ENGINEERING
TOMORROW

Danfoss

Hydronic balancing valves | AB-QM

Significant **energy savings** and optimal **passenger comfort**

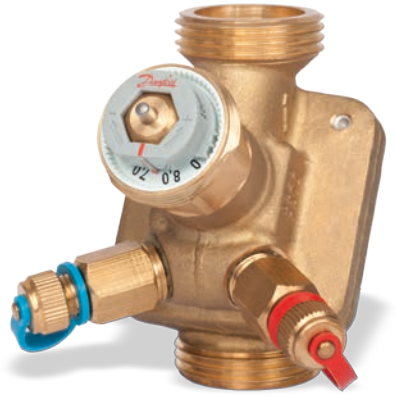
The latest Royal Class cruise ship to join the P&O Cruise Lines fleet, the Britannia, is designed for optimal passenger comfort and energy efficiency. The Italian air-conditioning manufacturer, Rhoss Spa, wanted to offer the Fincantieri shipyard a more energy efficient solution than the conventional valves used aboard cruise ships for distributing cooling to the cabins and public spaces. They chose the pressure independent balancing & control valve from Danfoss, the AB-QM, to reduce energy waste and ensure precisely the right amount of cooling is delivered.

2000

AB-QMs save energy and ensure optimal comfort for nearly 5000 people on P&O's new cruise ship.

www.hbc.danfoss.com

Less fuel, less emissions and more passenger comfort **with AB-QM**



Air-conditioning for passenger comfort is second to propulsion for using energy on a cruise ship and can account for 30-40% of fuel consumption which could be 50,000 tonnes of Bunker oil for a large cruise ship each year.

25-30% energy savings with AB-QM
The AB-QM, Pressure Independent Balancing and Control Valve, (PIBCV), can save 25-30% of HVAC energy costs compared to conventional distribution designs, equating to about US$1 million each year at today's oil prices for a large modern cruise ship.

Poor balancing costs more money
Chilled water is produced by a central chiller then pumped through pipes to fan coil units (FCUs) in passenger cabins and public areas, where the chilled water absorbs heat from the rooms.

Conventional distribution designs using constant flow systems or variable flow systems must be manually balanced to ensure there is enough pressure to reach those locations farthest from the pumps. But manual balancing cannot adapt to varying demand, causing over-pumping and low-delta T syndrome (where the chilled water is returned to the chiller still cold), keeping operating costs closer to 100% even when cooling demand is only half of that. The main challenge in using conventional distribution systems is that temperature regulation becomes unstable, varying similar to on/off control, reducing passenger thermal comfort, leading to additional cooling demand and higher costs.

Pressure independence – easy comfort with AB-QM
The AB-QM from Danfoss combines three functions in one valve body:

- Pressure Controller – ensures pressure independence
- Automatic Balancing – Limits maximum flow rate
- Control Valve – precisely regulates flow to match demand

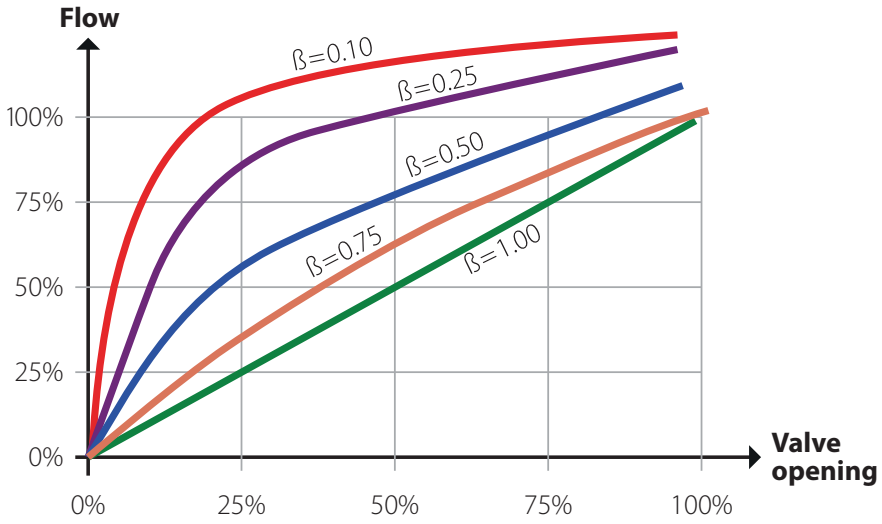
Not only does the AB-QM enable variable demand to be matched by variable supply, reducing pump speed and chiller output, it relieves designers of tedious, lengthy calculations necessary to ensure valve authority; the AB-QM always has 100% authority. Moreover, passenger thermal comfort is improved and assured.

Time to install and commission – reduced with AB-QM
Fewer AB-QM valves are required than in conventional designs, which means less installation, less commissioning and no balancing, since balancing is done automatically inside the PIBCV.

Chilled water flow can be modulated to match demand, achieving precise temperature regulation, optimized pump speeds and higher chiller efficiency.

Proven reliability – millions of AB-QMs installed
PIBCV technology has found application in the construction sector for the last 10 years with millions of valves in buildings around the world, proving the technology and reliability.

Return on investment – less than 1 year for the AB-QM
The PIBCV is especially appropriate for cruise ships, ferries, and luxury yachts, but all marine vessels with central heating or cooling and hydronic distribution will benefit. Energy savings will vary with size of vessel and number of heat exchangers, but the return on investment could be as little as three months for a large cruise liner.



For conventional systems, increasing pressure across the control valve decreases valve authority (β). The effect is nearly full flow for only a small valve opening.

The AB-QM however, always has authority β=1 , so that actual flow equals set flow.

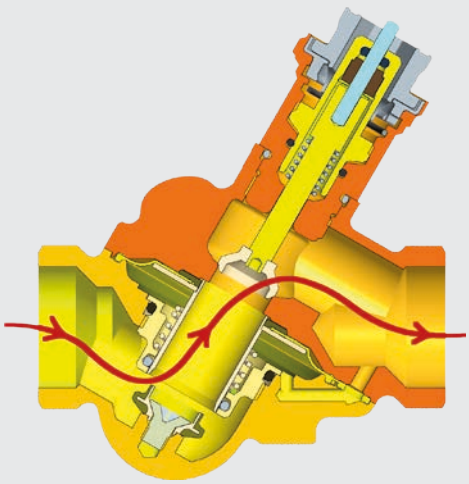
$$ß = \frac{\Delta p \text{ open valve at design flow}}{\Delta p \text{ closed valve}}$$

The AB-QM in cross-section
How does it work

The yellow lower part of the valve body holds the differential pressure controller, which operates independently governed by the membrane, restricting the opening directly before the control valve to maintain a constant differential pressure.

The orange upper part of the valve body contains both the control valve and balancing valve components.

In order to perform the balancing function, the maximum height of the control valve can be adjusted, effectively limiting the maximum flow. The adjustment is made by rotating a graduated ring at the top of the valve stem to a percentage position, indicating the maximum flow through the valve. The control valve is operated by applying a downward force to the top of the valve stem.



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Royal Class cruise ship equipped with **AB-QM**

The Britannia is one of the first cruise ships Fincantieri built with the AB-QM pressure independent balancing & control valve for its air-conditioning. With other ships already following, the AB-QM has set the efficiency benchmark for future cruise liners.

The P&O luxury liner is due to make her maiden voyage in early 2015, with 3647 passengers and 1350 crew. 2000 high efficiency Rhoss fan coil units (named PAX-iQ) fitted with AB-QM valves from Danfoss ensure comfort in the 1837 cabins. But more than comfort, the AB-QM delivers energy savings, reducing fuel costs and cutting emissions. The same is true for the new Rhoss floor standing type FCUs (named TOTEM) fitted with large sized AB-QMs for delivering cooling and heating to public spaces.

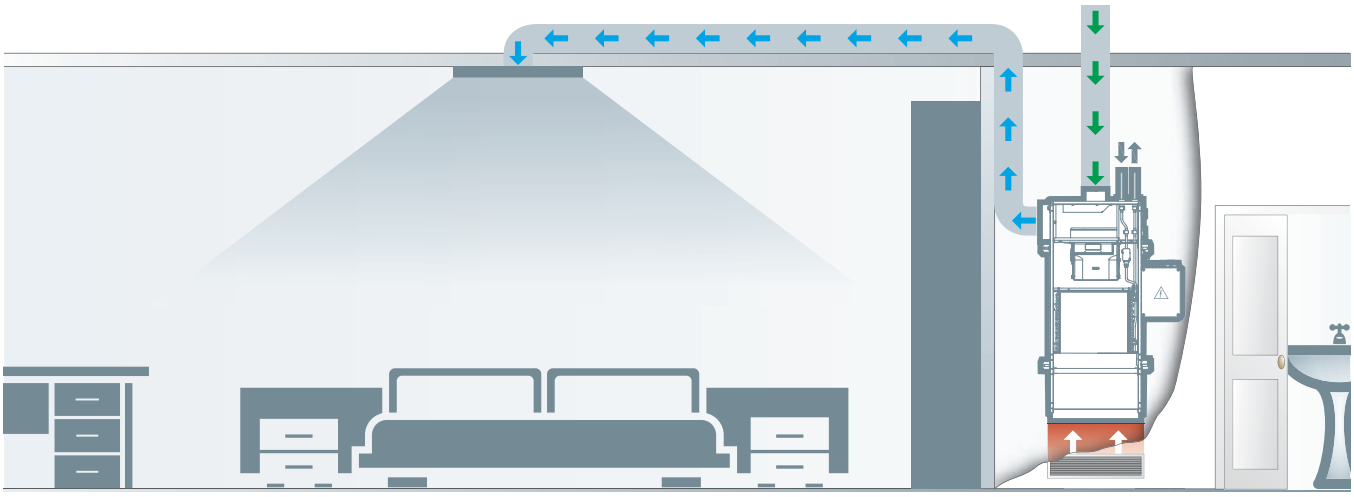
Savings are achieved by reducing unnecessary over-pumping, and thereby pump energy, when cooling demand is lower. Something the manual valves could not do, since their aperture is fixed. Even higher savings were possible for the chiller, since over-pumping causes overflow and low delta-T syndrome. The chilled water flows too quickly though the fan coils, unable to absorb enough heat from the space, reducing chiller efficiency dramatically.

It took less time to design the air-conditioning system using the AB-QM, since it is not necessary to calculate

valve authority or Kv values for sizing the valve correctly; just knowing the required flow to match the room size is enough.

It also took less time during installation, since the AB-QM combines 3 valves in 1, there were fewer valves to install and there was no need to balance the system, the AB-QM automatically adjusts to pressure changes, always ensuring the correct flow.

The additional investment pays for itself during construction and installation and continues to save energy every year, reducing fuel used and emissions. Air-conditioning for passenger comfort is second to propulsion for using fuel on a cruise ship, so the added efficiency of the new Rhoss fan coils with integrated AB-QMs from Danfoss play a major role in reducing environmental impact as well as reducing running costs.



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