NCPC
NATIONAL CLEANER PRODUCTION CENTRE
SOUTH AFRICA

BEST PRACTICE GUIDE

Motors

A motor system refers not only to the motor but also the power quality of the electricity supply, the motor controls, the coupling to the load, the load, and the process being served.

The overall efficiency of the motor driven process depends on many factors and could include motor efficiency, motor speed controls, power supply quality, system oversizing, distribution network, mechanical transmission (coupling), maintenance regime, load management, and efficiency of the end-use device (e.g. fan, pump).

CONSIDERATION	GOOD PRACTICE
Systems approach	• The design of the process can influence the overall efficiency of the system. • Match the load and the motor. • Consider implementing an energy management system (EnMS) such as used for ISO 50001. An EnMS could require a policy regarding motors, and is a sound way of embedding good practice in an organisation. • A good systems approach leads to increased productivity, improved reliability, and reduced costs.
Motor types	• There are many motor types, including direct current or alternating current. • The squirrel cage induction motor is used in more than 90% of industrial applications, mostly the three phase. • Squirrel case induction motors are robust, easy to maintain, relatively low-cost and can be easily controlled by a variable speed driven motor. • Replacement motors should always be of the highest efficiency available. The improvement over less efficient motors is numerically small but the cost to operate over the motor lifetime is vastly lower and a premium motor quickly pays for itself from lower running costs.
Motor rewinds	• Many motors are rewound rather than replaced after failure. This tendency increases with motor size because it is slightly cheaper than a new motor. • Rewinds can reduce motor efficiency by up to 2%. This is approximately the value of efficiency improvement for a higher efficiency motor compared with a lesser one and the same financial argument can be made. • Decisions to rewind should be reflected in a motor policy.
Motor system assessment (audit)	• An opportunity to look for parts of the system that can be improved in order to improve the whole system. • Quantify potential improvements, possibly with the support of an external specialist. • Prioritise action plans for the implementation of improvements, starting with the largest system, this is usually the biggest scope for improvement. • Pay particular attention to run times that are unnecessary, and switch off when they are not needed. Also pay attention to varying loads that may respond appropriately to the installation of a VSD. • Start assessment by working back from the load to ensure that the smallest motor is selected.

Power quality

- Power quality relates to supply voltage levels, voltage unbalance between phases, power factor, and harmonics.
  - Running a motor 5% above or below its rated voltage reduces efficiency and motor life.
  - Maintain a high power factor as this improves efficiency and can save electricity tariff cost penalties.
    - Partially loaded motors have poor power factors.
- A 5% voltage unbalance between phases is equivalent to a 25% de-rating of a motor. System losses increase and motor efficiency falls.
- Some electronic equipment can introduce harmonic distortion in a system. Harmonic voltage distortion of less than 1% can nearly halve the available power.

Maintenance

- Good maintenance is a good link to energy efficiency and can be a useful driver for efficiency gains.
- Regular maintenance should consider shaft alignment, lubrication of bearings, dirt removal (particularly from fan cooling area), and voltage balance.
- ‘Fix when broken’ is a poor maintenance approach. Use predictive maintenance techniques to capture degradation as soon as it starts, well before inevitable failure.
- Noise, vibration and heat are warning signals of future failures and probably indicate a current loss.