

Induction units vs. Fan Coil units

Economical and technical comparison for cooling in hotel bedrooms

A comparison of induction units and fan coils with EC Technology was undertaken as part of a scientific study. Owing to their lower noise emissions, both systems are frequently selected solutions for the decentralised air conditioning of hotel bedrooms, but both have definite pros and cons. The aim of the study was to compare the economical and technical differences between both systems for the cooling of hotel bedrooms.

Functional comparison of induction units and fan coils

Both units are installed in hotel bedrooms below suspended ceilings to meet the heating and cooling loads of the rooms.

Induction units

Induction units are connected directly to the air duct system and induce the air to the rooms through nozzles. The temperature of this air is adjusted in the heat exchanger and fed back into the room with the primary air through an air outlet grille.

Fan coil units

With fan coil units, the supply air outlet is located in the suspended ceiling. The room air is drawn in by the fan through a shadow gap in the suspended ceiling, its temperature is adjusted before it is fed back into the room.

Object of the scientific study

Various parameters were defined and a calculation model produced taking into account Guidelines VDI 2067 "Efficiency of building services systems." A fictitious building with varying number of rooms and room sizes was used as the basis for the study. The loads of the rooms were determined for different cases using hourly calculations, and the fan coils and induction units were selected on the basis of this.

Defined parameters for the calculation basis

▶ Induction unit:	Dry cooling at CPW 16/18 °C Heating at LPHW 45/35 °C
▶ Fan coils:	Dry cooling at CPW 16/18 °C (as a comparison) Wet cooling at CPW 7/12 °C Heating at LPHW 45/35 °C
▶ Assumed room temperatures:	In winter: 21 °C / In summer: 26 °C
▶ Assumed heating load:	60 W/m ²
▶ Assumed cooling load:	40 W/m ²
▶ Load profile:	The load profile and the times the rooms were used were in compliance with DIN 18599-10
▶ Primary air percentage:	With both versions using baffle-controlled primary air
▶ Building pollutants:	1 m ³ /(h x m ²)
▶ People:	20 m ³ /(h x person)
▶ Room size:	20 m ²
▶ Room use:	Unoccupied room: 20 m ³ /h required Occupied room: 60 m ³ /h required
▶ Air handling unit:	Kampmann Airblock KG

Scope of analysis

The following aspects were examined based on the defined parameters:

- ▶ electrical energy consumption
- ▶ heating and cooling energy requirement
- ▶ investment, maintenance and repair costs

Comparison of induction units and fan coils with dry cooling

The analysis first compared fan coil units and induction units based on dry cooling. The analysis showed that a higher external pressure is required with induction units, which leads to higher power uptake by the fans in the central ventilation unit. Furthermore, the percentage of primary air needed to meet the cooling load is greater than with fan coil units. The volume of air needed to dispel pollutants in the air is significantly exceeded, which, in turn, has a negative impact on energy consumption.

However, often fan coils operating with wet cooling are used to air condition hotel bedrooms. The fan coils, used as decentralised units, use a fan with EC Technology, thereby generating higher heating and cooling output, with the result that the units need approx. 1/3 less space. As hotel bedrooms are generally becoming ever smaller, from a cost-benefit aspect, fan coils have a distinctive advantage here.

Comparison of energy consumption

The findings of the comparison show that the electrical energy requirement, that is the heating energy and cooling energy requirement of an air handling unit, is fundamentally higher when using induction units than when using fan coils.

The reason for the higher energy requirement is the volumetric flow needed by the system, which is higher with induction units. The pressure loss also increases with the same air duct dimensions. If the air ducts are increased, the space requirement and material costs also rise.

One reason for the significant differences in the energy requirement is that a higher air volume is often needed from induction units than the minimum air volume needed to discharge the humidity and pollutants.

It is also possible that induction units have to be operated with a higher air volume without the room being occupied. The high power consumption is generated by the centralised ventilation unit in a system operating induction units.

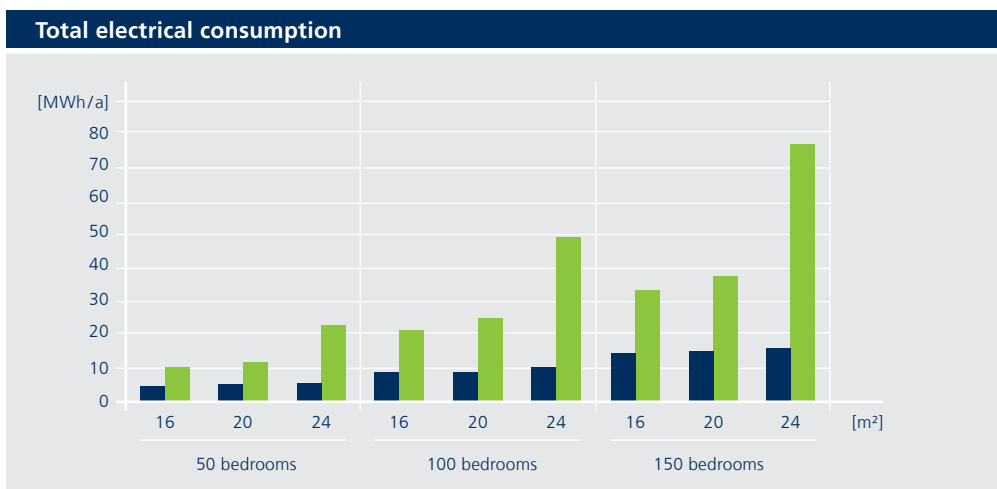


Fig. Comparison of electrical energy requirement of an induction unit and fan coil including air handling unit, split according to hotel and room size.

■ System with fan coils
■ System with induction units

Comparison of the heating energy requirement

There is no significant difference between the heating energy requirement of induction units and fan coils, although the heating energy requirement of the air handling unit is higher with induction units due to the higher volumetric flow of the system. The outside air volume is increased by the air volume of the system that has to be heated by the heater in the centralised ventilation unit.

It is not possible to use the recirculating air in a mixing chamber in the centralised ventilation unit, as the extract air from the bathrooms may not re-enter the supply air on account of the odours produced there.



Fig. Comparison of the heating energy requirement based on the total of the hourly heat load multiplied in each case by one hour and the number of bedrooms.

■ System with fan coils
■ System with induction units

Comparison of the cooling energy requirement

The result of the electrical energy requirement in the air handling unit is reflected in the cooling energy requirement. It was assumed that the primary air enters the room pre-conditioned. Greater cooling output from the air handling unit is fed to induction units owing to the increased air volume, regardless of whether the cooling output is actually needed. It is also possible that the outside air is cooled in the centralised ventilation unit and has to be re-heated in the room to the customer's requirement.



Fig. Comparison of the cooling energy requirement based on the total of the hourly cooling loads multiplied in each case by 20 hours and the number of bedrooms.

■ System with fan coils
■ System with induction units

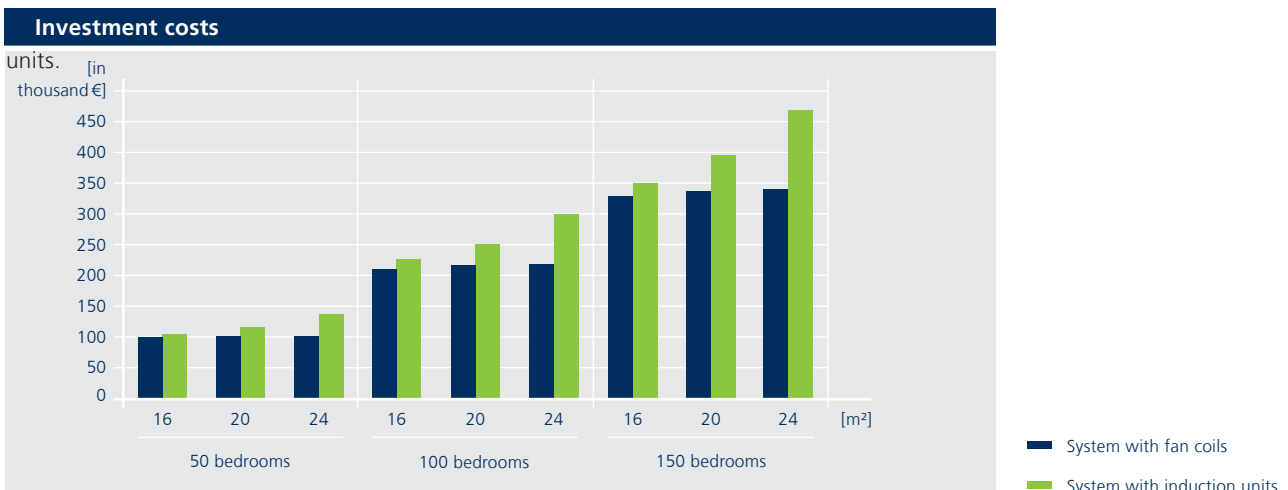
Investment, maintenance and repair costs

In calculating the investment cost, the accessories have also been considered as well as the units. This includes the safety equipment on the condensation drain, the outlet grille and the valves and actuators.

The procurement cost of fan coils is higher than that of induction units on account of the lower number of rooms and the smaller rooms. The additional cost is based on the cost of the filter and filter replacement. Induction units are generally supplied without filter. Guideline VDI 6022 (Hygienic standards for ventilation and air conditioning systems) states that equipment needs to have an ePM10 50% (formerly M5) filter to comply with these standards. This is not common but is possible in fan coils. Coarse dust filters are usually used in these units. It is impossible to use this kind of filter in induction units as the pressure loss is too high, which means that induction units no longer conform to VDI 6022 according to the new standards. Replacement costs with fan coil units can be significantly lowered by the use of regenerative filters.

However, when considering the total cost including accessories, the cost of induction units is higher than the cost of fan coil units. With induction units, the higher primary air volumes caused by the design have a negative impact on the investment cost for the ductwork*, the air handling unit and the rebuilding of the room to accommodate duct work. The total cost of the system

*Cost of ductwork including leakage rate – € 45 / m² Ductwork surface area



Maintenance and repair work

Maintenance and repair costs need to be calculated for both systems. Whereas the filter in a fan coil unit has to be replaced if regenerative filters are not used, the maintenance of induction units barely incurs costs. Induction units also entail higher maintenance and repair costs associated with the ductwork and air handling unit, in view of the larger rooms and higher volumetric flow required.

Conclusion

In conclusion it is possible to state that a definitive comparison of the two systems always depends on the corresponding room loads as well. As there are serious fluctuations in the primary air flow required when designing induction units, this, in turn, results in large differences in energy consumption and also in investment costs.

A comparison of the total costs of both systems has shown that fan coils units are the less expensive option with virtually identical investment costs. One reason for this is the higher energy consumption of the centralised ventilation unit when using induction units. What is more, subsequent expenditure for wear parts, such as the fan, do not let the total cost of fan coil units exceed the total cost of a system with induction units over the period under review.

A further aspect is the size of the centralised ventilation unit. If the statutory requirements of Stage 2 of the Energy-related Products (ErP) Directive 2018 are taken into consideration, the centralised ventilation units will have to be around 30 % larger to transport the same air volumes. Correspondingly any anticipated additional costs relating to the size of the unit have not been taken into consideration.

Comparison of both systems at a glance

Induction units	Fan coil units
<ul style="list-style-type: none">▶ Higher investment cost due to larger duct networks and shafts▶ According to the new Energy-related Products (ErP) Directive 2016/2018, the centralised ventilation unit requires approx. 30 % more space to transport the same air volume▶ Induction units are approx. 1/3 larger than fan coil units▶ Higher air volume needed than the minimum air volume required to discharge the humidity and CO₂ loads produced in the room▶ Low sound emissions (operation at stage 2: 22 – 30 dB(A))▶ Ease of maintenance, no maintenance costs due to filter changer	<ul style="list-style-type: none">▶ Lower investment costs▶ Smaller space requirement (installation in the suspended ceiling)▶ Energy savings due to decentralised air conditioning of the hotel bedrooms (only as much primary air as is needed) and thanks to high-performance heat recovery▶ Low sound emissions (<20 – 33 dB(A))▶ Low maintenance costs through the use of regenerative filters▶ Ease of maintenance

Do you have questions about the study or about the Kampmann GmbH hotel air conditioning system? Get in touch with us! We'd be happy to advise you.

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