Energy Efficiency HVAC System for bigEE

Authors
Nan Wang
CNES University of Pretoria
Approved by
SANEDI

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Abbreviations AND Acronyms

Acronym	Description
EE	Energy Efficiency
POET	Performance, Operation, Equipment and Technology
HVAC	Heating, Ventilation and Air Conditioning
VFV	Variable flow volume
SANS	South African National Standards

This document provides guidance on the state of the art efficient heating, ventilation and air conditioning (HVAC) systems and Energy Efficiency (EE) improvements to existing HVAC systems in South Africa.

1 INTRODUCTION

Information on HVAC systems is provided in terms of the performance, operation, equipment and technology (POET) framework. When possible, the information is classified in to groups of South Africa best available technologies and practices and International best available technologies and practices.

The feasibility of using energy efficiency technologies such as demand controlled ventilation shall be evaluated based on the incremental investment costs incurred to achieve energy and energy cost saving. An easy and quick decision making indicator is the payback period. A maximum payback period should be fixed for each energy efficiency technology or optimal component design. The energy efficiency technology or optimal component design will be recommended if its payback period does not exceed the maximum payback period.

1.1 HVAC system technology

1.1.1 Demand controlled ventilation

A. **International best available technology/practice**: Combines carbon dioxide sensors with economizers to maintain optimum fresh air levels while avoiding excessive ventilation, which leads to wastage of energy.
B. **South Africa best available technology/practice**: Not Available.

1.1.2 Dedicated outdoor air system

A. **International best available technology/practice**: Improves humidity control by conditioning outdoor makeup air separately from indoor return air. Removing moisture from the outside air reduces the latent load on the cooling system.
B. **South Africa best available technology/practice**: Not Available.

1.1.3 Displacement ventilation

A. **International best available technology/practice**: Uses a low velocity stream of fresh, cold air at floor level to displace stale and warm air near the ceiling. The energy-saving potential varies by building and system design as well as climate.
C. **South Africa best available technology/practice**: Not Available.

1.1.4 Electronically commutated motors

A. **International best available technology/practice**: Same as South Africa best available technology/practice.
B. **South Africa best available technology/practice**: Include a variable-speed component. They save energy by varying HVAC fan/blower speed to match demand.

1.1.5 Energy recovery ventilation

A. **International best available technology/practice**: Captures energy from exhausted air and uses it to precondition incoming makeup air. It save energy by reducing heating and cooling system needs while maintaining comfortable indoor air levels.
B. **South Africa available practice**: Same as International best available technology/practice.

1.1.6 Advance feedback control

A. **International best available technology/practice**: Improves upon conventional control approaches by allowing more flexibility in adapting to HVAC systems with a wide range of operating states.
B. **South Africa best available technology/practice**: Same as International best available technology/practice.

1.1.7 Desiccant dehumidification

A. **International best available technology/practice**: Absorbs moisture with a liquid desiccant solution and then evaporates it using heat. The system saves energy by removing humidity and precooling makeup air, reducing air conditioning load.
B. **South Africa best available technology/practice**: Not Available.

1.1.8 Micro environments

A. **International best available technology/practice**: Create a virtual zone for occupant environmental control. While energy savings are possible, micro environments can also increase staff comfort and productivity.
B. **South Africa best available technology/practice**: Not Available.

1.1.9 Thermal energy storage

A. **International best available technology/practice**: Provides cooling capacity by extracting heat from storage material, such as ice or chilled water. Savings are realized by shifting electrical use to night time when ambient temperature and tariff rates are usually lower.
B. **South Africa best available technology/practice**: Not Available.

1.1.10 Variable Refrigerant flow/volume (Vrf/Vrv) systems

A. **International best available technology/practice**: They are ductless systems that are highly flexible in capacity and design. These systems use multiple variable speed compressors to provide part-load performance and thereby provides zoned temperature control, and saves energy while ensuring occupant comfort.

B. **South Africa best available technology/practice**: Same as International best available technology/practice.

1.2 HVAC equipment and maintenance

1.2.1 Compressor

A. **South Africa best available technology/practice**: Variable speed drives (VSDs) on compressor motors. Installing VSDs on compressor motors improves compressor efficiency by matching the compressor speed to the cooling demand.

B. **International best available technology/practice**:
   - Compressors should be located in cool and well-ventilated areas as they generate large amounts of waste heat and where possible waste heat should be recovered for reuse.
   - Insulating the suction lines reduces energy loss as compressor efficiency is improved with lower suction gas temperature.
   - Heat recovery from compressors may be viable if a potential application exists close to the heat source. A plate heat exchanger that recovers heat from the compressor's lubricating oil can heat water up to 90 °C without adversely affecting compressor performance.

1.2.2 Condenser

A. **South Africa best available technology/practice**: Cooler air may allow the compressors to operate more efficiently.
   - Rooftop cooling units containing compressors and condensers generally draw air from close to the rooftop. Cooler air may be available – as close as 1.2 to 1.5 metres high off the roof.
   - Condenser units run cooler when installed on the southern side of a building.
   - Avoid direct sunlight to shine on condenser units anytime during the day.
   - Ensure sufficient natural cross ventilation over the condenser unit to remove any hot air efficiently.
   - Avoid installing condenser in closed confined rooms where hot air might accumulate. Provide enough vents for hot air to escape or install whirley birds to remove hot air efficiently.

B. **International best available technology/practice**: Variable speed drives (VSDs) on condenser fans. Installing VSDs on condenser fans can reduce operating costs, especially on systems with fixed-head pressures.

1.2.3 Evaporator

A. South Africa best available technology/practice:
   - Raise evaporator temperature.

- Size the evaporator to suit the load. A small evaporator may have a low capital cost but may require a larger compressor to cope with the load and therefore, have higher operating costs.

B. International best available technology/practice: Same as above.

1.2.4 Electric heating equipment maintenance

A. South Africa best available technology/practice:

- Ensure heat transfer surfaces of all units are kept clean and unobstructed.
- Make sure that air movement in and out of the units is unobstructed.
- Inspect heating elements, controls and, as applicable, fans periodically to ensure proper functioning and cleanliness.
- Determine if electric heating equipment is operating at rated voltage.

B. International best available technology/practice: Same as above.

1.2.5 Air conditioning and refrigeration equipment maintenance

A. South Africa best available technology/practice:

- Clean heat exchange surfaces.
- Check and reset – if possible, evaporating and condensing temperatures.
- Avoid non-condensable items in the refrigerant.
- Insulate the cooled space and refrigeration/chilled water lines.
- Reduce warm air infiltration to the cooled space.
- Perform chemical treatment tests on cooling tower system to determine if solid concentrations are being maintained at an acceptable level.
- Keep the cooling tower clean to minimise both air and water pressure drop.
- Clean intake strainer of cooling tower.
- Use the sight glass to spot problems – bubbles indicate problems.
- Check lubricants frequently.
- Log the operating parameters such as motor currents to spot abnormalities
- Listen for unusual compressor operation such as continuous running or frequent stopping and star ting, either of which may indicate inefficient operation. Determine the cause and, if necessary rectify the problem.
- Inspect instrumentation frequently to ensure that the operating oil pressure and temperature comply with the manufacturer's specifications.
- Inspect the tension and alignment of all belts and adjust as necessary.
- Lubricate the motor bearings and all moving parts according to the manufacturer's recommendations.
- Inspect the insulation on suction and liquid lines.
- Inspect all heat exchanger surfaces and clean as necessary.
- Inspect compressor joints and piping connections for leaks and repair as necessary.

B. International best available technology/practice: Same as above.

1.2.6 Air handling system maintenance

A. South Africa best available technology/practice:
   - Inspecting ductwork for air leakage. Seal all leaks by taping or caulking.
   - Inspect ductwork insulation and repair or replace as necessary.
   - Inspect damper blades and linkages. Clean the oil and adjust these on a regular basis.
   - Inspect mixing dampers for proper operation.
   - Clean or replace air filters on a regular basis.
   - Inspect air heating, cooling, and dehumidification coils for cleanliness.
   - Inspect for leakage around coils or out of the casing and seal all leaks.
   - Inspect all room air outlets and inlets (diffusers, registers, and grilles). These should be kept clean and free of all dirt and obstructions.

B. International best available technology/practice: Same as above.

1.2.7 Fans and pumps maintenance

A. South Africa best available technology/practice:
   - Check the alignment of the motor, fan or pump. Align and tighten as necessary.
   - Lubricate motor and drive bearings on a regular basis.
   - Check for overvoltage or low voltage condition on motors.
   - Check for excessive noise and vibration. Determine cause and correct as necessary.
   - Keep fan blades clean.
   - Inspect drive belts. Adjust or replace as necessary to ensure proper operation. Proper tensioning of belts is critical.
   - Inspect inlet and discharge screens on fans. They should be kept free of dirt and debris at all times.

B. International best available technology/practice: Same as above

1.2.8 Hot and chilled water piping maintenance

A. South Africa best available technology/practice:
   - Inspect all piping for leakage at joints. Repair as necessary.
   - Inspect strainers and clean regularly.
   - Inspect vents and remove all clogs. Clogged vents retard efficient air elimination and reduce efficiency of the system.
   - Inspect insulation of hot and chilled water pipes and repair or replace as necessary.
   - Check flow measurement instrumentation for accuracy and adjust, repair, or replace as necessary.

B. International best available technology/practice: Same as above.

1.3Recommendation

Best available practice from either South African or international one shall be used subject to financial feasibility and technical suitability in HVAC system.

2 HVAC system operation

2.1 Sizing

A. South Africa best available technology/practice: HVAC system should be designed to match the peak time cooling load.
B. International best available technology/practice: Same as above.

2.1.1 Recommendation

South Africa available practice shall be used for high-energy efficiency.

2.2 Control philosophy

A. South Africa best available technology/practice: Each air-conditioning system (AC) shall be provided with at least one automatic control device for regulation of temperature. Thermostatic controls for comfort shall be capable of adjusting the set point temperature of the space they serve to between 20 °C and 24 °C. Each air-conditioned zone shall be controlled by individual thermostatic control
corresponding to temperature within the zone.
B. International best available technology/practice: NA

2.2.1 Recommendation

South Africa available practice shall be used for high-energy efficiency.

3 HVAC system performance

3.1 coefficient of performance (COP)

A. South Africa available practice: The minimum coefficients of performance of unitary and packaged air-conditioning equipment are given in the following table:

Equipment Type	Capacity Range	Minimum COP
Unitary (console) and split type	< 7	2.5
Packaged and split air conditioning	7<19	2.6
	10<40	2.96
	40<70	2.72
	>70	2.64

Water cooled package	<20	3.2

B. International available practice: A+++ (Europe EE rating).

3.1.1 Recommendation

International available practice shall be used subject to financial feasibility and technical suitability.

References

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Your guide to energy efficiency in buildings.

bigee.net

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The bigee.net platform informs users about energy efficiency options and savings potentials, net benefits and how policy can support achieving those savings. Targeted information is paired with recommendations and examples of good practice.

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Dr. Stefan Thomas • bigee@**wupperinst.org**

Wuppertal Institute for Climate, Environment and Energy • Doeppersberg 19 • 42103 Wuppertal • Germany • Phone: +49 (0)202 2492-129