

Lesson A4–8

Selecting and Maintaining Electric Motors and Controls

Unit A. Mechanical Systems and Technology

Problem Area 4. Electrical Systems

Lesson 8. Selecting and Maintaining Electric Motors and Controls

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: X: Use available power source to plan and apply control systems.

Benchmark: X-B: Reference electrical drawings to design, install, and troubleshoot control systems.

Performance Standard: 1. Develop and read schematic drawings for a control system. 2. Identify and describe uses of various components of control systems; (i.e., transistors, relays, HVAC, logic controllers). 3. Discuss the importance of maintenance schedules. 4. Identify system performance problems and apply troubleshooting techniques.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Identify and explain the advantages of electric motors.
2. Describe factors to consider in selecting electric motors.
3. Describe the basic parts of an electric motor.
4. Discuss the basic types of electric motors and their differences.
5. Identify and describe the different types of motor enclosures.
6. Describe the proper maintenance and care principles for electric motors.
7. Describe the importance of electrical controls in agriculture.
8. Describe the proper maintenance principles for electrical controls.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Brown, Robert H., and G.E. Henderson. *Electric Motors*. Winterville, Georgia: AAVIM, 1999.

Electric Motors Worksheets, No. 758. Minneapolis, Minnesota: Hobar Publications.

Johnson, Donald M., et al. *Mechanical Technology in Agriculture*. Danville, Illinois: Interstate Publishers, Inc., 1998 (Textbook, Chapter 6).

VAS U3058. *Selecting Electric Motors for use in Agriculture*. Urbana, Illinois: Vocational Agriculture Service.

VAS U3059. *Installing and Caring for Electric Motors in Agriculture*. Urbana, Illinois: Vocational Service.

VAS U3057. *Electrical Controls in Agriculture*. Urbana, Illinois: Vocational Agriculture Service.

Other Resources. The following resources will be useful to students and teachers:

Allison, James M. *Electrical Controls*. Winterville, Georgia: AAVIM, 1997.

Bear, W. Forrest, and Harry J. Hoerner. *Electric Motors—Principles, Controls, Service, and Maintenance*. St. Paul, Minnesota: Hobar Publications, 1990.

Parady, W. Harold, and J. Howard Turner. *How Electric Motors Start and Run*. Winterville, Georgia: AAVIM, 1994.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheet
Split-phase motor
Capacitor-start motor
Repulsion-start induction run motor

Terms. The following terms are presented in this lesson (shown in bold italics):

Cap screws
Capacitor motors
Capacitor-start motors
Capacitor-start, Capacitor-run motors
End shields

Explosion-proof motors
Frame
Open enclosures
Permanent-split capacitor motors
Repulsion-start induction run motors
Rotor
Shaded-pole motors
Soft-start motors
Splash-proof enclosures
Split-phase motors
Stator
Synchronous motors
Three-phase motors
Through bolts
Totally enclosed motors
Universal motors

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Place three different examples of electric motors before the class. Ask students how the motors are different from each other. They may recognize them from motors they have at home. Ask students to identify the various uses or applications of electric motors around their home and/or shop. Lead a discussion to help students recognize differences in each motor and where each type of motor might be best used. Explain the importance of electric motors in our daily lives and the importance of controlling them with various controls. Ask students to identify various types of electrical controls that may be used around their home and/or shop.

Summary of Content and Teaching Strategies

Objective I: Identify and explain the advantages of electric motors.

Anticipated Problem: What are the advantages of using electric motors over other sources of power?

- I. Electric motors offer many advantages when compared to many other sources of power such as small gasoline engines or gasoline or diesel power units. Advantages include:
 - A. Low initial investment—Electric motors may not be cheap, but when you consider the amount of work they accomplish, their cost is relatively low. They are lower in cost because they are mass-produced, have few moving parts, and are simple in construction.

- B. Inexpensive to operate—While electricity is not cheap, if you consider what it costs to accomplish various tasks, the cost is low. One kilowatt hour of electricity costs somewhere around \$.10/kWh. One kilowatt hour of electricity will provide enough power to pump over 1,000 gallons of water or supply air pressure to paint 700 square feet of surface.
- C. Efficient—Many electric motors operate at 85 percent efficiency or higher. Some 3-phase motors may operate at 93 percent efficiency.
- D. Simple to operate—May be started or stopped by flicking a switch, pushing a button, moving a lever, or automatically by an electrical control.
- E. Little servicing required—Usually restricted to occasional cleaning and lubrication.
- F. Operate quietly—They operate smoothly, quietly, and with little vibration.
- G. Compact in size—Usually much smaller than the machine they operate as well as other sources of power.
- H. Long life—They have few moving parts, do not vibrate excessively, and are lubricated efficiently. As a result, many remain in service 30 years or longer.
- I. Ready to operate—Start in extreme winter cold or severe summer heat.
- J. Will start a reasonable load—Many electric motors are designed to start under load, which eliminates the need for a clutch or transmission.
- K. Will tolerate temporary overloading—They are designed to carry up to one and a half times their rated capacity for short periods.
- L. Automatically controlled—This is important for operating heating, refrigeration, and ventilation equipment.
- M. Remotely controlled—They have the capacity to be controlled from great distances, which provides convenience, and safety of operation of electrical equipment.
- N. Adaptable—They may be moved from one operation to another by remounting the motor and changing the pulley and the belt. The direction of rotation is usually reversible as well.
- O. Portable—They are light, easily moved, and readily mounted so they may be taken to the job.
- P. Safe to operate—They are designed to prevent the operator from coming into contact with live wires or other electrical parts. They use no volatile fuel, give off no dangerous exhaust gases or fumes, have no hot exhaust manifold, and have no open gears to provide a safety hazard to operator or others.

Ask students to identify reasons why electric motors offer advantages over other types of power. Students should be able to generate many of the advantages. Use TM: A4–8A to present the list of advantages. Use the summary of content to elaborate on specific advantages. VAS U3058 pages 1–3 also discusses the various advantages.

Objective 2: Describe factors to consider in selecting electric motors.

Anticipated Problem: What factors should be considered in selecting electric motors?

- II. There are many factors to consider in selecting electric motors. They are:
- A. Type of electrical power available—AC (alternating current) may be 120, 240, or 208 voltage. AC may be single-phase or three-phase.
 - B. Size of motor—Horsepower ranges differ depending on type of motor. Shaded-pole motors range from $\frac{1}{500}$ to $\frac{1}{2}$ hp, split-phase motors range from $\frac{1}{20}$ to $\frac{3}{4}$ hp, capacitor-start motors range from $\frac{1}{8}$ to 10 hp, and three-phase motors range from $\frac{1}{4}$ to 500 hp or larger.
 - C. Starting load—Some loads are easy to start, such as fans or grinding wheels. There is usually little or no load until the motor reaches full speed. Some loads require more effort to start than to keep running, such as piston-type water pumps, air compressors, and refrigeration units.
 - D. Speed requirements—Some equipment requires higher operating speeds than other equipment. Although, some regulation of speed can be accomplished through pulley selection, motors should be selected to match closely to the speed needed.
 - E. Type of bearings—Depending on size and type, motors may provide a choice between sleeve bearings or ball bearings. There may also be several methods of lubricating the bearings.
 - F. Type of mounting—The type of base or method of mounting an electric motor may depend upon the load it drives. Some may have a resilient mounting allowing for some flexibility, while others are mounted directly to the machine. Still others may have a mounting bracket welded to the motor housing.
 - G. Environment—Motor enclosures must be selected according to the environment in which they will operate, such as dusty, dirty, or wet conditions. Some may operate in the presence of explosive vapors.
 - H. Efficiency—Select a motor that operates at high efficiency.

Use TM: A4–8B to discuss this section. It presents the characteristics of single phase motors. Have students read pages 206–209 in Mechanical Technology in Agriculture to understand how to interpret nameplates on electric motors. Have students complete LS: A4–8A, Reading an Electric Motor Nameplate, using one or more of the electric motors available for the class. Finish discussing other characteristics of electric motors using the information found on the nameplate(s). If available, have students complete Worksheet No. 740 from Electric Motors Worksheet Masters No. 758 available from Hobar Publications.

Objective 3: Describe the basic parts of an electric motor.

Anticipated Problem: What are the basic parts of an electric motor?

- III. Electric motors are relatively simple in design and contain only a few basic parts. They consist essentially of a rotating part called the **rotor** that revolves freely within a stationary part called the **stator**.
- A. The rotor consists of a slotted core, made up of thin sections of a special soft steel, carefully balanced on a central shaft. There are two types of rotors:
 - 1. A squirrel-cage rotor has slots that contain bare copper, brass, or aluminum bars which are short-circuited together at each end by end rings. They also contain a centrifugal device for operating the starting-switch mechanism.
 - 2. A wound-rotor, which is used in a repulsion-start induction motor, has coils of insulated copper wire wound in the rotor slots. It has a commutator made up of copper segments. Each segment is insulated from the other segment and the ends are soldered to individual commutator segments. When the brushes contact these segments, they complete the circuit, thus permitting currents to flow through all of the coils in the rotor in the proper sequence for starting. They contain a centrifugal device for short-circuiting all the commutator segments when running.
 - B. The stator, or stationary part, has insulated copper wire wound in slots to form one or more pairs of magnetic poles. It is mounted to the frame.
 - C. The **frame** provides for mounting the motor when it is in use.
 - D. The **end shields** house the bearings for the rotor and one end shield contains the starting switch, brushes, and electrical connections.
 - E. **Through bolts** or **cap screws** hold the motor together.

Have students read pages 15–16 in VAS U3058. You may also have students read pages 191–192 in Mechanical Technology in Agriculture text. Use the notes in the summary of content to discuss the various parts of an electric motor. If possible, have an electric motor that has been disassembled or disassemble a motor that is available to discuss the various parts. Students should be able recognize each of the various parts and discuss their purposes. Use TM: A4–8C to highlight the main parts as you identify them.

Objective 4: Discuss the basic types of electric motors and their differences.

Anticipated Problem: What are the basic types of electric motors and how are they different?

- IV. Electric motors are different in how they start, operate, and the amount of power they are able to provide.
- A. **Shaded-pole motors** are constructed simply, are low cost, and have low starting torque. They are not electrically reversible and have low efficiencies. They are used for small, light loads such as small fans.
 - B. **Split-phase motors** are simple in construction and relatively low in first cost. They have a low starting torque and require a high starting current. They are limited for use on loads

that are easy to start. They are seldom used in sizes larger than $\frac{1}{3}$ hp. They are made for either 120 or 240 volt current and are not readily changed from one to the other.

- C. **Capacitor motors** have starting and running windings in the stator and have squirrel-cage rotors. They account for the majority of electric motors sold for farm use. There are a variety of types of capacitor motors. They are used for hard to start loads such as water pumps or air compressors.
1. **Capacitor-start motors** have a capacitor placed in series with the starting winding. The capacitor is often in a tube-shaped container on the top of the motor. The capacitor in the starting winding circuit gives these motors greater starting and accelerating torque for the same starting current, usually at least twice as great as a split-phase motor of the same horsepower rating. These are used on hard-to-start loads. They range in size from $\frac{1}{8}$ hp to 10 hp and generally can be connected to either 120 or 240 volts.
 2. **Capacitor-start, capacitor-run motors** have a capacitor which stays in series with the starting winding while the motor runs. The starting switch removes only the starting capacitor from the circuit, leaving the starting winding operational. These operate more efficiently because they require lower line current when running. They also have slightly higher starting torques than capacitor-start motors.
 3. **Permanent-split capacitor motors** use the same value of capacitance in both starting and running windings. They have very low starting torques and no starting mechanism.
- D. **Repulsion-start induction run motors** have the same high starting torque as the capacitor start motors and can be used for the same type of loads. They are heavy-duty motors and can be operated on either 120 or 240 volts. They have more moving parts, have a higher first cost, and require more maintenance. They are available from $\frac{1}{6}$ hp to 10 hp. Reversing is accomplished by shifting the position of the brushes.
- E. **Universal motors** are normally found as component parts on portable power tools or appliances. Sizes range from $\frac{1}{150}$ hp to 2 hp.
- F. **Three-phase motors** are very simple in construction, have few moving parts, and require a minimum of maintenance. They have high starting torque and are used for difficult to start loads. Their size ranges from $\frac{1}{4}$ hp to as high as 500 hp. They are easily reversed by switching any two of the three line leads.
- G. **Synchronous motors** are found on clocks and timers and must be replaced with a new motor of the same kind if they fail.
- H. **Soft-start motors** may be useful for applications requiring large motors, but needing only a very low starting torque. These are single-phase motors, but if three-phase power is available, it is best to use a three-phase motor.

Have students read pages 199–204 in *Mechanical Technology in Agriculture* text. Use the summary of content to discuss the various types of motors. Have several of the different types of motors available as you discuss their characteristics so students can associate characteristics with particular types of motors.

Objective 5: Identify and describe the different types of motor enclosures.

Anticipated Problem: What are the different types of motor enclosures and how are they different?

- V. It is important to select the correct type of motor enclosure depending on the environment in which the motor will operate.
 - A. **Open enclosures** are designed for use indoors where the motor will be kept dry and clean. Openings for ventilation are usually of drip-proof design, which prevents objects or liquids from falling into the motor. They are sometimes referred to as drip-proof motors.
 - B. **Splash-proof enclosures** may be used indoors or outdoors in mild climates. They may be washed with a hose without water reaching important parts inside the motor. They are usually found on motors over $\frac{3}{4}$ hp.
 - C. **Totally enclosed motors** are recommended for extremely dirty conditions. This enclosure protects the motor from dust, dirt, grit, and moisture in the atmosphere.
 - D. **Explosion-proof motors** are manufactured in two totally enclosed types of enclosures. One will withstand an explosion of gas or vapor inside it without igniting the gas or vapor surrounding it. They are used around gasoline and similar explosive vapors. The other is designed and built so that it will not cause ignition or explosion of a hazardous dust concentration on or around the motor. They are often found in grain elevators, feed mills or flour mills where hazardous concentrations of dust are present in the air.

Have students read pages 209–211 in Mechanical Technology in Agriculture text. Use summary of content above to discuss differences in motor enclosures and appropriate locations where the various enclosures should be used. Use the motors available in the classroom, and note the type(s) of enclosures on those motors.

Objective 6: Describe the proper maintenance and care principles for electric motors.

Anticipated Problem: What are proper maintenance and care principles for electric motors?

- VI. Electric motors can provide years of trouble-free service if they are properly maintained and cared for. Some basic care principles are:
 - A. Cleaning should take place at least once a year and more often if used in extreme conditions. Always clean the outside before disassembling the motor. A soft brush and a vacuum cleaner may be used to loosen and remove dust and foreign material. Compressed air may be used if pressure is kept below 25 psi. Grease or oil may be removed with a cleaning solvent and a brush. After all parts have been cleaned, they should be dried with a clean cloth.
 - B. Lubricating the motor with the proper lubricant, in the correct amount, and at the proper time intervals is important. Follow manufacturers' recommendations.
 - C. Storage is also important. Motors should be stored in a dry place and kept free from dirt. To prepare a motor for storage, the following steps are important:

1. Wipe the outside free of all dirt and grease.
 2. Check the bearings for lubrication and add fresh oil or grease as required.
 3. Cover the shaft extension with a coating of grease to prevent rusting.
 4. Wrap the motor with heavy paper to protect it from dust, dirt, and moisture from condensation.
- D. If motors remain idle for long periods time, they should be turned on and operated for a 15-minute period every couple of weeks. This allows the motor to warm up and dry out any moisture that may have accumulated. It also lubricates the bearings.

Have students read pages 12–15 in VAS U3059 on maintenance of electric motors. Using the notes from above, discuss the proper techniques for maintaining electric motors.

Objective 7: Describe the importance of electrical controls in agriculture.

Anticipated Problem: Why are electrical controls important in agriculture?

- VII. Electric motors must be controlled in a way that their power is used when and where it is needed. They must be used in the most efficient and economical way possible. The system must provide safety for the operator, the motor, and the equipment being operated. The primary purpose of electrical controls and motors is to save labor through automation.
- A. Examples of uses of electric motors and controls include labor saving equipment used to move grain and feed, to milk dairy cattle, feed and water livestock, handle waste, ventilate buildings, and dry grain.
 - B. Controls may also be used without being associated with electric motors. One example includes photo cells used to control security lights. Other examples include smoke alarms and trigger alarms in security systems. Greenhouse operators regulate light levels and misting systems with electrical controls.
 - C. Automation depends on extensive use of time switches, thermostats, pressure switches, humidistats, and other devices used to start and stop electrical equipment without the constant attention of the operator.

Divide class into groups of 2–3 students and ask each group to identify places around their home, farm, or an agricultural business where electrical controls are used. Ask them to name the type of control that is used and how that control may save time and/or money. When sufficient time has been granted, have each group report their findings. Use transparency master, TM: A4–8D, to supplement the discussion.

Objective 8: Describe the proper maintenance principles for electrical controls.

Anticipated Problem: What type of maintenance is required for electrical controls?

VIII. If properly maintained, electrical controls should provide years of trouble-free service. Basic maintenance that should be done includes:

- A. Cleaning the controls so heat does not build up and moisture does not accumulate. Free circulation of air is necessary for efficient operation of many controls, especially thermostats and humidity controllers.
- B. Wiping the sensing element with a clean cloth to remove any oil film.
- C. Checking contacts for rough surfaces and remove rough projections with a fine file.
- D. Keeping oil and grease away from electrical controls.

Have students read page 16 in VAS U3057 on maintenance of electrical controls. Use transparency master, TM: A4–8E to discuss various maintenance tips for electric motors.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different perspective. Questions at the end of chapters of textbooks covering this material may also be used in the review/summary.

Application. Application may involve the following student activities using attached lab sheet:

Reading an Electric Motor Nameplate—LS: A4–8A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample test is attached.

Answers to Sample Test:

Part One: Matching

1 = e, 2 = h, 3 = c, 4 = b, 5 = a, 6 = d, 7 = f, 8 = g.

Part Two: Completion

- 1. oil, grease
- 2. Thermostats
- 3. dry out
- 4. Synchronous
- 5. rusting

6. Capacitor-start
7. rotor
8. pressure

Part Three: Short Answer

1. Use TM: A4–8A as a guide for scoring.
2. Answers may vary, but should include four of the following:
 - Type of electrical power available.
 - Size of motor needed.
 - Starting load required.
 - Speed requirements.
 - Type of bearings available.
 - Type of mounting necessary.
 - Environment where motor will be run.
 - Efficiency of motor.
3. Answers may vary. Below are possible answers.
 - Thermostat to control temperature.
 - Pressure switch to shut off feed/grain auger.
 - Humidistat to control humidity in greenhouse.
 - Photocell to turn on security light.
 - Smoke alarm to warn of possible fire.
 - Timer to turn misting bench on at specific intervals.

Test

Lesson A4–8: Selecting and Maintaining Electric Motors and Controls

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|---|----------------------------|
| a. stator | e. shaded-pole motors |
| b. explosion-proof enclosures | f. end shields |
| c. repulsion-start induction run motors | g. splash-proof enclosures |
| d. universal motors | h. through bolts |

- _____ 1. Simple construction, low cost, and low starting torque.
- _____ 2. Holds the motor together.
- _____ 3. Heavy duty, used on heavy loads, can be used on 120 or 240 volts, and are reversed by moving position of brushes.
- _____ 4. Use two enclosures and are suitable around gasoline or heavy dust.
- _____ 5. Stationary part of electric motor.
- _____ 6. Normally found as component parts of power tools.
- _____ 7. Houses the bearings for the rotor.
- _____ 8. Enclosures that can be used indoors or outdoors in mild climates.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. Keep _____ and _____ away from electrical controls.
2. _____ are used to regulate temperatures in agricultural buildings or greenhouses.
3. If motors remain idle for extended periods of time, they should be turned on and operated periodically for a 15-minute period. This allows the motor to warm up to _____ any moisture that may have accumulated.
4. _____ motors are found on clocks and timers.

5. When storing an electric motor, cover the shaft with a coating of grease to prevent _____.
6. _____ motors have a tube-shaped container on the top and have a higher starting torque than a split-phase motor of same rating.
7. The _____ is the rotating part of an electric motor that revolves freely within the motor.
8. A _____ type of switch would be used on a rural water system or air compressor.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. Identify six advantages of electric motors.
 - a.
 - b.
 - c.
 - d.
 - e.
 - f.
2. What are four factors one should consider when trying to select an electric motor?
 - a.
 - b.
 - c.
 - d.
3. Name three different locations for use or applications of electrical controls.
 - a.
 - b.
 - c.

ADVANTAGES OF ELECTRIC MOTORS

- 1. Low initial investment**
- 2. Inexpensive to operate**
- 3. Efficient**
- 4. Simple to operate**
- 5. Little servicing required**
- 6. Operate quietly**
- 7. Compact in size**
- 8. Long life**
- 9. Ready to operate**
- 10. Will start a reasonable load**
- 11. Will tolerate temporary overloading**
- 12. Automatically controlled**
- 13. Remotely controlled**
- 14. Adaptable**
- 15. Portable**
- 16. Safe to operate**

Types of Single Phase Motors and Their Characteristics

Type/Power Range	Load-Starting Ability	Starting Current	Characteristics	Electrically Reversible	Typical Uses
Split-Phase 35 to 370 W 1/20 to ½ hp	Easy starting loads. Develops 150 percent of full-load torque	High; 5 to 7 times full-load current.	Inexpensive, simple construction. Small for a given motor power. Nearly constant speed with varying load.	Yes	Fans, centrifugal pumps; loads that increase as speed increases.
Capacitor-start 100 W to 7.5 kW 1/8 to 10 hp	Hard starting loads. Develops 350 to 400 percent of full-load torque.	Medium, 3 to 6 times full-load current.	Simple construction, long service. Good general-purpose motor suitable for most jobs. Nearly constant speed with varying load.	Yes	Compressors, grain augers, conveyors, pumps. Specifically designed capacitor motors are suitable for silo unloaders and barn cleaners.
Two-value capacitor 15 to 150 kW 2 to 20 hp	Hard starting loads. Develops 350 to 450 percent of full-load torque.	Medium, 3 to 5 times full-load current.	Simple construction, long service with minimum maintenance. Requires more space to accommodate larger capacitor.	Yes	Conveyors, barn cleaners, elevators, silo unloaders.

Type/Power Range	Load-Starting Ability	Starting Current	Characteristics	Electrically Reversible	Typical Uses
Permanent-split capacitor 35 to 750 W ½ to 1 hp	Easy starting loads. Develops 150 percent of full-load torque.	Low, 2 to 4 times full-load current.	Inexpensive, simple construction. Has no starting winding switch.	Yes	Fans and blowers.
Shaded pole 3 to 370 W 1/250 to 1/2 hp	Easy starting loads.	Medium.	Inexpensive, moderate efficiency, for light duty.	No	Small blowers, fans, small appliances.
Wound-rotor (Repulsion) 125 W to 7.5 kW 1/6 to 10 hp	Very hard starting loads. Develops 350 to 450 percent of full-load torque.	Low, 2 to 4 times full-load current.	Larger than equivalent, size split-phase, or capacitor motor. Running current varies only slightly with load.	No (rev. by brush ring change)	Conveyors, drag burr mills, deep-well pumps, hoists, silo unloaders, bucket elevators.
Universal or series 5 W to 1.5 kW 1/150 to 2 hp	Hard starting loads. Develops 350 to 450 percent of full-load torque.	High.	High speed, small size for a given hp. Usually directly connected to load. Speed changes with load variations.	Yes	Portable tools, kitchen appliances.
Synchronous Very small, fractional hp			Constant speed.		Clocks and timers.
Soft-start 7.5 to 560 kW 10 to 75 hp	Easy starting loads.	Low, 1.5 to 2 times full-load current.	Excellent for large loads requiring low starting torque.	Yes	Crop driers, forage blowers, irrigation pumps, manure agitators.

Source: Soderholm and Puckett (1974).

BASIC PARTS OF AN ELECTRIC MOTOR

- ◆ **Rotor**
- ◆ **Stator**
- ◆ **Frame**
- ◆ **End Shields**
- ◆ **Bearings**
- ◆ **Through bolts**

USES OF ELECTRICAL CONTROLS IN AGRICULTURE

- ◆ **Thermostat to control temperature.**
- ◆ **Pressure switch to shut off feed/grain auger.**
- ◆ **Humidistat to control humidity in greenhouse.**
- ◆ **Photocell to turn on security light.**
- ◆ **Smoke alarm to warn of possible fire.**
- ◆ **Timer to turn misting bench on at specific intervals.**

MAINTENANCE TIPS FOR ELECTRICAL CONTROLS

- ◆ **Clean controls of dirt.**
- ◆ **Wipe sensing element to remove oil film.**
- ◆ **Check contacts for rough surfaces.**
- ◆ **Keep oil and grease away from controls.**

Lab Sheet

Reading an Electric Motor Nameplate

Purpose: Students will learn many characteristics of electric motors by finding the appropriate information within the nameplate of an electric motor.

Directions: Using any of the electric motors provided, find the following information from the nameplate found on the motor. Depending on the motor and nameplate, you may not find every feature listed below.

1. Horsepower _____
2. Type of Current _____
3. Phase _____
4. Cycle or Hertz _____
5. Revolutions per Minute _____
6. Voltage _____
7. Amperage _____
8. Thermal Protection _____
9. Code _____
10. Service Factor _____
11. Time Rating (Duty) _____
12. Efficiency Index _____
13. Enclosure and End Bell Ventilation _____
14. Insulation Class _____
15. Temperature Rise _____
16. NEMA Design _____
17. Frame _____
18. Shaft Diameter _____
19. Bearing Type _____

LS Key: A4–8A

Lab Sheet Key

Reading an Electric Motor Nameplate

Answers: Answers will vary according to motors that are available.