Knowledge Domain: Motors
Unit: Cleaning/Lubrication
Skill: Squealing/Grinding/Overheating/Foreign objects

Tools and Parts Required:

1) **Electric motor**
2) **Rag or cloth or brush**
3) **Screwdriver set**

Introduction

An electric motor converts electrical energy into mechanical energy. Motors are found in many diverse applications. Motors may be powered by DC or AC. A commonly used motor is the single phase Ac induction motor.

Motors need to be maintained. Improper care of motors may result in noise or overheating. Sources of noise may be the belt, shaft, start switch, bearings etc. Noise can also result from improper motor selection, overheating or dirt collection. Noise may be described as squealing, whistling, crunching or grinding. Inappropriate noises are indicators of more serious problems. Motor failure can result from such problems.

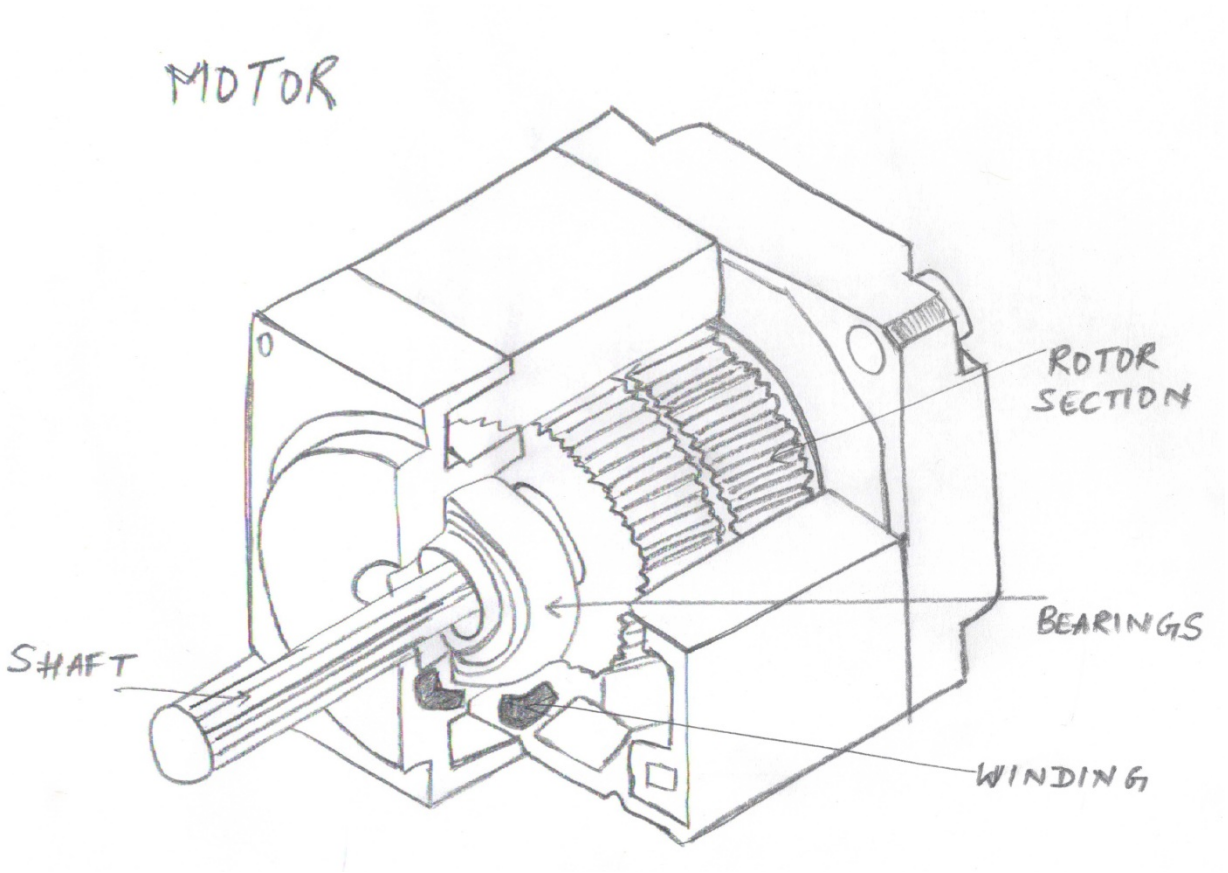
Example

The motor shaft, brushes, insulation, bearings and electrical connections are locations where problems commonly occur.

Identification and Diagnosis

You can first identify the problem in the motor - noise, vibration or over-heating. The motor may be kept running while listening to sounds. Always turn off the motor before touching it.

See picture of a common motor with some parts labeled below.



Overheating

Over-heating reduces insulation life. Motor failure can result from over-heating. Over-heating may also be a symptom of other problems. Identify excessive heat by placing your hand on the motor case at various points while the motor is running. Excessive heat can be felt at the motor's insulation. Grinding can cause excessive heat at the motor's shaft. Do not touch the running motor. A good rule is that a motor must never be too hot for you to touch it.

Some causes of overheating are:

1. Excessive motor load: The object the shaft is driving is called the motor load. An over-loaded motor draws too much current and over-heats. Check the motor torque and electrical specifications. These must match the specifications of the device the motor is driving. This information is most often present on the body of the motor (motor data plate input parameters) and the device. Jams in the device may also cause overload. Use of an under-rated motor will cause over-heating. Replace the motor if it does not match the specifications of the device.
2. Motor location: Maximize free space around the motor to allow cooling to occur.
3. High ambient temperatures may also be harmful. Motors must not be kept in temperatures exceeding the motor temperature ratings.

4. Dirt, dust, or corrosion on moving parts: Dirt prevents airflow. Check the motor for external dirt. External dirt on the motor may prevent necessary heat transfer. Dirt may be wiped off with a cloth or scraped off with a brush. Be sure the area around the motor shaft is free from dirt and rust. Refer to the BTA skill *Mechanical-Cleaning-Rust* for help. Place your hand near any air passages on the motor to check for obstructed air flow. Unsteady or weak air flow may indicate clogged passages.
5. Bearings: Problematic bearings will cause the motor to make significant noise after the load and mechanical connections are removed from the motor's output shaft. Bearings must be properly maintained and lubricated. Bearings may over-heat due to drying of lubrication. Over-lubrication may also damage bearings. Seized up bearings may also cause the motor to over-load. Over-heating bearings may be difficult to detect. The bearings may have cooled off when the motor is opened to examine the bearings. Motors ranging from 1-5hp (horsepower) usually have sealed bearings. Sealed bearings should be replaced. For other types of bearings, refer to the BTA skill *Motors-Cleaning Lubrication-Repack Bearings* for information on cleaning, lubrication and repacking.
6. Electrical connections. Check that the voltage rating and AC voltage frequency of the motor are correct for your location. For example, do not use a 50Hz motor with a 60Hz connection. Check that the windings of the motor are intact. Repair any shorts or frays in the electrical connections.
7. Loose belt: A slipping belt may cause a motor to over-heat. Refer to the BTA skills *Motors-Belts Etc- Worn Cracks Glazing* for help.
8. Start switch: A dirty switch will cause over-heating. A motor may need to be rewound after replacing or repairing the start switch.

Noise

Noise from a motor may be of several types. Squealing and grinding noises can be used to diagnose motor problems.

Squealing and grinding may be caused by the following factors:

Bearings

Bearings may be either sealed or lubricated type. Generally, bearing sounds are crunch or grinding sounds. At high speeds, there may be whistling sounds. Generally, good quality bearings last a long time. Typically, belts and coupling wear out before bearings.

Shaft

A bent shaft may cause noise. Noise from a shaft may be a scraping or grinding sound. Shafts do not usually bend unless the motor has been dropped. See the BTA skill *Motors-Belts Etc – Bent Shaft* for more information. Mechanical imbalance due to shaft misalignment may lead to excess friction or vibration. Check for excess wear due to friction near the mounting, shaft, and rotor. See the BTA skill *Motors-Tightening Etc-Vibration Motor.*

Belt

A slipping belt can be diagnosed by a sliding, rubbing sound. Verify by visual inspection. Tighten loose belts.

Motor load

An over loaded motor may cause noise. Diagnosing motor overload by sound is difficult. A motor overload may have a lower pitched sound than normal.

Foreign objects

Check for any foreign objects within the motor. Visually inspect motors gears by manual rotation. Remove any foreign objects from the motor's gears. Worn gears may need to be replaced. Worn gears may exhibit a high degree of 'gear lash'. Gear lash can be diagnosed when the shaft can be moved by hand before the gear train engages.

Procedure

Obtain a device with an electric motor. Be sure that the device is running at the specified AC voltage and frequency. Follow the procedure to identify and eliminate any sources of overheating or noise.

1. Start the motor.
2. Check the motor for over-heating as described above.
3. If motor is over-heating, refer to the list of causes listed above.
4. Identify causes of over-heating
5. Address cause of over-heating using instructions for specific source of heat.
6. If unusual noise is heard, check for vibration.
7. In case of vibration, refer to skill on motor vibration for help.
8. Identify possible cause of noise using list given above.
9. Address sources of noise using the instructions for specific source.

Exercise

Your instructor will provide a device with a motor. Follow the procedure to check for any overheating, squealing, or grinding. Clean the motor thoroughly. Your instructor must verify your work before you continue.

Preventative Maintenance and Calibration

The following may be performed as routine maintenance:

1. Clean any dirt from the motor frame or air passages.
2. Check the air passages for obstructed flow. Clean any obstructed air passages.
3. Check all parts for rust or corrosion.
4. Check the motor for excess heat, noise, or vibration.
5. Lubricate non-sealed bearings on a regular schedule. Insure grease is clean and not contaminated with dirt. Clean and lubricate bearings that are noisy or hot.
6. Check the state of the brushes and commutator. Replace or clean as necessary.

Always calibrate every medical device before returning it to use.