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Best Practice	REPLACEMENT OF TRANSMISSION SYSTEM	HVAC-04
Application	Optimisation of HVAC systems	
SME sector	All	
SME Sub-sector	All	

Technical description

Existing components can be exchanged for new, more efficient components.

In order to get an indication whether the transport system (fan, drive type, motor) is efficient or inefficient, the specific fan power value (SFP) can be used.

This measure indicates how much energy is needed for the transport of a given volume flow.

All occurring losses (efficiencies, pressure losses, line losses, etc.) are included in this figure. Determining the specific fan power (SFP) requires the following data:

- Electrical power consumption (P_{el}) of the fan motor [W]
- Nominal volume flow by the fan [m^3/s]

The calculation is made by the following formula: $PSFP = \frac{P_{el}}{V_N} = \frac{\Delta p}{\eta}$

PSFP [W/m^3s]: specific fan power
P_{el} [W]: electric power of the engine
V_N [m^3/s]: nominal air volume flow of the fan
Δp [Pa]: total pressure increases of the fan
η: overall efficiency (fan, drive, motor)

The specific fan power is compared with the following table. The lower the PSFP value, the more effective the system will be. SFP values not higher than SFP 3/4 are recommended.

Specific power classes for fans

class	Specific fan power (SFP) [$W/(m^3/s)$]
SFP 1	< 500
SFP 2	500 ÷ 750
SFP 3	751 ÷ 1250
SFP 4	1251 ÷ 2000
SFP 5	2001 ÷ 3000
SFP 6	3001 ÷ 4500
SFP 7	> 4500

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Recommendation for optimisation	An optimally designed belt solution results in a better overall efficiency of the drive system. 95% of all fans are currently connected to the engine via a belt drive, with the V-belt accounting for the largest share. In general, the use of flat belts instead of V-belts can improve the efficiency by an average of approx. 5%. Due to the positive power transmission efficiency losses due to bending stress and friction between the belt and pulley hardly occur for timing belts.
Relevant technical considerations	• Direct drive: η = 1 • Single V-belt - Pel < 5 kW → η=0.83 - Pel > 5 kW → η=0.90 • Multiple V-Belts: each additional V-belt reduces the efficiency of the transmission 1% ▪ Flat belt - Pel < 5 kW → η=0.90 - Pel > 5 kW →η=0.96 In direct drives, the loss of energy due to power transmission is the lowest, while that of V-belts is the greatest. Therefore, if possible, the direct drive should be preferred.
Economics	The cost of the transmission belts is limited (approx. 30 EUR/m)
Energy savings	Using flat belts instead of V-belts can improve efficiency about 5% on average.
Economic savings	Improved efficiency means energy savings and consequently a reduction in energy costs (5-10%).
Average Payback Time	Less than 3 years
Emissions	This measure does not involve further emissions.
Environmental benefits	Reduction in CO_2 emissions due to lower energy needs.
Main NEBs (Multiple benefits)	☒ Environmental benefits ☐ Increased productivity ☐ Work environment/ Health/Safety ☐ Increased competitiveness

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	☐ Maintenance
Replicability	High
Related measures	• HVAC-01: Reduction of fan running time • HVAC-02: Flow rate reduction through variable speed variation (VSD) • HVAC-03: Replacement of fan • HVAC-05: Heat and moisture recovery • HVAC-06: Reduction of pressure loss • HVAC-07: Leakage reduction of pipes • HVAC-08: Replacement of motor
Case study	Replacement of fan pulleys company "Kanuf GmbH" (Austria, 2006) • Initial Situation: in the drying plant big fans are necessary to exhaust the humid air. The drying plant consists of three zones, in each zone there are two fans. The flow rate was controlled by an inappropriate vane control, which worked rather as a throttle because of its big distance to the fan. The 6 Fans of the drying plants consume 20% of the overall electricity consumption. • Description of the optimisation: by changing the size of the pulleys of the fans in zones 1 and 2 the speed and the flow rate were reduced. The reduction of the necessary power by 63 kW and the resulting energy saving led to a cost reduction of 24,000 EUR. • Implementation costs: 3,500 EUR • Payback Time: 2 months
References	Gerstbauer, Ch., Kulterer, K., Gorbach, Ch., Brunner, W.: Leitfaden für Energieaudits von Lüftungsanlagen, klimaaktiv energieeffiziente betriebe, Wien 2013

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