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Guidelines for Selection of Energy Efficient Agricultural Ventilation Fans

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1 Purpose and Scope

Ventilation in many agricultural livestock and crop buildings and structures is crucial to maintain animal health or crop quality. Agricultural operations may have large numbers of ventilation fans operating for extended time periods making ventilation a large electrical consumption end use. Unlike other electrical energy–consuming equipment, there is little opportunity to manage operational schedules and electrical use of ventilation fans on a daily or seasonal basis without severely affecting operational management and having adverse effects. Improving the energy efficiency of an agricultural fan is the only practical way to reduce electrical energy use for ventilation. Energy efficient ventilation fans use less electrical power to move equivalent amounts of air, resulting in energy savings. This Engineering Practice is intended to provide information helpful in making decisions involving selection of energy efficient ventilation fans in agricultural operations.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies unless noted. For undated references, the latest approved edition of the referenced document (including any amendments) applies.

ANSI/ASHRAE 51 (ANSI/AMCA 210), Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

ANSI/ASAE S493, Guarding for Agricultural Equipment

ANSI/AMCA 210 (ANSI/ASHRAE 51), Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

ANSI/NFPA 70, National Electrical Code

ASAE EP 270, Design of Ventilation Systems for Poultry and Livestock Shelters

IEEE Std 112 IEEE Standard Test Procedure for Polyphase Induction Motors and Generators

NEMA MG 1.1, Tests and Performance of AC Fractional and Integral Horsepower Motors

OSHA 29CFR 1910.147, The control of hazardous energy (lockout/tagout)

ASABE S565, Agricultural Ventilation Constant Speed Fan Test Standard

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3 Definitions

3.1 airflow rate: The volume of air moved by the ventilation fan, L/s (ft^3/min).

3.2 fan efficiency: The volumetric airflow rate per unit of input power. Sometimes referred to as the ventilating efficiency ratio (VER), L/s/W (ft^3/min/W).

3.3 static pressure: The portion of air pressure due to compression of the air. This is the difference in air pressure between the inside and outside of a building due to airflow resistance created by restrictions such as inlet vents, cooling pads, exhaust outlets, fan shields and louvers, prevailing breezes, etc., Pa (in. H_2O).

3.4 airflow ratio (AFR): The airflow rate at a static pressure of 50 Pa (0.2 in. H_2O) divided by the airflow rate at a static pressure of 12.5 Pa (0.05 in. H_2O).

4 Agricultural Ventilation Fan Components

The typical parts of agricultural ventilation fans and their effects on fan efficiency include the following:

4.1 Fan motors. Fan motors range in size from fractional horsepower to large horsepower electric motors. Common motor types used for agricultural ventilation fans are split phase, permanent split capacitor, capacitor start, capacitor start-capacitor run, and three phase motors. Split phase and capacitor start motors are medium energy efficiency motors commonly used on direct and belt drive fans. Capacitor start-capacitor run motors are often used on direct and belt drive fans and are high efficiency motors. Some motor types do not lend themselves to variable speed control using variable voltage controllers. The speed of permanent split capacitor motors can be controlled using a variable voltage controller provided the permanent split capacitor motor was designed for this type of service. Information on electric motor efficiency ratings and test methods can be found in IEEE Standard 112 or NEMA Standard MG-1.

4.2 Fan blades. Most agricultural ventilation fans are propeller type fans. Propeller fans are ideal for moving large amounts of air at low static pressures seen in agricultural applications. Conditions inside agricultural buildings may be corrosive, requiring heavy gauge fan blades made from corrosion resistant materials. The blades may be constructed of many different materials including stamped steel, stamped aluminum, cast aluminum, molded fiberglass, and plastics.

4.2.1 Direct drive fans. The fan blade is mounted directly on the motor shaft and driven directly by the motor. This arrangement results in minimal losses in efficiency between the motor and fan blades themselves. Common sites of direct drive agricultural ventilation fans include 20, 25, 30, 35, 40, 45, 50, 55, and 60 cm (8, 10, 12, 14, 16, 18, 20, 22, and 24 in.) fans.

4.2.2 Belt-driven fans. For noise and vibration control and to utilize commonly available 1725 r/min motors, most 90 cm (36 in.) and larger fans are belt driven. This allows the use of high efficiency 1725 rpm motors to run the fan at slower operating speeds ranging from 400 to 800 r/min. A drawback to belt drives is the maintenance requirement, since large efficiency losses can occur if belts are not aligned or tensioned correctly. Some manufacturers provide spring loaded belt tensioners to keep belt tension constant over longer periods.

4.3 Fan housing. The fan housing supports the motor and fan shaft bearings and may be designed so that attachments such as shutters and guards can easily be installed. Depending on the application, the housing may be constructed of galvanized steel, fiberglass, plastic, wood, or other corrosion resistant materials. Factors such as the amount of intake area in the fan housing and length and shape of the housing affect the overall efficiency of the ventilation fan unit as a whole. Well-designed fan housings reduce air restriction and air turbulence and increase fan efficiency.

4.4 Shutters. Shutters may be located on the inlet or discharge side of the fan. Shutters exclude rain and cold air while the fan is not running and are needed for fans that do not operate continuously. A typical shutter may reduce airflow and efficiency from 2% to 25% compared to the same fan without a shutter. Shutters should be corrosion resistant and easy to clean and should close completely when the fan stops. Shutters are of two general types; motor-activated and air-activated. Motor-activated shutters lift and close automatically.

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