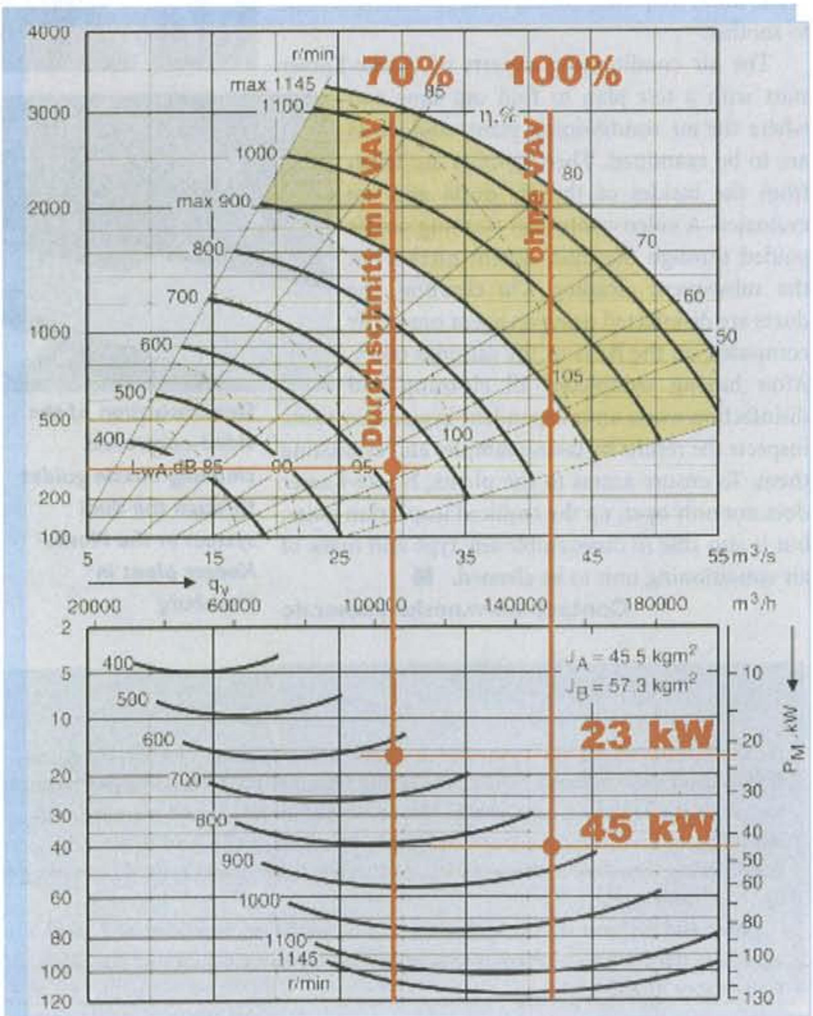
Up to 50% energy savings on board

The worldwide increase in the price of oil has especially affected fuel prices. Burning diesel fuel ultimately generates the energy required on board a ship. This means that each kilowatt-hour of electrical energy saved on board has a direct influence on the consumption of diesel and thus a lasting effect on the operating costs.

A considerable amount of energy is expended for the well being of passengers, particularly on cruise ships. Proper air conditioning of the cabins and day rooms plays an important role in this. A bad room climate will inevitably result in complaints, and even the best food and entertainment on board will not be able to compensate for this shortcoming.

Figure 1



For this reason, variable air volume (VAV) systems are used for room air conditioning on many cruise ships. VAV systems are established on modern cruise ships throughout the world and already ensure that processed air is handled economically. The following describes how the efficiency of these systems can be increased even further using state-of-the-art bus technology, without having to forgo the usual convenience.

VAV systems

Today's VAV systems adapt the required air volume to the needs of passengers by controlling the room temperature. This reduces the required volumetric flow by up to 30% compared to systems with constant volume control. The reduced volumetric flow means that less fan energy needs to be expended for conveyance. The example in figure 1 shows that up to 64% of the fan energy can be saved by reducing the volumetric flow by one-third. The reason for these savings is that the ratio of the actuator output of the fan changes to the third power in relation to the volumetric flow. The additional savings potential for heating and cooling, as well as for humidifying/dehumidifying due to the reduced volumetric flow, is not taken into account yet.

In today's VAV systems, a constant supply pressure

Proportionality laws

The proportionality laws form the basis of the volumetric flow transport.

- The **volumetric flow** is proportional to the **speed** $\left(\frac{V_1}{V_2}\right) = \left(\frac{n_1}{n_2}\right)$
- **Pressure increases** change to the second power with the volumetric flow ratio. $\left(\frac{\Delta p_1}{\Delta p_2}\right) = \left(\frac{V_1}{V_2}\right)^2 = \left(\frac{n_1}{n_2}\right)^2$
- The **power consumption** changes to the third power with the volumetric flow ratio. $\left(\frac{P_1}{P_2}\right) = \left(\frac{V_1}{V_2}\right)^3 = \left(\frac{n_1}{n_2}\right)^3$

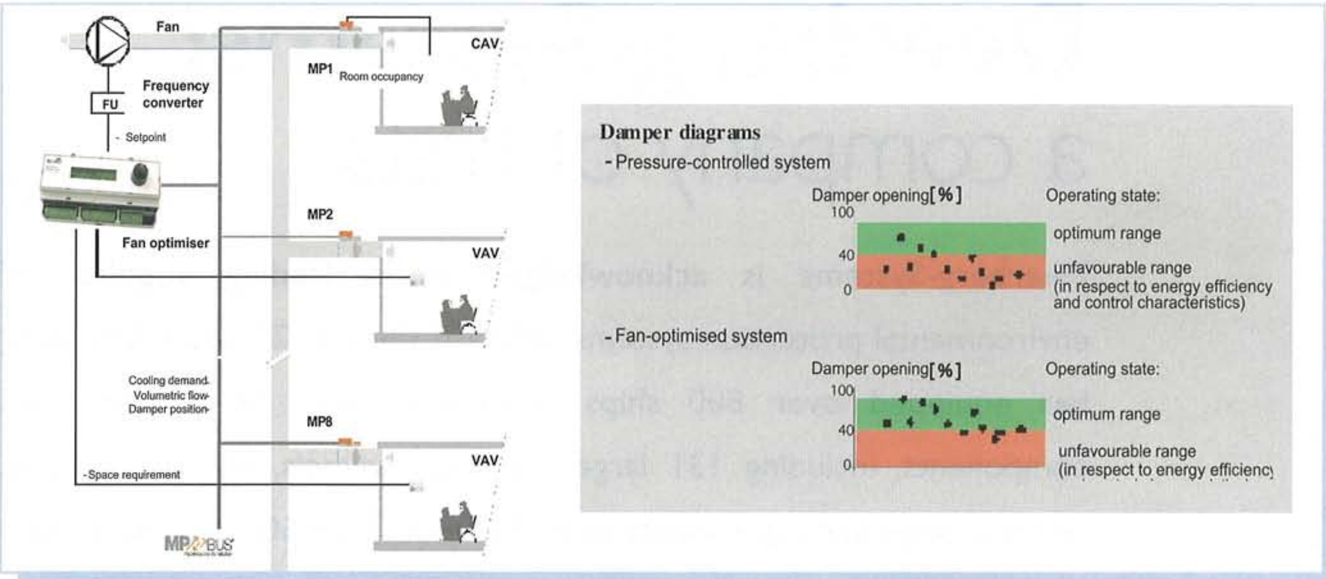


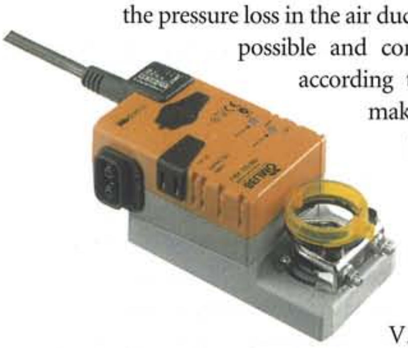
Figure 2

control in combination with a speed-controlled fan has been proven in practice. The supply pressure is set so that even the most distant rooms can still be supplied with the necessary volumetric flow, taking into account all pressure losses. To ensure this, even when operating with maximum volumetric flow, the system supply pressure is set higher than necessary. This safety surplus is eliminated by the individual VAV controllers, however.

In accordance with the space conditions on board, small air duct cross-sections are normally used to transport the air. This means that a considerably higher-pressure loss occurs in the air duct system compared to buildings. Consequently, the fans on board a ship have to generate a considerably greater pressure to overcome this resistance.

Up to 50% less energy

As shown in figure 1, a large part of the electrical energy is expended for transporting air (fan). The optimization potential of a VAV system lies in keeping the pressure loss in the air duct system as low as possible and controlling the fan according to demand. This makes safety reserves unnecessary.



The use of modern, bus-capable VAV controllers such as the VAV-Compact from Belimo (above) makes it possible to evaluate the current damper position, as well as to transfer set points/actual values and status information.

Based on the information of the individual damper positions (see figure 2), the output of the fan can be decreased until all possible control dampers of the VAV units are nearly open. As a result of the continuous evaluation of the individual damper positions, the fan output is always optimally adapted to the current demand and the pressure loss in the air duct system is reduced to an absolute minimum, without diminishing the room comfort. Because the fan is controlled according to the damper position, up to 50% additional electrical energy can be saved compared with today's VAV systems, depending on the operating state. In the case of lower air duct pressures, the risk of interfering noise is also automatically reduced – a positive side effect.

When the individual VAV-Compacts are directly integrated in a bus system, the evaluation of the damper positions and the fan control can take place on the control system level.

The Belimo fan optimiser also allows conventional systems to benefit from the advantages of fan control via damper position.

Using the Belimo VAV-Compact in combination with damper position evaluation results in decisive advantages on ships:

- Energy savings of up to 50% compared with VAV systems controlled by supply pressure.
- Less noise in the air duct network.
- Pressure control is no longer needed for fans.
- Easier commissioning of the system because of self-adapting control characteristics.
- Simple retrofitting of existing VAV systems with the Belimo fan optimizer. ■

Detailed information on the products can be found on the website: **www.belimo.com**

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