



DOMINO

Modular air/water chillers and heat pumps
Cooling capacity: 40-1200 kW



Grandimpianti
System





DOMINATE



Domino.

The innovative line of packaged modular units.

SPACE. BREAK THE RULES.



3

Domino is living evidence of Thermocold's will to combine the flexibility of its product range, both in terms of basic models and proposed accessories, with a state of the art industrialisation capable of rationalising the production process and guaranteeing delivery times in line with the changing market needs.

State of the art industrialisation means reducing the number of components used on the whole range of products, manufacturing just in time, guaranteeing availability for the basic models and extremely low delivery times (less than two weeks) for all the least common models, guaranteeing extremely high manufacturing quality and reliable operation.

All this without losing the flexibility in proposing models with differing outputs, particular versions and accessories which have always characterised Thermocold products.

DOMINO

It achieves all the aims it was created for.



UP TO TWELVE MODULES



Domino. Conceiving the cooling units with a new philosophy.

WITH A UNIQUE CONTROL.



5

Domino is an innovative line of air cooled packaged modular cooling units for external installation with axial fans and tandem mounted Scroll compressors. The refrigerant used is R410A.

Domino uses the best technologies available on the market to achieve the best energy and noise performances.

Domino is capable of operating up to an external air temperature of 48°C and is available in the only cold, heat pump, multifunction and two and four pipe with standard equipment, high efficiency and super soundproofed versions.

Domino is made up of five basic modules which can be used alone or coupled amongst themselves up to 12, so as to reach the required power. Over 120 couplings are possible to cover a range of powers from 40 kW to about 1200 kW.

This solution allows maximum installation flexibility because the base modules can be positioned at will, just like the dominoes in the game of dominoes. Moreover the modules can be of different types so that they adapt to the needs of a system like a tailor made suit.

Domino is covered by a series of international patents which are the result of the continual research in which Thermocold invests a significant amount of its turnover.



THE PLUSSES OF DOMINO:



Domino has many advantages:
the ideal solution for most plants.

MANY ADVANTAGES IN A SINGLE PRODUCT.



7

Customisation on an industrial scale

Medium and high power cooling units have always been built to order, customised each time according to the customer's needs. With Domino, Thermocold brings large scale production to this sector, without neglecting the flexibility granted by a customized production, actually strengthening it thanks to the extreme nature of the modularity concept.

Short delivery times

Modularity makes it possible to manufacture no longer to order but directly to stock. This means short delivery times: the basic versions are in stock, whereas the customized versions are available in an extremely quick time, less than two weeks.

DOMINO

It solves all plant problems.

High energy efficiency

All the basic modules are equipped with Scroll compressors in tandem so as to guarantee extremely high efficiency energy classes and seasonal energy indices (ESEER and IPLV) at all times. This also makes it possible to rapidly satisfy the plant load variations.

Beside the basic version, Thermocold proposes the HP (High Performance) version characterised by larger heat exchangers and by the innovative owl wing profile fan characterised by low electrical consumption. Moreover, the patent Hybrid Smart Cooling allows a 40% increase of the energy efficiency.





Low noise impact

The use of the innovative fan with owl wing profile, capable of reducing the influence of the air vortexes, along with that of the best suitably insulated Scroll compressors available on the market, allows the soundproofed Domino versions to achieve an exceptional acoustic performance.

Moreover, the possibility of freely arranging the individual base modules allows optimised installations from an acoustic point of view to be created. Compared to an individual cooling unit of the same capacity, Domino reduces problems connected to noise in all architectural situations.





DOMINO IS BORN



Domino. Better performance, less emissions.

Respect for the environment

The low refrigerant content and the excellent energy performances allow CO₂ emissions in the atmosphere produced during operation to be kept down. To produce 1 kWh of cooling power Domino emits 100 g of CO₂ in the basic version which drops to 90 g in the HP version and just 65 g in the version equipped with the Hybrid Smart Cooling system.

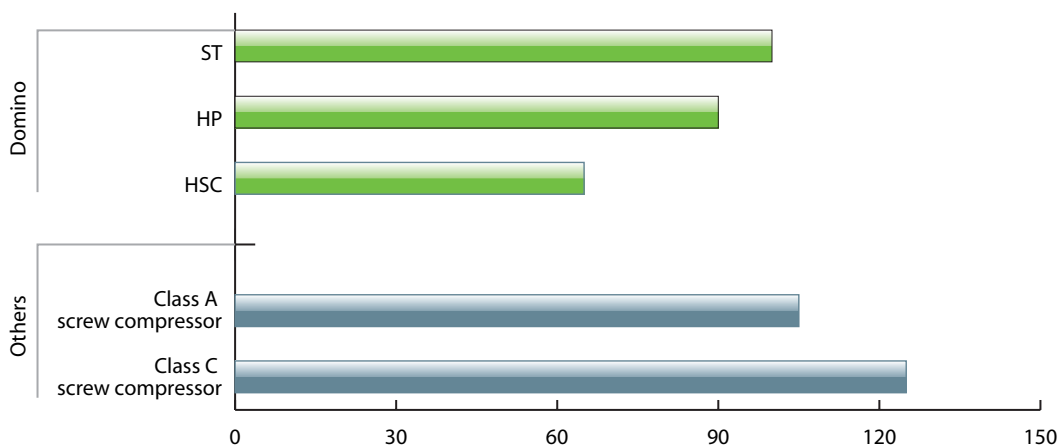
Low refrigerant content

Each base modul has a limited refrigerant content, according to NO. 842/2006 regulation issued by the European Parliament and Council which make obligatory controls more frequent as the load of each individual circuit increases. Domino only requires sporadic controls.

TO RESPECT THE ENVIRONMENT.



Emissions of CO₂ per kWh produced

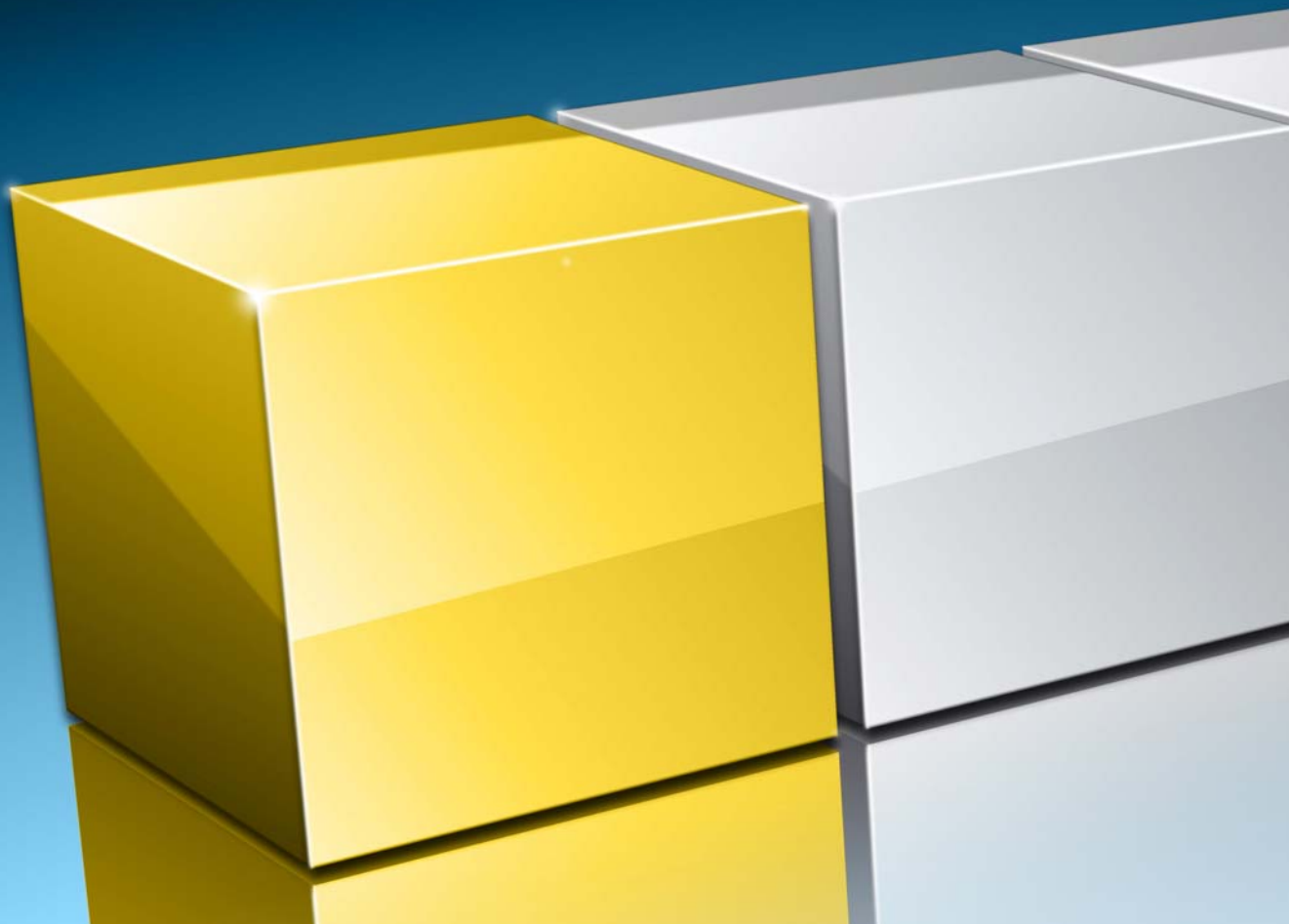


Extremely reliable

The state of the art industrialisation, the number of compressors and the steps of part loading, the choice of components and the design quality guarantee high operating reliability.

Each basic module has its own microprocessor and switchboard, so it can operate independently from others even in the event of damage to the supervision system. This, indeed, makes it impossible for the whole system to stop, whatever the failure. Modularity plays a decisive part in plants where total redundancy is necessary. Total redundancy of the system can be guaranteed with a single module.

DOMINO: JUST ONE MORE ELEMENT





Easy maintenance

The arrangement of the components of Domino has been designed to allow easy maintenance even when several basic modules are installed side by side.

The components requiring more frequent calibration and maintenance, like valves and filters, are positioned in such a way as to be easy to reach.

The state of the art industrialisation of the cooling lines makes the supply of spare parts immediate and any replacement simple.

TO OBTAIN TOTAL REDUNDANCY.



High safety

Domino has been designed to satisfy the strictest safety requirements. The two-door switchboard is proof of this: it guarantees an IP 66 level of protection, which is hard to find on other cooling units present on the market.

Available accessories include protective and security gratings for the most delicate installations. Domino is not only safe for the people operating in the vicinity, but also for itself.

The particular V shaped design of the heat exchangers protects them from particularly dangerous atmospheric agents like hail.





Over 120 possible combinations: an example of flexibility and modularity.

Modular

Thanks to the infinite number of combinations (more than 120), Domino can be used for conditioning areas which are completely different to one another. The couplings can even be made for different types, by connecting together chillers and heat pumps for instance. Basically Domino stitches itself to a system like a tailor made suit.

Flexible

Domino allows the installation to be adapted to the system development requirements. The output can be increased quickly and cheaply in time by simply adding new units.



Slim

Domino occupies less space than equipment of the same output, thanks to both its compact design and to the possibility of putting the base units on three sides.

Easy to handle

Domino, with its compact and slim line, can be easily transported using hoists.

Adaptable

Domino exploits all useful spaces by means of its customisable layout. The high refrigerating density (power over area) makes it suitable for any situation, even the most complex ones.



DOMINO PATENTS.



Domino is covered by a series of international patents: a unique product.

AN EXCLUSIVE VALUE OF THERMOCOLD



17

Our patents concern:

- Industrial design.
- Supervision system.
- **EASY CHANGE.** The possibility of transforming each basic module from one version to another on the installation place.
- **HYBRID SMART COOLING.** An increase of 40% of the power delivered and of the energy efficiency, thanks to hybrid cooling.
- **HYBRID SMART COOLING.** Doubling the recovery of partial heat (from 35% to 70%) and continual production of hot water for sanitary use at a temperature above 65°C.
- **HYBRID SMART COOLING.** Reduction of the noise produced by the cooling unit with a simultaneous increase of the energy efficiency.
- **ENERGY MULTIPLIER for WATER STORAGE.** Accumulation of 50 kWh every 1000 litres of water chilled to 7°C, exploiting it to increase the production of the cooling unit by 50%.
- **EXTERNAL AIR RECOVERY.** In heat pump operation, heating the external replacement air of a system free of charge, avoiding the use of a heat recovery system, with an increase of COP of 40%.

DOMiNO

Wins the technological challenge

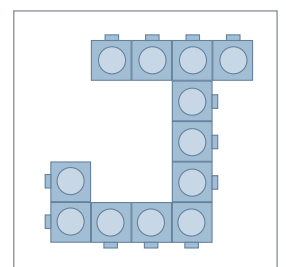
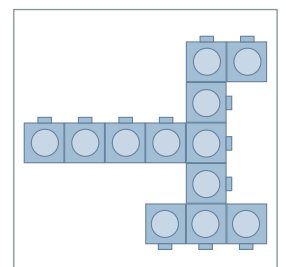
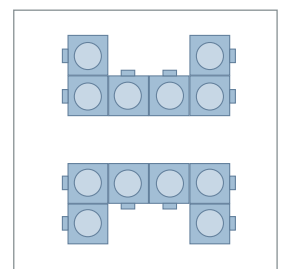
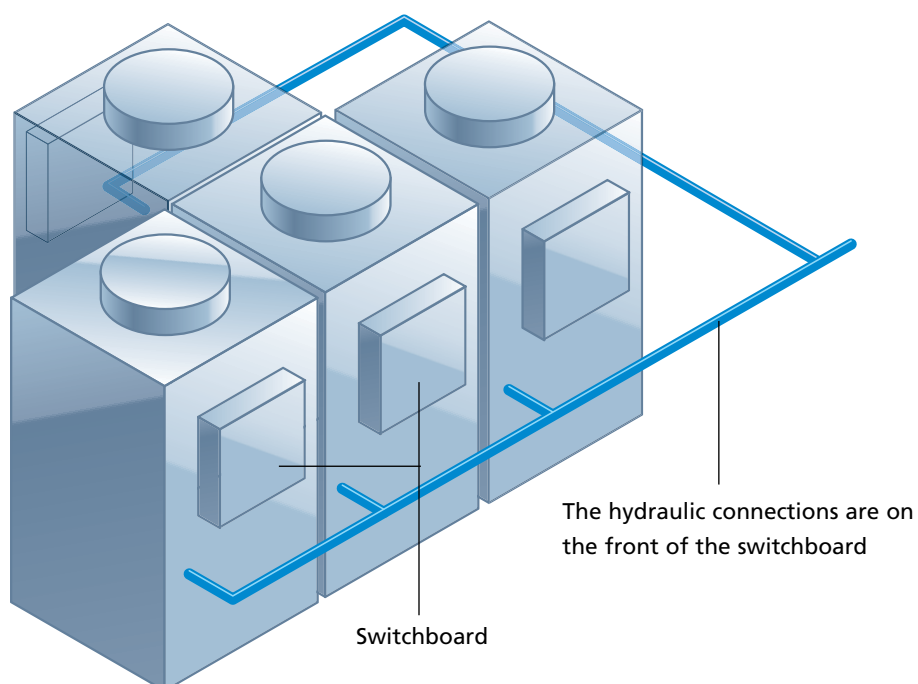
Industrial design

Domino is covered by a patent as regards industrial design, which is at least as important as the supervision system for the final success of the product. The extremely compact size, achieved thanks to a particular study of the V shaped layout of the heat exchange surfaces of the air coils and the arrangement of all the components inside the structure are fundamental features.

Each basic module has been designed so that all the hydraulic connections are on the switchboard side, in order for them to be backed on to the other modules on the three remaining sides. This makes it possible to arrange the basic modules like dominoes, which is where the name of the product comes from.

Each element has a precise codified position inside the structure, which is always the same whatever the version. This allows state of the art industrialisation and it is also at the basis of the EASY CHANGE patent, which allows each version of Domino to be changed into another even after installation.

Examples of modularity of the Domino system





If the needs of the plant change, Domino changes with them.

Supervision system

The supervision system is the heart of the Domino system. It allows up to 12 basic modules, even of different types to be controlled (for example chillers and heat pumps) and manages their operation according to the real plant requirements.

The supervision system basically manages all the basic modules as if they were a single cooling unit, even if they are positioned a long way from each other.

The supervision system has been designed to guarantee independent operation of the individual basic modules even in the event of failure of the supervision system itself.

This makes a total stop of the plant impossible, because in this emergency condition, each module behaves independently and is managed by its internal microprocessor. It is a fundamental security for critical plants, like those in hospitals, industrial ones and ones in hotels, where power must be delivered in all conditions.



Easy Change

The concept of modularity does not only characterise the Domino line macroscopically, but also in its constructive design. Each part of the cooling circuit has a precise physical position, which is always the same in any version. This makes it possible to rationalise and industrialise the cooling lines, but also to provide quick transformation kits from one version to another.

If, during the lifetime of a plant it should be necessary for a cooling unit to be fitted with heat recovery or to be transformed into a heat pump, the EASY CHANGE patent makes it possible.

Simple cooling and electrical kits are provided to modify any basic model of Domino simply and quickly, even after years of operation, with certain costs and a guarantee of a perfect result.

Hybrid Smart Cooling. Changes the selection logic of a chiller.

- An increase in the cooling capacity of the chiller as the external air temperature increases, according to the requirements of the plant.
- An increase in the cooling capacity of 40%, leaving energy consumption unchanged.
- An increase in the energy efficiency (EER and COP) of 40%
- A doubling of the partial heat recovery (from 35% to 70%)
- Continual production of hot water for sanitary use at a temperature above 65°C.
- A reduction of the noise of the chiller, increasing the efficiency.

These results are obtained in a simple manner, by operating naturally on the cooling cycle.

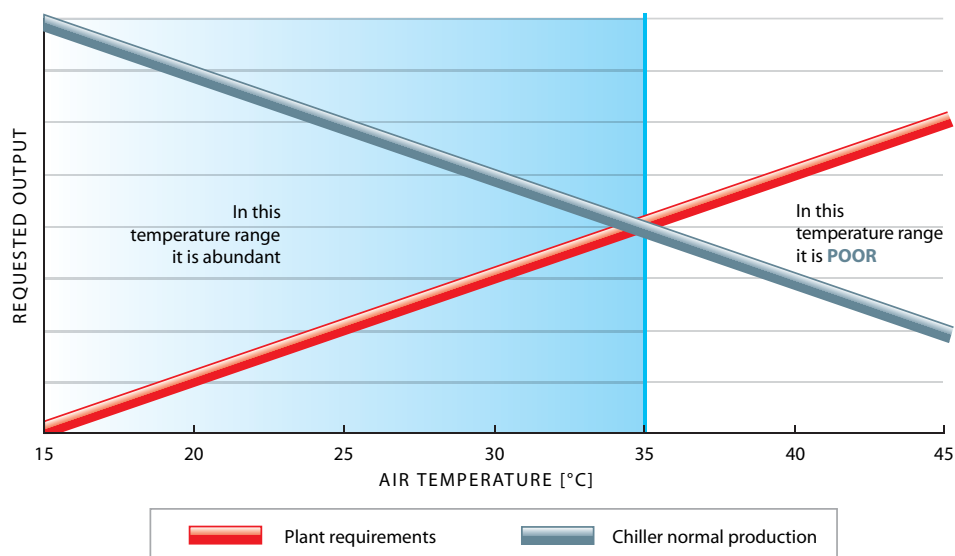
It is well known that by increasing the undercooling, the yield is increased while leaving the electrical consumption of the compressors unchanged. Normally we try to achieve this result either by increasing the surface area of the heat exchangers, or by adopting particular circuits, like those equipped with an economiser.

Thermocold has changed the perspective: the increase of undercooling is obtained by exploiting a more favourable heat source, at temperatures lower than that of the air.

This source is water, almost always available at a temperature of 15°C.

Cooling is not always and only carried out with air, but in some conditions, a part of water cooling is also added to increase the undercooling, by means of a dedicated heat exchanger. This is where the patent gets its name from.

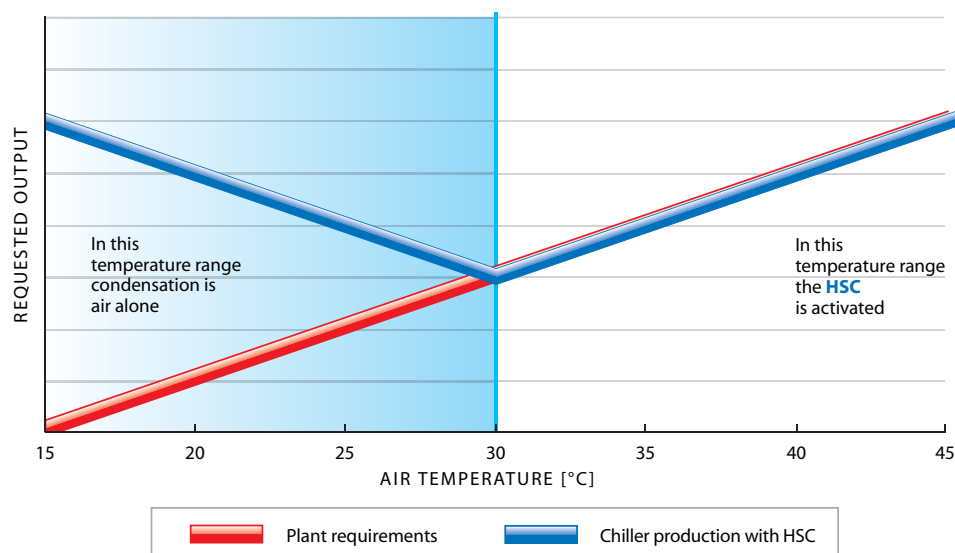
Hybrid Smart Cooling revolutionises the criteria for choosing cooling units. The main problem of a conditioning system is that with increases in the air temperature, the required power of the plant increases, while the power output of the chiller decreases.



The cooling unit is generally chosen for the power required by the plant at 35°C. In this way we have an oversized cooling unit for temperatures lower than 35°C and an undersized one for air temperatures exceeding 35°C.



The ideal thing would be to have a cooling unit which follows the power required by the system, increasing the output as the external air temperature increases. This is what Domino does thanks to the patent Hybrid Smart Cooling, thus changing the criteria for choosing the cooling unit. Selection is no longer made at 35°C, but at a lower temperature, for instance 30°C. From this temperature up, Hybrid Smart Cooling is activated and the cooling unit is capable of following the plant power request with precision.



With Hybrid Smart Cooling the following kind of chiller is selected:



smaller



quieter



lighter



with less water content



lower electrical output

Hybrid Smart Cooling is the only system in the world which allows a reduction of energy consumption and at the same time a reduction of the initial investment cost.

Hybrid Smart Cooling consumes water. Consumption is, however, extremely limited. If, consumption is nothing up to an external air temperature of 30°C, at 35°C water consumption is 7 litres/hour for each kWh of cooling produced, reaching 10 litres/hour for every kWh when the external air temperature rises to 45°C.

The water requirement is comparable to that of an evaporating tower (approximately 7 lt/h kWh) but it is only necessary with air temperatures above 30°C. The water requirement is so low that it is viable to use Hybrid Smart Cooling even if the water is thrown away.

An example clarifies the concept better. If the system requires a power of 240 kW at 35°C, a traditional cooling unit with $EER = 3$ consumes 80 kWh of electricity in one hour. With Hybrid Smart Cooling, first of all a cooling unit with an output of just 180 kW can be installed. The efficiency increases to a value of $EER=4.05$. Hourly consumption is 59 kWh of electricity and 1680 litres of water. If the cost of electrical energy is 0.13 €/kWh and that of water is of 0.5 €/m³, the hourly operating cost is 10.70 € for the traditional cooling unit and just 8.51 € in the case of Hybrid Smart Cooling.

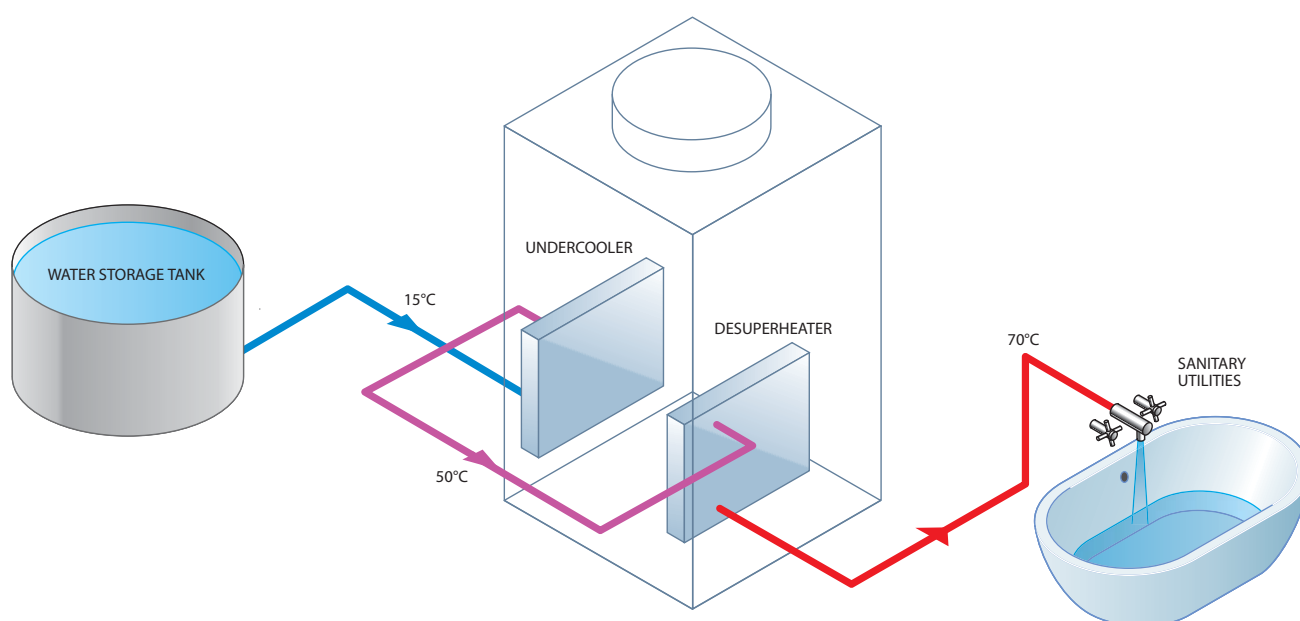


However, the water does not necessarily have to be wasted. Hybrid Smart Cooling heats the water from 15°C up to 40-50°C according to the temperature of the air. It is, therefore, possible to recover heat for producing domestic hot water. Moreover, by putting the heat recovery of the HSC system in series with a normal desuperheater, the free heat recovery power is doubled, the efficiency of the cooling unit is improved and domestic hot water can be produced continually at a temperature exceeding 65°C.

The advantages do not finish here either. When the HSC system is operating, the noise of the cooling unit can be reduced by lowering the fan rotation speed. The energy efficiency remains high, above that of a traditional cooling unit, with the fans at the maximum speed, thanks to the activation of the hybrid cooling system.



Double stage heat recovery





DOMINO INCREASES



EMWS (Energy Multiplier for Water Storage). The regenerative storage system: another great advantage of Domino.

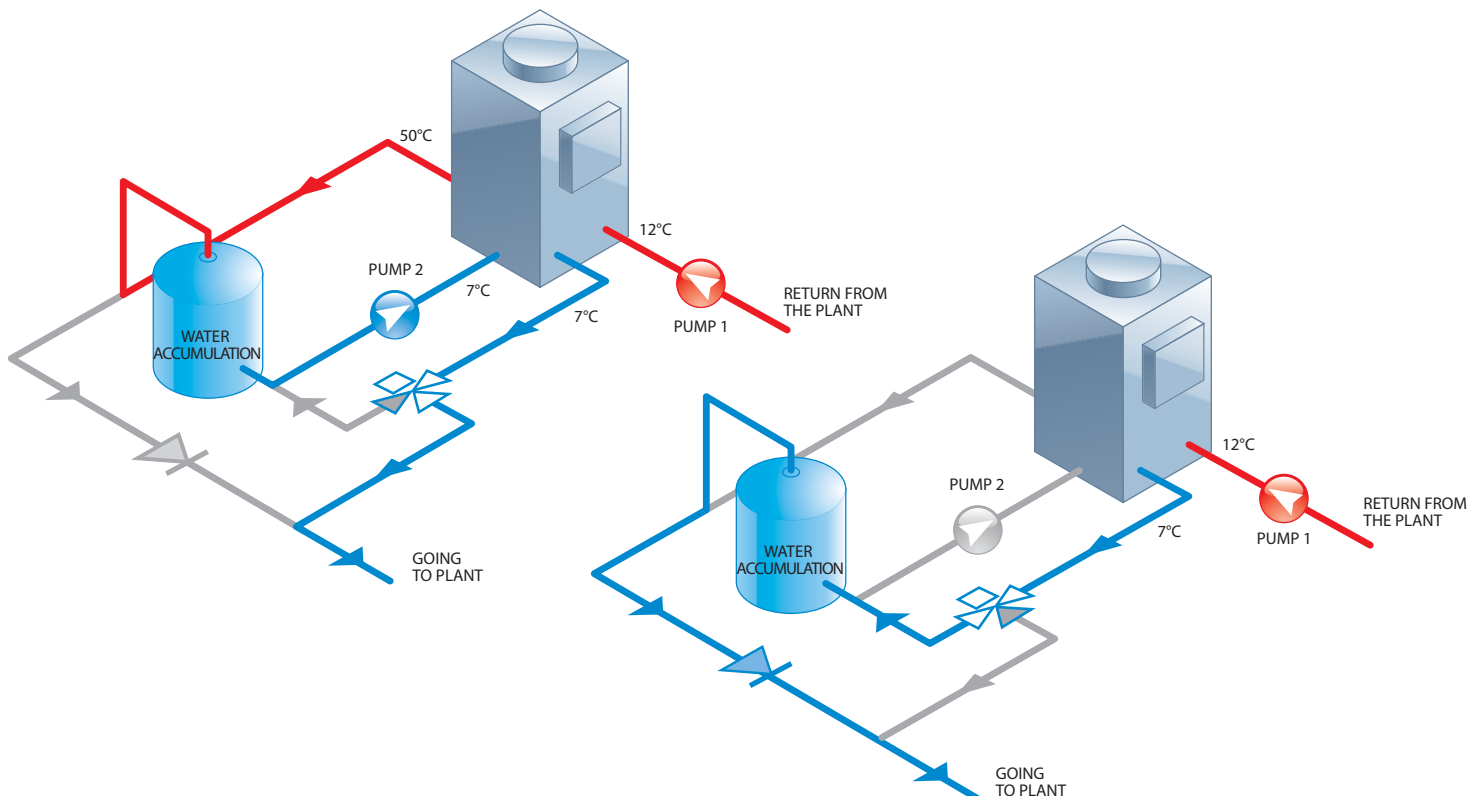
If there is no water available, the HSC system may be used to increase the instantaneous power of the cooling unit by 50%, by using the cooling energy previously accumulated. This patent allows the accumulation of up to 50 kWh for every 1000 litres of water, to make it available when the power required by the plant exceeds the power supplied by the cooling unit.

In this case too it is possible to select a much lower power cooling unit to that of a traditional chiller.

TEN TIMES THE ENERGY ACCUMULATED IN THE WATER



EMWS system operating scheme



The EMWS is an excellent alternative to the ice storage systems. Compared to these, it has much lower installation costs and does not need glycol to operate. Moreover, the energy efficiency is much higher.

During the phase of recharging the systems with ice storage, the cooling units must produce chilled water at temperatures lower than 0°C, with a loss of power and efficiency. With regenerative storage, the regeneration occurs at much higher chilled water temperatures, thus with higher yielded power and higher efficiency.

Another great advantage of regenerative storage is that it can even work at higher temperatures than those of the plant, for instance at 15°C. This makes it possible to use the fire prevention system tanks for accumulation. These tanks are characterised by enormous volumes of water, of around 50 cubic metres.

One of the limits for use as storage for the chilled water is the need for them to be insulated. In a traditional accumulation in freezing water, a 50m³ storage may accumulate about 580 kWh if the water is stored at 5°C. This means an insulation of the whole structure, which is sometimes very expensive.

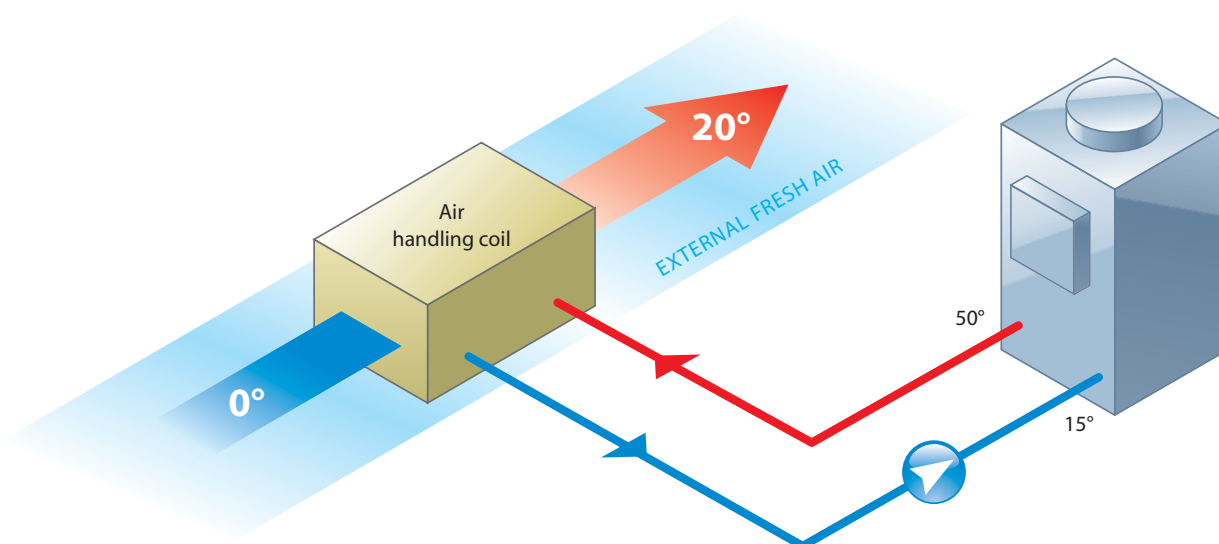
With regenerative storage on the other hand, it is possible to store water even at 15°C, the same temperature as the supply tank. Therefore, there is no need to insulate the tank structure. Obviously the increase of power of the cooling unit equipped with HSC system is no more than 50%, like in the case of water at 7°C, but limited to 40%.

The temperature difference inside the storage is much larger than that of a traditional system, about 35°C, from 15°C to 50°C. Therefore in 50 m³ of water 2000 kWh cooling can be stored. Therefore it is possible to have a 1000 kW cooling unit produce 1400 kW for 4 hours or a 700 kW cooling unit produce 700 kW for 8 hours.

We can understand the enormous advantage provided by regenerative storage compared to all the other storage systems.



EAR (External Air Recovery) system.



Regenerative storage can only be used in summer operating mode. However the HSC system can also be exploited in winter in heat pump operation to heat the external replacement air.

Indeed, it is a total heat recovery because the enthalpic differences otherwise unused are exploited, precisely because underheating is performed thanks to external air. Compared to traditional heat recovery systems or dynamic ones (with dedicated heat pump) there are significant advantages.

- No additional electrical consumption, because recovery is total and completely free of charge.
- A single coil on external air intake is sufficient: recovery can also be performed when the expulsions are distributed (for instance through the bathrooms) and not concentrated, with expulsion near the replacement air intake.
- The installation costs are extremely limited because a very small capacity pump and a tiny hydraulic circuit are sufficient. At the most, in some cases, if the air flow is low, a regulating valve is necessary.
- No further equipment like heat recovery units or heat pumps are necessary for dynamic recovery. A cooling unit equipped with HSC system is sufficient.
- There is a mean seasonal energy saving estimated at 20% more than even the most sophisticated dynamic recovery system.



DOMINO ADAPTS ITSELF



Where to use Domino.



Buildings in old town centres



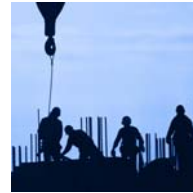
Buildings of artistic importance



Buildings with static problems



Replacement of existing units



Plant expansion and evolution

ON ANY TYPE OF BUILDING AND PLANT. 29

	Easy to handle (easy to transport)	Adaptable (free layouts)	Slim (compact size)	Flexible (adaptable to plant developments)	Low noise impact
Buildings in old town centres	■	■	■	■	■
Buildings of artistic importance	■	■	■	■	■
Buildings with static problems		■	■	■	
Replacement of existing units	■	■	■	■	
Plant expansion and evolution	■	■	■	■	■

DOMiNO

It solves all problems of space.

Domino.

Small dimensions and easy transport and movement.

Easiness to handle

It makes the installation of Domino suitable above all in buildings in old town centres and in buildings of artistic importance. In old town centres, moving large cooling units is always complicated. The roads are narrow, the positioning of lifting cranes is extremely difficult. The situation in the buildings of artistic importance is even more critical, because, added to the external movement difficulties, there are also those inside the building, which is not designed to house any machinery. With Domino everything is more simple because more units of extremely compact size and weight must be moved.

Adaptability – free layouts

It is a “universal” advantage, suitable to any building type and use. Each basic module of Domino can be connected to the others both hydraulically and electrically, no matter where its is positioned. Wherever there is a static or space problem, the adaptability of Domino becomes essential.

Slimness - compact size

It is an advantage which goes hand in hand with adaptability. Domino is easy to position and to hide to the sight because it requires extremely small installation spaces. The spaces to respect are also much less than those of traditional units, so their occupation in the plan is optimised.

Flexibility – capacity to adapt to plant evolutions

Whatever evolutions the plant undergoes, Domino is capable of adapting itself either by adding a new basic module or by modifying one thanks to the EASY CHANGE patent. This makes Domino preferable to any other traditional cooling unit in any building type, especially where physical dimensions and weights have a vital importance.

Low noise impact

In the HP soundproofed version Domino has excellent acoustic performances. This advantage, along with the fact of being able to distribute the lay out of the basic module freely, even on the basis of the acoustic requirements of the installation place, makes Domino the best solution wherever there are noise problems.



Why to use Domino.

The performance features of Domino make it suited to any plant type for any use, particularly for:



Hotels and houses



Hospitals



Industries



Entertainment premises



Restaurants



	Reliable	Heat recovery	HSC	EMWS	EAR	Easy Change
Hotels and houses	■	■	■		■	■
Hospitals	■	■	■		■	■
Industries	■	■	■	■	■	■
Entertainment premises	■		■	■	■	
Restaurants	■	■	■	■	■	

Domino.

The most technologically advanced chiller.

Reliability

It is ensured by the large number of compressors, independent cooling circuits, switchboards and microprocessors for individual base module, capable of operating in emergencies even with the supervision system out of order, and by the total redundancy easily obtainable. Whatever the use, the reliability of Domino is a guarantee for the operation of the plant in any circumstance.

Easy Change (EC)

The patent allows any basic module to be transformed into a different version anywhere and at any moment, for instance from a chiller to a heat pump. This guarantees the designer and the final user a flexibility to modify the performance and the function of Domino following any new plant requirements.

Heat recovery

The recovery of heat improves the energy performances of the plant every time it is necessary to produce heat and cold at the same time.

Thanks to the Hybrid Smart Cooling patent, Domino is the only cooling unit capable of increasing simultaneously both the cooling capacity and the heating capacity, doubling the energy benefit.

It is also the only heat pump capable of recovering heat for the production of hot water for sanitary use free of charge in winter and producing it constantly at a temperature exceeding 65°C, at the same time improving the COP by 40%.

Hybrid Smart Cooling (HSC)

The patent allows an improvement of 40% of not only the power delivered but also of the efficiency of the cooling unit, against an extremely limited water consumption. This consumption can even be completely eliminated, if the water is recovered for other uses, like sanitary use for instance.

The patent also allows the load requested by the system to be followed precisely, no matter what the external air temperature is. Domino is the only cooling unit capable of increasing the power with increases in the external air temperature.



External Air Recovery (EAR)

The patent allows the heat in heat pump operation to be recovered to heat the external replacement air. This allows the efficiency of the heat pump to be increased by 40% and to use more simple heat and cheaper recovery systems than the traditional ones.

It is particularly suited in plants where the extractions are not concentrated in a single point, where the quantity of air entering is higher than that removed to guarantee a suitable overpressure. Moreover, it is particularly suited to mild climates in which the capacity of recovery of traditional systems is poor.



Energy Multiplier for Water Storage (EMWS)

The patent increases the energy accumulated in water and simultaneously increases the power delivered by the cooling unit by 50% while leaving consumption unchanged.

It is a valid alternative to the ice storage systems, with much lower costs and simplifications at a plant level (it is not necessary to use glycol nor add heat exchangers). The restoring of the accumulation is performed at the same production temperature requested by the plant. Therefore, it can be performed at the same time as normal operation, something which is impossible for ice storage systems, which require restoring at a production temperature of -5°C

The energy may also be stored at 15°C . Therefore, fire prevention tanks can also be used, without any need to perform heat insulation of their structure.

The EMWS system is particularly suited to all plants with power peaks in a few hours of operation, like rooms for artistic productions, restaurants and some industrial uses.

Technical features

		Domino	Setting	40	50	60	80	100
Performances kW	Cooling capacity	ST - HP		44,0	51,6	59,1	77,5	103,5
	Compressor input power	ST		16,0	18,1	20,2	28,0	35,4
		HP		14,5	16,6	18,7	25,0	32,4
	Heating capacity	ST - HP		50,0	58,4	66,8	86,1	115,5
	Compressor input power	ST		16,0	18,0	20,0	28,0	35,9
		HP		14,5	16,5	18,5	25,0	32,9
Partial heat recovery	ST D - HP D		15,4	18,1	20,7	27,1	36,2	
Total heat recovery	ST R - HP R		57,0	66,7	76,3	99,5	132,9	
Energy (consumption)	Summer energy efficiency class	ST		C	C	B	C	B
		HP		B	A	A	A	A
	Winter energy efficiency class	ST		B	A	A	B	A
		HP		A	A	A	A	A
	ESEER	ST		4,64	4,87	5,04	4,61	4,98
		HP		5,34	5,52	5,64	5,41	5,64
IPLV	ST		4,75	5,01	5,20	4,70	5,12	
	HP		5,55	5,75	5,89	5,61	5,86	
Acoustics dB(A)	Sound pressure level ***	ST		57	57	57	60	60
		HP		46	46	46	49	49
		HP SLN		43	43	43	46	46
Dimensions mm	Length			1100	1100	1100	2200	2200
	Width			1100	1100	1100	1100	1100
	Height			1900	1900	1900	1900	1900
	Weight kg			420	580	650	1020	1020
		Domino with HSC	Setting	40	50	60	80	100
Performances kW	Cooling capacity	ST - HP		61,6	72,2	82,7	108,5	144,9
	Heating capacity *	ST - HP		67,5	78,8	90,2	116,2	155,9
	Partial recovery power **	ST - HP		33,0	38,7	44,3	58,1	77,6
	Total recovery power **	ST - HP		74,6	87,3	99,9	130,5	174,3
Energy	Summer energy efficiency class	ST		A	A	A	A	A
		HP		A	A	A	A	A
	Winter energy efficiency class	ST		A	A	A	A	A
		HP		A	A	A	A	A
	ESEER	ST		5,25	5,51	5,71	5,22	5,64
		HP		6,04	6,24	6,39	6,12	6,38
IPLV	ST		5,23	5,51	5,73	5,18	5,64	
	HP		6,11	6,33	6,48	6,18	6,45	

* The difference between the heat output between the HSC version and the normal version is only used to produce water for sanitary use or for the EAR system.

** The difference between recovery output between the HSC version and the normal version is only used to produce water for sanitary use.

*** Sound pressure levels calculated according to ISO 3744 at 10 mt distance from the unit with outdoor temperature 35°C, evaporator water temperature 12/7°C.



