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Maintaining Electric Motors Used for Irrigation

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Electricity is a clean, economical and dependable source of power for irrigation. Electric motors can provide years of service when properly selected, operated and maintained. This fact sheet describes factors that affect electric motor performance and service life and describes procedures for controlling internal motor heat.

Proper Motor Selection

Electric motors are sized (rated) to operate under a standard set of conditions. Motors must be selected for different applications based on nameplate ratings. The nameplate describes the operating parameters for an electric motor and communicates this information to the user. If a 40 horsepower (HP) motor is overloaded (accidentally used to drive a load larger than 40 HP or operated at less than rated voltage), the motor will draw excessive amperage in an attempt to provide the necessary power to drive the load. When an overload exceeds the nameplate rating, the motor will run hotter than its design operating temperature. This increase in temperature deteriorates motor winding insulation and shortens motor life. Motor conductors and insulation are not designed to power loads larger than the nameplate ratings.

Factors Affecting Electric Motor Life

The life expectancy of electric motors are based on several factors. The following operating conditions affect motor life:

- ambient or surrounding air temperature
- elevation above sea level
- ventilation
- service factor (indicates amount of overload the motor can tolerate)
- operating voltage

Other factors affecting motor life include: moisture, corrosive environment (salt water), motor enclosure, maintenance, type of bearings, single or three phase power, motor type and duty rating.

Under normal operating conditions the expected life of a motor may be 5 to 10 years. The operating life of a motor may be extended to 20 years when it is used for 6-month irrigation seasons. Operation of the motor at internal temperatures above the nameplate rating will reduce motor life by damaging the motor winding insulation. Insulation materials deteriorate due to oxidation. The rate of oxidation increases very rapidly at temperatures above that listed on the motor nameplate. When winding insulation deteriorates sufficiently the motor will short internally, reducing the power output, which further overloads the motor causing it to fail, commonly known as "burning-up."

Another cause of motor overheating is the lack of air circulation through or around the motor. Small rodents or birds may build nests around the motor or in the motor air vents causing decreased air circulation and higher internal temperatures. Rodents will chew on the electrical insulation of the motor windings resulting in an electrical short which can destroy the motor.

MOTOR OPERATING TEMPERATURE

There are several factors that contribute to an increase in electric motor operating temperatures and heat. Some of these factors are ambient temperature, elevation above sea level, sunlight, overloading and low voltage operation.

- ♦ Ambient Temperature—Motors are normally rated for sea level operation at a temperature of 104ºF. Temperatures above 104ºF cause the internal motor temperature to exceed design limitations.
- ♦ Elevation Above Sea Level—Motors will operate within rated temperature limits at elevations up to 3,300 feet. Internal motor temperature increases approximately 1ºF for each 330 feet increase in elevation above sea level and beyond 3,300 feet, motor windings begin to overheat. Motors with a service factor greater than 1 (such as 1.15) can be operated at higher elevations (up to 9,000 feet) without overheating.
- ♦ Sunlight - Direct radiation from the sun can easily increase internal motor temperature by 10 to 20ºF.
- ♦ Overloading—When horsepower demand is greater than the nameplate rating a motor will attempt to produce the additional horsepower; however, the result is higher current (amperage) flow and overheating of the motor windings.
- ♦ Low Voltage Operation—When an electric motor operates at voltages less than rated values (undersized power lines, improper connections, distribution line overloads) the motor will draw additional current in an attempt to produce the rated horsepower. This increased current flow creates a temperature build-up of 1 to 2ºF for each percentage point the operating voltage is below rated voltage.

Preventing the Overheating of Motor Windings

Overheating is the main cause of reduced motor life. A producer who uses an electric motor for irrigation has little control over ambient air temperature or elevation. The damage caused by direct sunlight can be lessened if the motor is painted a reflective white or light color, and/or the motor is shaded from direct sunlight. Circulating air around the motor (built-in fan) is a practice that reduces internal heat build-up in the motor. Locating a motor in a small, well ventilated and screened building will prevent small animals and birds from building nests in or around the motor and protect the motor from damage by sunlight.

A motor may be purchased with an overload protective device, called a thermal protector, as an integral part of the motor or this device may be installed in the circuit with a motor. Such devices detect the temperature of the motor windings and/or high current situations and turn off the motor when overheating/overloading occurs. Although these protective devices will extend motor life, they may be inappropriate for pumping systems where irrigation is more critical than reduction of motor life.

Proper Maintenance of Motor Bearings

Remember to follow the motor manufacturers recommended maintenance schedule. In general, motor bearings should be lubricated once each year. Each spring before the irrigation season begins is the best time. The following procedures should be used when lubricating the bearings of a solid shaft motor.

- Open the drain plug in the bearing housing. Forcing grease into the bearing housing without opening the plug can damage the bearing shields and force old grease, moisture and dirt into the motor housing.
- Pump grease into the bearing housing until the new grease begins to come out of the drain.
- Replace the drain plug.

In a close-coupled centrifugal pump, where bearings are not sealed, it is important to keep the pump packing gland properly adjusted and maintained. Water spraying from the pump can enter the motor bearing causing it to prematurely fail.

For vertical hollow shaft motors, the bearing oil should be changed each year. When replacing the oil, follow motor manufacturers' recommendations or use 32 W clear turbine oil. The bearing oil level should be maintained at the proper level. Overfilling the oil reservoir can cause oil to overflow when a motor heats up during operation. The excess oil adheres to the motor and ventilation screens, collecting dirt and debris, and decreasing the motor's ability to dissipate heat.

Excessive motor or pump noise can be the result of motor bearing failure. When failing, motor bearings generate excessive heat that may also serve as a warning to the operator. Taking care of these problems before failure occurs can save money and prevent downtime.

General Maintenance of Motors

- Keep ventilation screens clean and in place
- Have motor windings dipped and baked every three to five years. This process adds insulation to the motor windings, provides an opportunity to inspect and clean the motor bearings and extends the life of the motor. The motor windings can be dipped and baked for a fraction of the cost of rewinding the motor. Replacing bearings before they begin to fail can save the cost of shaft repair, replacement of bearing housings and repairing damaged pumps. Scheduled maintenance of electric motors can also help avoid costly downtime during the irrigation season.
- At the beginning of each irrigation season, before the motor is used, inspect the electrical wiring and tighten all electrical connections. Loose connections cause heat build-up at electrical terminals and deterioration of motor winding insulation resulting in electrical shorts and/or motor failures. The voltage drop across loose connections cause the motor to operate at less than rated voltage, increasing internal motor temperature. A loose or broken connection can unbalance the phases of three-phase power and damage the motor windings.
- Use common sense; keep water away from the motor, keep the area around the motor dry and properly support the electrical panel to prevent motor vibrations from loosening electrical connections.

Electrical Protection of the Motor

A motor's electrical panel should include circuit breaker(s) for overload currents, a lightning arrester, surge protector and phase failure relay (to protect motor from phase reversal or failure, and low voltage). These devices protect the motor from external electrical problems, but they are not necessarily designed to protect the motor from overloading. Other safety devices such as a pressure switch (disconnects the motor if pumping pressure drops to undesirable levels), can be installed in the electrical panel for special situations.

Maintenance of Area Around Pump and Motor

A well ventilated and screened shed or shelter will provide shade for the pump and motor and protect the equipment from undesirable natural elements. Of special concern is the growth of plants and brush commonly found around irrigation pumps and motors. Weeds, grasses, and other plants should be kept away from electric motors. These plants provide a place for rodents and insects to live and such pests can crawl inside motors, chew insulation, and nest in the motor enclosure. Such pests can cause faulty connections and electrical shorts within the motor enclosure and motor electrical panel.

Winter Maintenance of Pumps and Motors

Ideally pumps and motors should be protected from the elements year round, and this is especially important in Utah during the winter months. Temperature extremes, snow and moisture can damage electrical irrigation equipment. It is also critical that all water be drained from irrigation pumps prior to freezing weather.

SUMMARY

The factors that affect an electric motor's service life include supply voltage, ambient temperature, overloading, and ventilation. These factors are not easily controlled; however, selecting the proper motor type and size to match the load, protecting the motor from direct sunlight, keeping the motor serviced and clean, keeping pests away from the motor, providing good ventilation and preventing overloads, will help assure maximum motor life.

The following items summarize electric motor maintenance.

1. Operate motor at proper voltage (It is the responsibility of the power company to provide the proper voltage and your responsibility to periodically check the operating voltage).
2. Select the appropriate size and type of motor to prevent overloading.
3. Have proper electrical motor protection installed in service panel and/or motor enclosure.
4. Regularly lubricate bearings, replace as needed.
5. Dip and bake windings at regular intervals, instead of rewinding.
6. Keep electrical connections tight.
7. Keep ventilation screens clean and in place.
8. Keep motors and area around motors clean.
9. Shade the motor to keep it cooler.
10. Protect the motor from extreme weather conditions.
11. Use common sense. Maintain and service instead of repair.

WHERE CAN YOU GET HELP?

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