

natural climate



THERMAL SOLAR LINE

ROTARTICA, air conditioning appliances:

- Solar Line, single effect 4.5kW

"No cooling tower required"
"Compact size"
"Easy to install"

BR050500EN

01/ Introduction

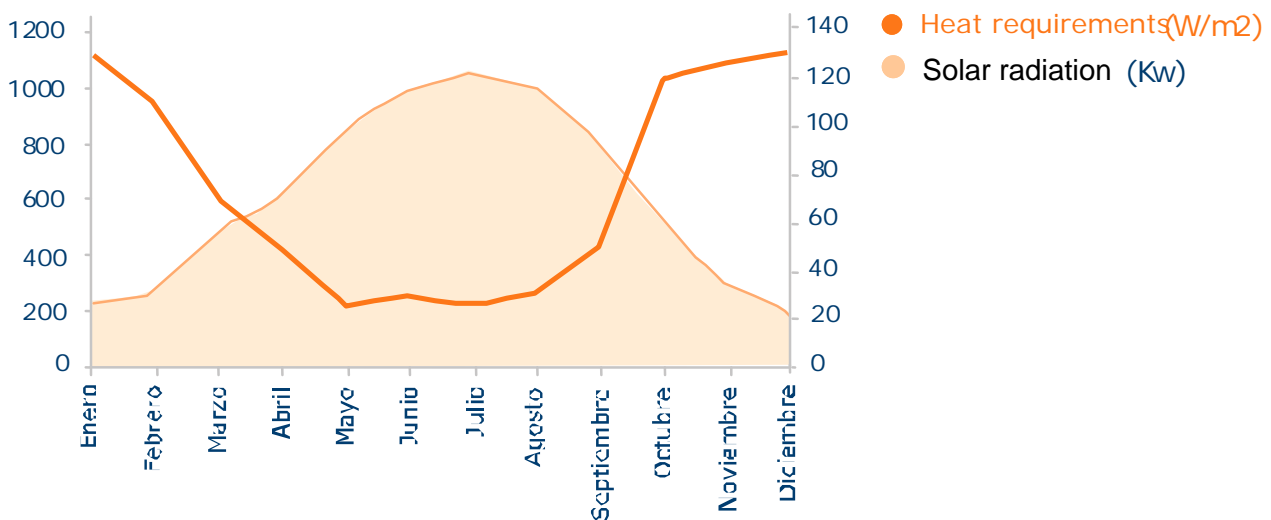
Between 1999 and 2003, annual sales of air-conditioning appliances rose by 31% worldwide and by more than 43% in Europe. In Spain this increase has been even more spectacular with sales doubling between 2002 and 2003.

This has led to an equivalent increase in electricity consumption, revealing patent shortcomings in the electrical grid. Spain suffered numerous voltage sags between spring and summer 2004 giving rise to critical situations.

RENEWABLE ENERGIES

In addition to electrical grid problems, there is also a serious threat of climatic change due to the today's society huge energy needs and, particularly, its need for comfort. One of today's biggest challenges is therefore to obtain a better balance with nature, but without losing the degree of comfort to which we are accustomed, which is constantly increasing.

Thermal solar energy represents an alternative to the use of fuel oil or all types of fossil fuel powered boilers, but up to this point in time it has only proved useful in DHW and heating applications, particularly domestic ones, thus leading to variations between the demand and availability of energy, as shown in the graph below.

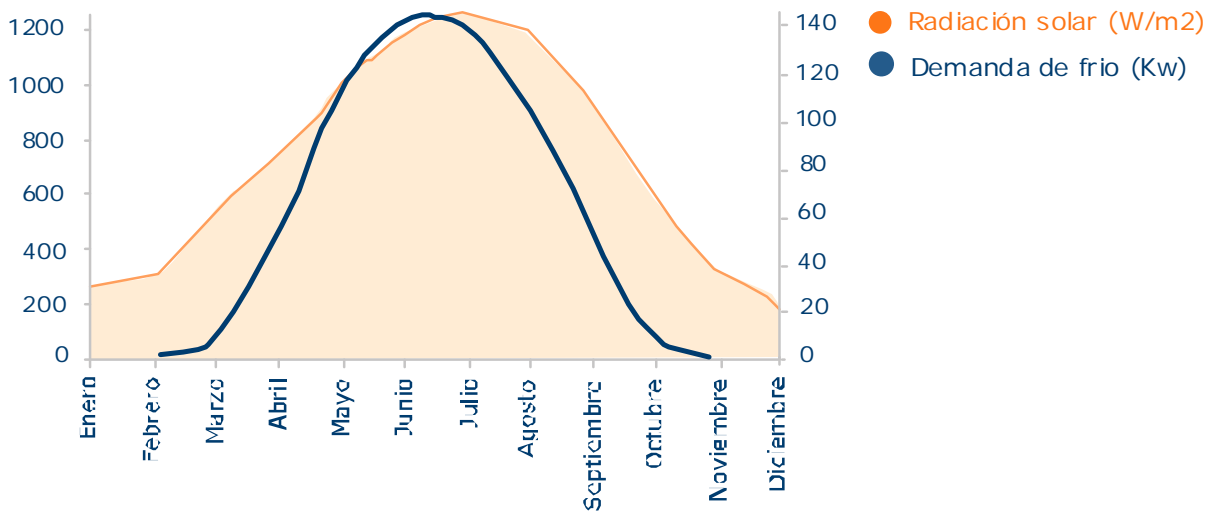


Loads and demand (depending on variables, type of house, latitude, etc.)

SOLAR COOLING

Solar Cooling is an application that can optimise the use of Thermal Solar Energy, greatly increasing its harnessing and possibilities. The current market situation shows that there is an offer for large premises, but not for the private home sector or for any smaller premises. **ROTARTICA** has gone a step further with its Solar Line, marketing the most advantageous application for Thermal Solar Energy: **small scale solar cooling**, the use of which, amongst many other advantages, prevents the electrical distribution network from becoming congested. It also makes greater use of the sun's heat when it is more abundant - in summer (see graph below).

This means that in facilities where ROTARTICA is installed, panels can be set up for loading in winter, not in summer as up to now and which resulted in a poorer supply in winter.



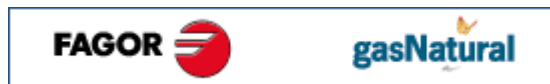
Loads and demand (depending on variables, type of house, latitude, etc.)

As part of its Solar Line, **ROTARTICA** has developed an air conditioning unit that uses water heated by the sun to produce cold air and does not require a cooling tower. Hot-water powered absorption chillers are already on the market, but are designed for large installations (over 35 kW), unlike **ROTARTICA's** chiller units (2 -10 kW).

02/ ROTARTICA: the Company

ROTARTICA's origins go back to a consortium of companies created by the R+D laboratory INTEROTEX in 1993, with shares held by major British and North American companies in addition to Fagor and Gas Natural. **ROTARTICA** is the natural continuation of INTEROTEX and has inherited all its evolution and know-how, continuing to develop its products and new lines of business.

ROTARTICA's capital is shared between the multinationals FAGOR Electrodomésticos S.Coop. and gasNatural SDG, S.A.



FAGOR ELECTRODOMÉSTICOS is one of the main companies in the Mondragón Corporación Cooperativa business group and Spain's leading domestic appliance manufacturer; and gasNatural SDG is Spain's number one gas company.

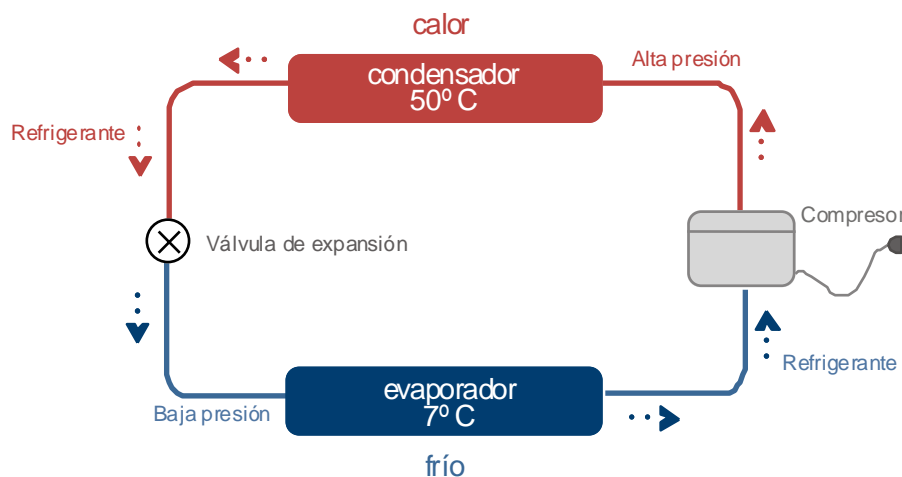
03/ ROTARTICA Technology

ABSORPTION

Absorption chiller units operate according to three very simple physical phenomena:

1. When a liquid evaporates it absorbs heat, and when it condenses it releases heat.
2. The boiling temperature of a liquid varies according to the pressure, i.e. as the pressure decreases, the boiling temperature decreases.
3. Certain pairs of chemicals have an affinity when it comes to one dissolving the other.

Before we go into more detail, let us take a look at the factor that sets absorption chiller units apart from electrical air-conditioning appliances. Conventional air-conditioning units comprise a mechanical vapour compression cycle. The refrigerant is evaporated in a low-pressure environment causing cooling to occur and is then compressed in a mechanical compressor at a higher pressure before it condenses (the compressor is an electrical motor and thus consumes electricity).



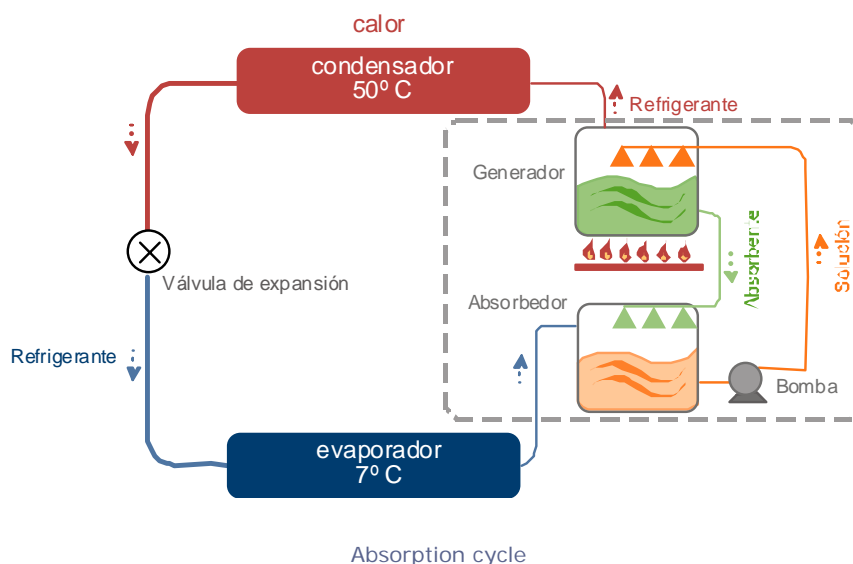
Mechanical vapour compression cycle

In an absorption chiller unit the evaporator and condenser are the same as in conventional systems but the function of the compressor is performed by a chemical absorbent (LiBr) and a

heat generator, with only a pump being required to provide the change in pressure. As there is no compressor, electricity consumption is reduced significantly.

The diagram below is a graphic representation of the Single Effect Absorption Cycle, which functions as follows:

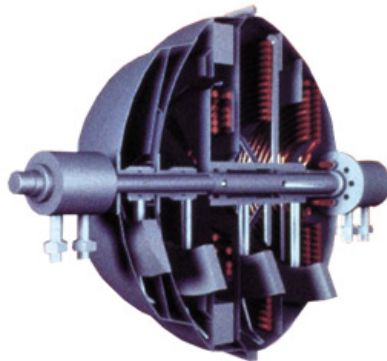
1. The refrigerant, together with the salt or absorbent in the **Generator**, evaporates due to the heat provided by a burner or an external circuit leading to a heat exchanger.
2. The absorbent is conveyed to the **Absorber** as a solution with a low refrigerant content, while the refrigerant that has evaporated in the Generator travels to the **Condenser** where it is condensed and releases heat.
3. Due to the difference in pressure, the refrigerant flows to the **Evaporator** where, at a low temperature and as a result of the low pressure, it evaporates and absorbs heat from the circuit which subsequently goes on to cool the room.
4. Lastly, the evaporated refrigerant is attracted by the absorbent in the Absorber, where the refrigerant-rich absorbent solution is created once more and is conveyed to the Generator where the whole cycle begins again.



The diagram shows a **Single Effect** cycle, with a Generator heated by water between 80°C and 120°C, for example. The **Double Effect** cycle is the same cycle but uses two Generators and two Condensers, and has an activation temperature of between 160°C and 180°C.

ROTARY ABSORPTION

ROTARTICA has developed “ROTARTICA Technology”, based on the absorption cycle and applying the same principles but in a rotary environment, to improve the efficiency of the cycle by optimising the mass and heat transfer processes.



As a result of this, the size and weight of the unit can be greatly reduced and there is a considerable improvement on the system’s effectiveness with respect to traditional absorption applications. The thermal step (from hot outlet water temperature to cold outlet water temperature) is also increased, meaning there is no need for a cooling tower to be installed, thus preventing bacteria such as legionella from propagating.

For rotary absorption new components have had to be developed, including the following:

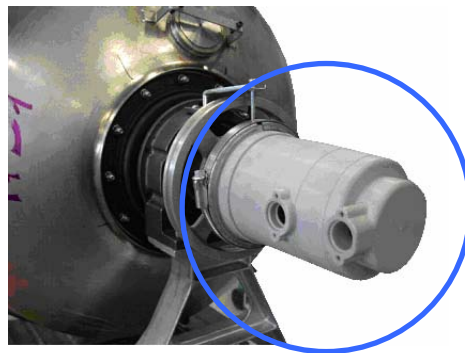
- Solution Exchanger: A stainless steel plate exchanger, which functions on the basis of the flows of solution low in refrigerant content travelling from the Generator to the Absorber being crossed with the refrigerant-rich solution flows circulating in the opposite direction.



- Solution Pump: most absorption machines are equipped with a pump that consumes electricity in order to convey the LiBr solution containing refrigerant from the absorber to the evaporator. In the case of “ROTARTICA Technology”, the pump consists of a

mechanism suspended from a bearing inserted in the shaft; pumping is produced when the rotary unit turns as a result of the static pressure developed by the liquid which rotates together with the rotary unit.

- The water collector and distributor of the three closed circuits, which transfers the fluids from a rotary environment to a static environment on the generator side, withstands temperatures of up to 120°C.



To summarise, this technology possesses a series of advantages, the most significant of which are resumed below:

- Better use is made of a totally renewable, unlimited energy: Thermal Solar Energy.
- Drastic reduction in electricity consumption (this factor also depends on the type of solar installation designed).
- Health risks are eliminated as there is no imperative need for a cooling tower.
- Water is used as a refrigerant instead of CFCs and HCFCs, etc., as water is used as a refrigerant.

04/ Product

On the basis of **ROTARTICA technology**, the commercial product developed is an Air Conditioning Unit activated by a heat source and which can be produced in a smaller size and with lower power consumption than those already on the market, thus reaching a public that has not had access to a product of this kind up to now.



The chiller units use environmentally friendly refrigerants (i.e. they use water instead of CFCs, HCFCs etc.) and are manufactured using production processes that respect the environment.

As for the **Solar Line**, absorption takes place in a single-effect system that generates a cooling power of 4.5 kW (from 2 to 8 kW depending on the conditions) with a COP of 0.7 (in terms of solar cooling).



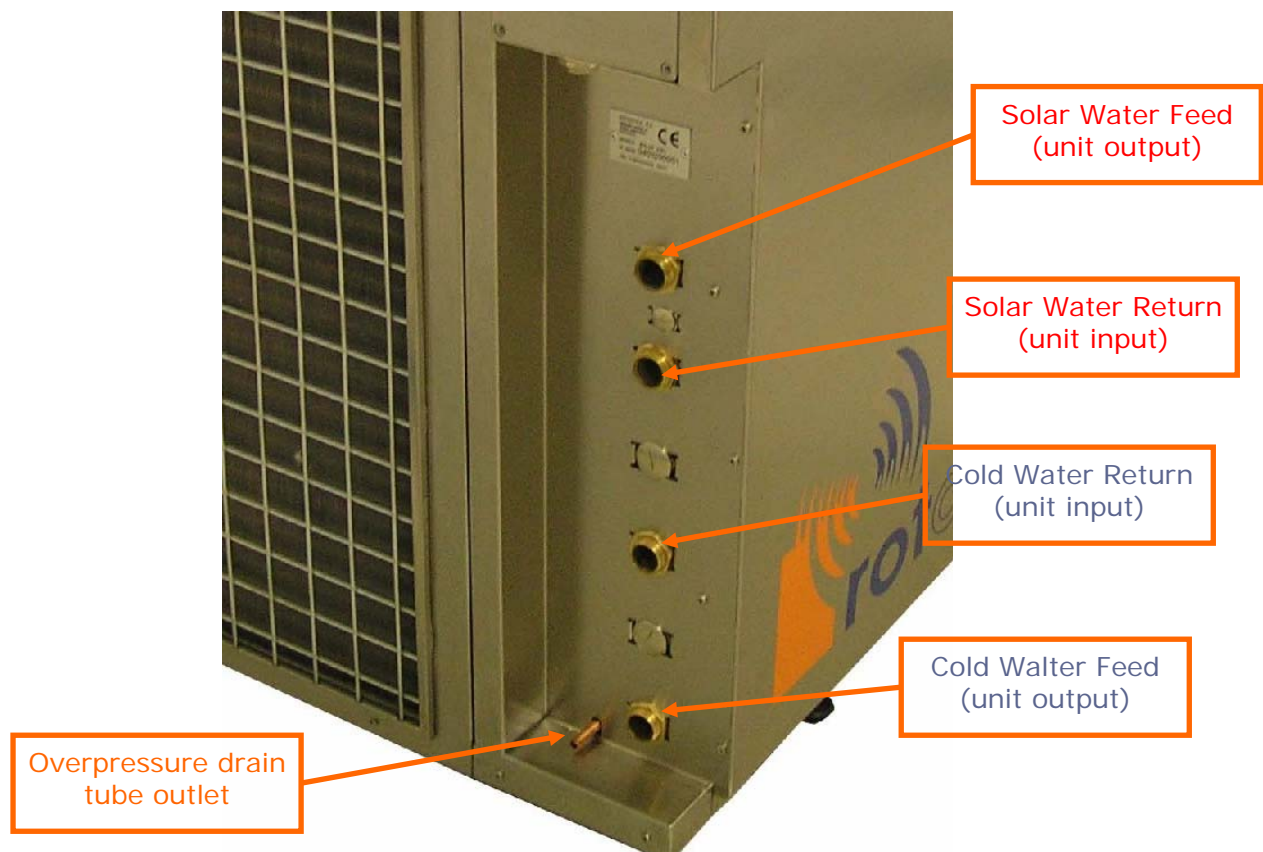
	Model	Nominal cooling capacity	Installation	Powered by	Absorption
Thermal Solar Line	SOLAR 045v	4.5 kW	Exterior (incorporates heat dissipation)	Thermal Solar Energy	Single Effect
	SOLAR 045	4.5 kW	Interior (without heat dissipation)	Thermal Solar Energy	Single Effect

05 / Services

A comprehensive service must also be offered to accompany the new **ROTARTICA** product, in view of its characteristics, the special features of the sector it is geared towards and the fact that it is destined for a new market, and this service must reach all the agents forming part of the value chain: engineering, installation and maintenance, architecture and building companies, promoters, collector manufacturers, final users, etc.

One of **ROTARTICA**'s goals from the start has been to create an easy-to-install product with practically no need for maintenance to the Generator Unit (see photograph in section 3), which should need no handling at all in its 15 years of estimated life.

The connection of the unit to the installation is a matter of great simplicity, as the figure below shows.



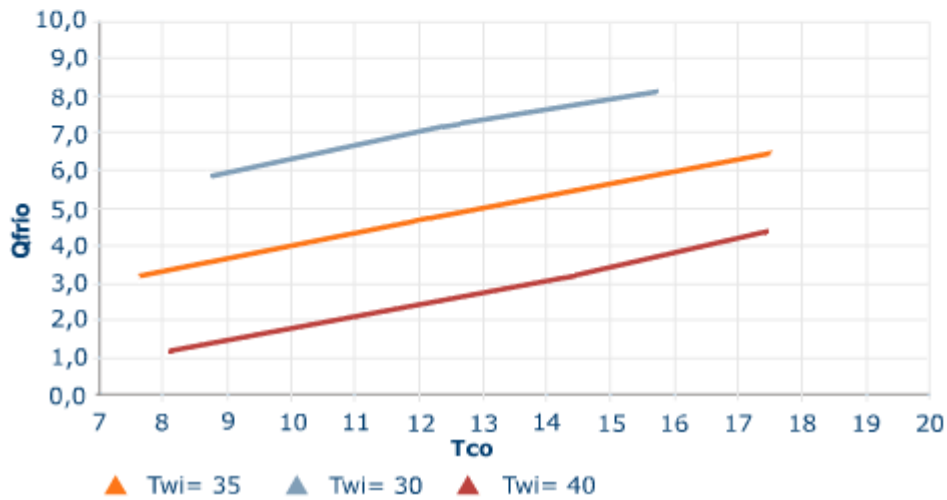
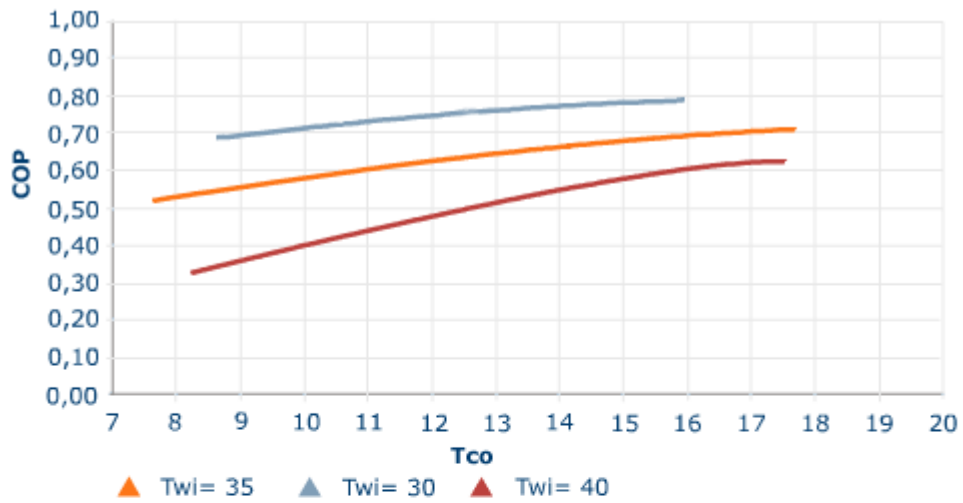
Absorption chiller unit water circuit output

which the residual hot water circuit is dissipated within the unit itself via a heat exchanger and fan.


- **Installation and Start-up Training Service:** Solar Cooling with **ROTARTICA** is an innovation in itself and, bearing in mind that the technology forms part of a relatively little-known sector, **ROTARTICA** considers that specific training in this area is necessary for installers, in addition to support with starting up the installation with **ROTARTICA**.
- **Repair and Maintenance Training Service (TAS):** **ROTARTICA**'s Authorised Installers will be able to partake of this training enabling quicker detection and repair of any possible failures in the installation.
- **Technical Assistance Service:** A qualified telephone assistance service has been set up to provide an immediate professional response to all matters relating to ROTARTICA installations.

06/ Technical Data

Operating curves for a supply temperature of 90°C:



Qfrío= Cooling power (kW) Tco= Cold water feed (°C) Twi= Hot water return to condenser (°C)

ROTARTICA			
PRODUCT SPECIFICATIONS		SOLAR Air/Water CHILLER	
		Technology	SINGLE-EFFECT LiBr/H2O ABSORPTION
		Manufacturer	ROTARTICA
		Models	SOLAR 045 and SOLAR 045v
Product Data	Company	ROTARTICA	
	Product	Air/Water Chiller	
	Nominal cooling power	4.5 kW	
	Powered by	Heated water	
	Absorbent/Refrigerant	LiBr/H2O	
		SOLAR 045	SOLAR 045v
Chilled Water Circuit	Capacity (kW)	4.50	
	Flow (m3/h)	1.56	
	Loss of head (bar)	0.52	
Condenser Circuit	Capacity (kW)	11,70	
	Flow (m3/h)	1,98	
	Loss of head (bar)	1,12	
Generator Circuit	Heat provided to Generator (kW) at 90°C	7,20	
	Flow (m3/h)	0,90	
	Loss of head (bar)	0,36	
Electricity supply	Electrical consumption of absorption chiller unit	0,40	1,11
Temperatures	Nominal inlet to Generator (°C)	90	
	Nominal chilled outlet (°C)	12	
	Nominal condenser outlet (°C)	40	-
	Outdoors temperature	30	
Dimensions	Length (mm)	1130	1202
	Width (mm)	720	803
	Height (mm)	790	1202
	Volume (m3)	0,64	1,16
	Weight (kg)	240	290
Nominal specifications			
Primary circuit: 90°C and flow 15 l/min, Chilled water circuit: 12°C and flow 26 l/min, Warm water circuit returning: 35°C (dry dissipation) and flow 33 l/min			

NOTE: There is no standard for absorption chiller units NOT comprising a cooling tower. The conditions stated above are applied in its absence.