

# Optimize Vacuum Systems, Increase Productivity and Save Energy

## TECHNICAL DATA SHEET

A typical dairy farm's vacuum system uses about 20 percent of the operation's electricity. Dairy farmers can cut this electricity consumption in half by replacing a conventional vacuum regulator system with a variable speed vacuum pump. In addition to the energy savings benefits, a variable frequency drive will provide excellent control of vacuum levels and reduce noise levels.

### VACUUM PUMP OPERATIONS

The vacuum system used for milking dairy cows relies on an air pump to remove air continuously from the milking system to reduce the vacuum pressure. A conventional vacuum system runs the vacuum pump motor at a constant speed, while admitting air through the vacuum regulator to make up for the air not being used by milking operations at any time.

A variable speed vacuum pump, on the other hand, regulates the system's vacuum level by adjusting the motor speed and pumping rate, instead of admitting air, to reduce pressure. The ability to change the motor's speed to match the system's need offers energy efficiency benefits: when the vacuum pump motor slows down, it uses less electricity and reduces vacuum pump wear and noise levels.

Farmers can either purchase variable speed vacuum pumps or retrofit existing pumps with variable speed controllers, sometimes called variable speed drives (VSDs) or variable frequency drives (VFDs). Pump manufacturers recommend that variable frequency drives be used on blower or lobe type vacuum pumps. (All but one manufacturer will support variable frequency drive use with rotary vane pumps.)

### DEBUNKING A MYTH: VARIABLE FREQUENCY DRIVES (VFDs) DO NOT CAUSE STRAY VOLTAGE

A common myth—that VFDs cause stray voltage—sometimes deters farmers from installing variable frequency drives on vacuum pumps. This myth is just that—a myth. The most recent research from several Midwestern universities, state agriculture departments and the USDA demonstrates that properly installed systems DO NOT cause stray voltage. Many Wisconsin farmers have done their homework and partnered with Focus on Energy to understand the facts and benefits of variable frequency drives.

### VACUUM PUMP COMPONENTS AND INSTALLATION TIPS

A vacuum pump system controlled by a variable frequency drive is comprised of three primary parts: a vacuum pump with a three-phase electric motor, a variable frequency drive unit and a pressure transducer.

- **Motor.** A unit that converts electrical energy—such as electricity—into mechanical power or motion.
- **Variable frequency drive.** An electronic device that modifies the voltage and frequency of the electricity delivered to the motor. The variable frequency drive regulates the motor speed, based on the pressure transducer reading, to maintain a constant vacuum level.
- **Pressure transducer.** A device that converts air pressure into an electrical signal, which is used by the variable frequency drive unit to control the motor speed.

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**TABLE 1. EXAMPLES\* OF RECENT FOCUS ON ENERGY VARIABLE SPEED VACUUM PUMP PROJECTS**

RECOMMENDATION	HERD SIZE	INSTALLED COST RANGE (DOLLARS)	ANNUAL SAVINGS AVERAGE (DOLLARS/YEAR)	TYPICAL PAYBACK ** (YEARS)
VSD on Vacuum Pump	<100	\$ 3,000 – \$ 4,000	\$ 250 – \$ 1,200	3 – 6 years
VSD on Vacuum Pump	100 – 199	\$ 3,000 – \$ 4,500	\$ 250 – \$ 2,500	2 – 5 years
VSD on Vacuum Pump	200 – 499	\$ 3,000 – \$ 4,500	\$ 400 – \$ 3,500	1.5 – 3.5 years
VSD on Vacuum Pump	>500	\$ 3,500 – \$ 5,000	\$ 1,300 – \$ 6,000	6 months – 2 years

\*Installation costs and corresponding savings will vary depending on the site conditions and use. Our energy advisors can help determine savings estimates for your situation.

\*\*Before any incentive.

Farmers should consider several factors when selecting and installing variable speed vacuum pumps:

- Make sure the vacuum pump is sized properly. If a unit is either undersized or oversized, it will not perform well or produce the expected energy savings.
- Locate the variable frequency drive as close to the vacuum pump as possible. Electromagnetic emissions will be reduced by placing the variable frequency drive within ten feet.
- Make sure that the minimum speed setting of the variable frequency drive is adjusted to your system’s need. Operating the vacuum system below the manufacturer recommended minimum speed may shorten the lifespan of your equipment.
- Make sure that your equipment dealer follows all manufacturer recommended installation procedures and conforms to all electrical codes.

**NON-ENERGY BENEFITS OF A VARIABLE SPEED VACUUM PUMP**

Farmers that install variable speed vacuum pumps will obtain several additional important benefits.

- **Improved vacuum regulation.** The variable frequency drive controller can be adjusted to provide improved vacuum regulation to ensure that the vacuum level remains constant.
- **Reduced noise levels.** Because the vacuum pump does not have to operate at full load all the time, the noise levels near the pump are significantly reduced for both workers and neighbors.

- **Longer equipment life.** Using a variable speed controller slows the average speed of the pump to less than half that of a constant speed pump. In the long term, this reduces wear and maintenance costs and lengthens the life of the motor and vacuum pump.
- **Beneficial environmental impacts.** Because it uses less energy, air emissions are reduced. Also, unlike a rotary vane pump, a blower pump does not require constant lubrication of the pump cavity, reducing air and soil contamination from oil aerosols.

Table 1 illustrates examples by herd size of recent Focus on Energy variable speed vacuum pump projects. It notes the cost range of the project, average annual energy savings and estimated payback. The payback period was calculated using energy savings benefits; the non-energy benefits are not included.

**FOCUS ON ENERGY CAN HELP**

Focus on Energy’s agricultural energy advisors can help Wisconsin farmers learn more about the operational benefits of variable speed vacuum pumps. Call 800.762.7077 for information or assistance, or visit our Web site at [focusonenergy.com](http://focusonenergy.com).

