The Modern Cabin Ventilation on Board

WHITE PAPER

The basic differences between cabin units, fancoils and beams

Enabling Wellbeing

Halton

About the paper

Halton has supplied user-friendly and energy-efficient ventilation solutions for over 150,000 cruise ship cabins. The company offers three different type of cabin ventilation solutions for ships and ferries: system based on cabin units, fancoils and now chilled beams. This white paper explains in a general level what kind of solutions these three different options are and how they differ from each other.

About Halton Marine

Halton Marine is one of the world's leading suppliers of HVAC solutions specifically designed for demanding environments. Halton's track record includes deliveries to well over 150 major cruise ships, 200 oil & gas projects both offshore and onshore and 150 naval vessels.

Halton's scope of supply for ships and offshore applications

- Cabin ventilation solutions
- Galley ventilation solutions
- Ventilation fire safety
- Airflow management and distribution
- Air intake products
- Central vacuum cleaning systems
- Laboratory ventilation - clean spaces

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Foreword: Halton develops ventilation solutions for demanding indoor air environments

Halton is known for its ventilation solutions for demanding spaces. Within company's over 50 years of experience the company has developed, manufactured and supplied its products and solutions to 5-star restaurants and hotels, hospital operating rooms, isolation rooms, airports, stadiums, oilrigs, submarines, nuclear power plants and cruise ships just to name the few.

Halton has 9 Innovation Hubs around the world where it researches good indoor air conditions. Halton also uses third party (independent) laboratories and research centers for testing and verifying its solutions.

Halton has supplied user-friendly and energy-efficient ventilation solutions for over 150,000 cruise ship cabins. The company offers three different type of cabin ventilation solutions for ships and ferries: system based on cabin units, fancoils and now chilled beams.

Cabins use approximately 30% of the total HVAC consumption on board cruise ships. Systems might differ from one manufacturer to the another. The choice of the solution is usually done by the cruise line owner. This white paper presents the very basic system descriptions and comparisons between the solutions by Halton who is the manufacturer of all three different solutions.

Background information

In year 2019 approximately 30 million ocean cruise passengers took a cruise. Majority of the passengers came from North America.

Cruise Lines International Association (CLIA) is an association of cruise lines. During 2019 there where altogether 272 CLIA-Member cruise ships in operation and around 20 new ocean ships were scheduled to debut.

cruisemapper.com tracks currently altogether 1417 ships. Some of those however are still on construction stage.

The cost of building a cruise ship generally depends on the vessel's size, the building shipyard, the design, the onboard features like facilities and amenities and the economy itself. All the world's big to biggest cruise ships costs in million of US dollars - usually several hundreds of million dollars - and the biggest even over billion dollars. The passenger capacity varies from small cruise ships with a little over hundred passengers to over 6000 passengers depending on ships' size and purpose.

Ventilated beams - Halton CaBeam

Halton has manufactured chilled beams for commercial building industry for over 20 years. In the past few years the company has developed a ventilation beam solution specifically designed for different types of ships and ferries. This solution improves energy efficiency and has lowers running costs.

Halton Marine's CaBeam™ is a combined ventilation device for cooling, heating and ventilation. It can be installed in various locations inside the cabin or room as an exposed, covered or integrated solution. Halton CaBeam™ is an air/water system that utilizes the heat transfer properties of water and provides excellent indoor climate conditions with good energy efficiency. The system is designed to use the dry cooling principle, operating with conditions where condensation is prevented by system design and controls. Structure and operation of the products is designed so that filtering of recirculated air is not needed.

The sufficient amount of primary supply air enters the plenum of the chilled beam from where it is diffused into the cabin through nozzles or supply grille. The supply air nozzle jets efficiently induce cabin air. The induced air flows through the heat exchanger, where it is cooled. Heating can be either separated water circulation inside of the coil, integrated or external electrical heater. Automation controls cooling water flow and heating based on temperature requirement.

Independent research has shown that chilled beams create uniform air quality and offer substantially lower lifecycle costs and maintenance requirements compared to more traditional systems like fancoils. In addition, this type of system reduces noise, eliminates draughts and enables individuals to control temperatures. The system can be also connected into network – just like cabin units and fancoils.

Halton manufactures several different types of beams for cabins. The suitable choice is based on both: customer's architectural needs and ventilation requirements.

Picture 1. Halton CaBeam integrated above a closet

Picture 2. Halton CaBeam integrated in false ceiling

Features

- The air supplied into the space is usually a mixture of recycled and fresh air. Only supplying the small amount of fresh air is required.
- Relatively high chilled water temperatures are used. This means saving in energy and smaller cooling plant.

Benefits

- The cooling energy is transported by water. Because water has much higher specific heat thermal capacity than air, the needed space for transferring energy is much smaller resulting in smaller ducting and air handling units (AHU). The saved space can be used for other purposes like an additional cabin or building technology.
- Lower life-cycle costs compared to cabin units and fancoils
- Lower maintenance needs: no filter to be changed, no fan maintenance; no electrical consumption of the fan. Easy to clean coils and surfaces
- Dry cooling coil: no condensate collection system
- Comfortable, stable cabin conditions with individual control of temperature and indoor air quality
- Lighting, speakers and other building technology equipment can be integrated in the beam
- Draught free also in maximum cooling load conditions
- Ultra-low sound levels compared to any other system

Cabin units

Halton's cabin units have been designed specifically for cabins and other similar areas on board ships and offshore installations. Halton cabin units are installed above the false ceiling of the space. Cabin units gets all fresh supply air from Air Handling Unit (AHU). Air is typically between 14-18°C, depending on geographic location of vessel.

We have a wide range of different room thermostat styles available to connect to our cabin unit to enable individual adjustment of temperature level in each cabin.

Halton cabin units can be connected to a network which enables controlling, monitoring, trouble-shooting and adjusting indoor climate centralized via network without a need to entering the cabin.

Halton cabin ventilation system based on cabin units is completed with suitable diffuser and exhaust valve.

Features

- The air supplied into the space is always 100% fresh
- Silent operation - excellent sound attenuation properties
- No need for an air filter change

Benefits

- No need for cooling water system and piping network, savings in investment cost and vessel weight (weight of piping and cooling water system)
- Low maintenance needs due to robust mechanical and electrical components
- Pressure independent system is easy to balance as it adapts automatically to pressure variations on ductwork and keeps airflow on setpoint

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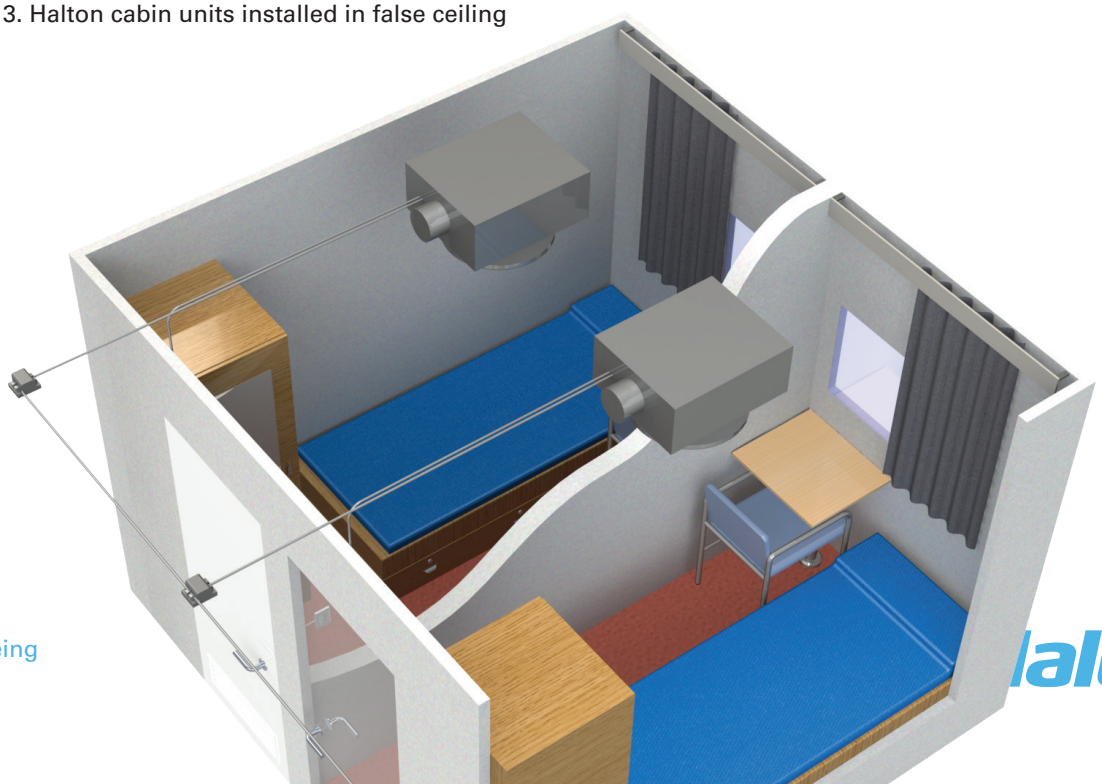
Picture 3. Halton cabin units installed in false ceiling



Fancoils

Halton manufactures fancoil units that can be installed in proximity of the cabin/room to service a single space. Multiple small fancoil units can be used to service a small apartment / suite.

Halton Marine's fancoil is a pressure dependent constant air flow (CAV) unit as standard. Pressure independent variable air flow (VAV) operation system for fresh air is available as an option.

We have a wide range of different room thermostat styles available to connect to our fancoil units to enable individual adjustment of temperature level in each cabin.

Features

- The air supplied into the space is usually a mixture of recycled and fresh air. Only supplying the small amount of fresh air is required. This means saving in energy and smaller cooling plant.

Benefits

- Because water has much higher specific heat thermal capacity than air, the required space for transferring energy to the cabin is much smaller resulting in smaller ducting and air handling units (AHU). The saved space can be used for other purposes like an additional cabin or building technology.
- Total cooling energy demand is smaller compared to cabin unit system
- If the fancoil is installed outside of cabin, in multi-function situation, there is no need to enter the cabin and cause disturbance for passengers
- Condensing cooling coil used inside the fancoil together with the heater can be used to remove moisture from cabin air
- Fancoils react quickly to changing ventilation needs with an integrated fan
- In case of an AHU failure it is still possible to maintain cabin ventilation with a fancoil unit

Summary: comparison of different solutions

By comparison of the Halton Marine's cabin ventilation solutions

- Ventilation requirements of the cabin/room remains the same whether the solution is based on cabin units, fancoils and beams.
- Energy transfer to the cabin is more efficient with water solutions like CaBeams and Fancoils
- Energy consumption of solutions differ substantially: cabin units utilize 100% fresh air taken from outside, then cooled in AHU and then electrically reheated to the desired level. Fancoils and CaBeams use approximately 30% of fresh air (based on ISO 7547 requirement) which is cooled with AHU, then mixed with the recirculated air and heated/cooled within the unit by means of water.

FEATURES	CABEAM	CABIN UNIT	FANCOIL
Installation	Inside the cabin or room as exposed, covered or integrated solution. Architect must be consulted. The unit itself distributes air.	Inside the cabin above false ceiling. Requires space.	Inside the cabin or proximity of cabin (service locker).
Installation	Requires some effort.	Most challenging.	Easiest.
Installation costs	Can be integrated into cabin at the cabin factory.	Most expensive of the three options to install. Needs to be integrated in the cabin at the ship yard unless a Halton swing down cabin unit is used.	Can be integrated into cabin at the cabin factory.
Space requirement for AHU and ductwork	Saves space compared to cabin units.	Requires more space than CaBeam and fancoil.	Saves space compared to cabin unit.
Product invesment cost	Approximately the same as cabin unit.	Approximately the same as CaBeam.	Most expensive.
Energy transfer to cabin	By water - more efficient than air.	By air.	By water - more efficient than air.
Energy consumption	More energy efficient than system based on cabin units. CaBeam recirculates air.	As the system uses 100% fresh air, it consumes more energy than CaBeam and fancoil.	More energy efficient than system based on cabin units. Fancoil recirculates air.
Maintenance needs	Low maintenance needs.	Low maintenance needs.	Needs more service than cabin units and CaBeams.
Sound levels	Ultra-low sound levels.	The unit attenuates sound.	Fan can cause some sound in cabin if unit installed in cabin.
Air quality	Recirculated air (appr. 30% fresh air, 70% recirculated air).	100% fresh air.	Recirculated air (appr. 30% fresh air, 70% recirculated air)

Life-cycle and maintenance calculations: Fancoils vs. Beams

The figures of the below calculations are indicative and based on estimations however, they give an idea of the maintenance costs of two different solutions in 20 years. The maintenance needs for chilled beams appear to be substantial lower also because there is no filter to be changed, no condensation collection system to be cleaned and there is no fan that might break. The basic maintenance of chilled beam requires cleaning of the coils when needed.

The example calculations show that chilled beams are over 75% more economical choice what comes to maintenance costs within 20 years.

You are welcome to change the figures according to your project.

Case study: Fancoil	2500	cabins	20	-year life cycle:	
	20 €	Labor cost per hour			
Filter change:	25 €	per filter	/ 3	filters a year	3 750 000 €
	5	min to replace			250 000 €
Fan replacement:	300 €	per fan	/ 50 %	to be replaced in life cycle	375 000 €
	15	min to replace			6 250 €
Watervalve actuator replacement:	100 €	per unit	/ 10 %	to be replaced in life cycle	25 000 €
	15	min to replace			1 250 €
Heater replacement:	100	per unit	10 %	to be replaced in life cycle	25 000 €
	15	min to replace	/		1 250 €
Thermostat replacement:	100	per unit	10 %	to be replaced in life cycle	25 000 €
	15	min to replace	/		1 250 €
Cleaning of condensation tray:	15	min to clean	/ 2	times a year	500 000 €
Fancoil replacement:	3 000 €	per unit	/ 10 %	to be replaced in life cycle	750 000 €
Total:					5 710 000 €

Case study: Chilled beam	2500	cabins	20	-year life cycle:	
Cleaning of chilled beam:	20	min to clean@20€/h	/ 2	times a year	666 667 €
Watervalve actuator replacement:	100 €	per unit	/ 10 %	to be replaced in life cycle	25 000 €
	15	min to replace			1 250 €
Heater with integrated thermostat replacement:	100	per unit	/ 10 %	to be replaced in life cycle	25 000 €
	30	min to replace			2 500 €
Chilled beam replacement:	2 000 €	per unit	/ 10 %	to be replaced in life cycle	500 000 €
Total:					1 220 417 €

Difference in maintenance and replacement costs:	**4 489 583 €**

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About us

Halton Group

Halton Group specializes in indoor environment solutions, ranging from public and commercial buildings to foodservice facilities. Founded in Finland in 1969, Halton operates today in over 35 countries around the world, with annual sales of €220 million and over 1600 employees. The company has production facilities in Brazil, Canada, China, France, Finland, Germany, Malaysia, United Kingdom, and the USA.