entering and leaving chilled water temperatures, input kW, % of design chilled water flow, % of design capacity, system refrigerant level, EXV position, suction and discharge pressures, saturated suction temperatures, saturated discharge temperatures, system demand, number of compressors running.
- The control system shall allow software upgrade without the need for new hardware.

The controller shall include contacts for interfacing to the building management system for the following functions:

- Summary fault
- Start/Stop
- Chilled water flow interlock
- Chiller water reset
- Demand limit

STANDARD CONTROLS, INTERLOCKS & SAFETIES (CONT'D)

Unit shall be equipped to provide the following protection:

- Loss of refrigerant charge.
- Low chilled water temperature.
- Power supply error.
- Compressor motor thermal or electrical overload.
- Phase loss.
- High pressure.
- Low pressure.
- Loss of chilled water flow.

OPERATING CHARACTERISTICS

Unit shall be capable of starting up with 35ØC entering fluid temperature to the cooler and sustained operation in ambient air on conditions exceeding 50ØC

ELECTRICAL

Unit primary electrical power supply shall enter the unit at a single location.

Unit shall operate on 3-phase power at 400 volts, 50Hz.

Control voltage shall be 24VDC

Unit shall be shipped with factory control and power wiring installed.

Power factor shall be greater than 0.9 (compressors only) at full design load.

Provide EMI filtration for high frequencies EMC compliance.

High impedence reactors providing enhanced low frequency harmonic mitigation.

UNIT OPTIONS

- High level interface BACnet IP/MSTP.
- Economisers for extended operating range/efficiency.
- High flow fans.
- Alternative evaporator insulation.
- Acoustic condenser air diffusers.
- Stainless steel electrical enclosures.
- Flanged chilled water connections.
- Rapid Restart.

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