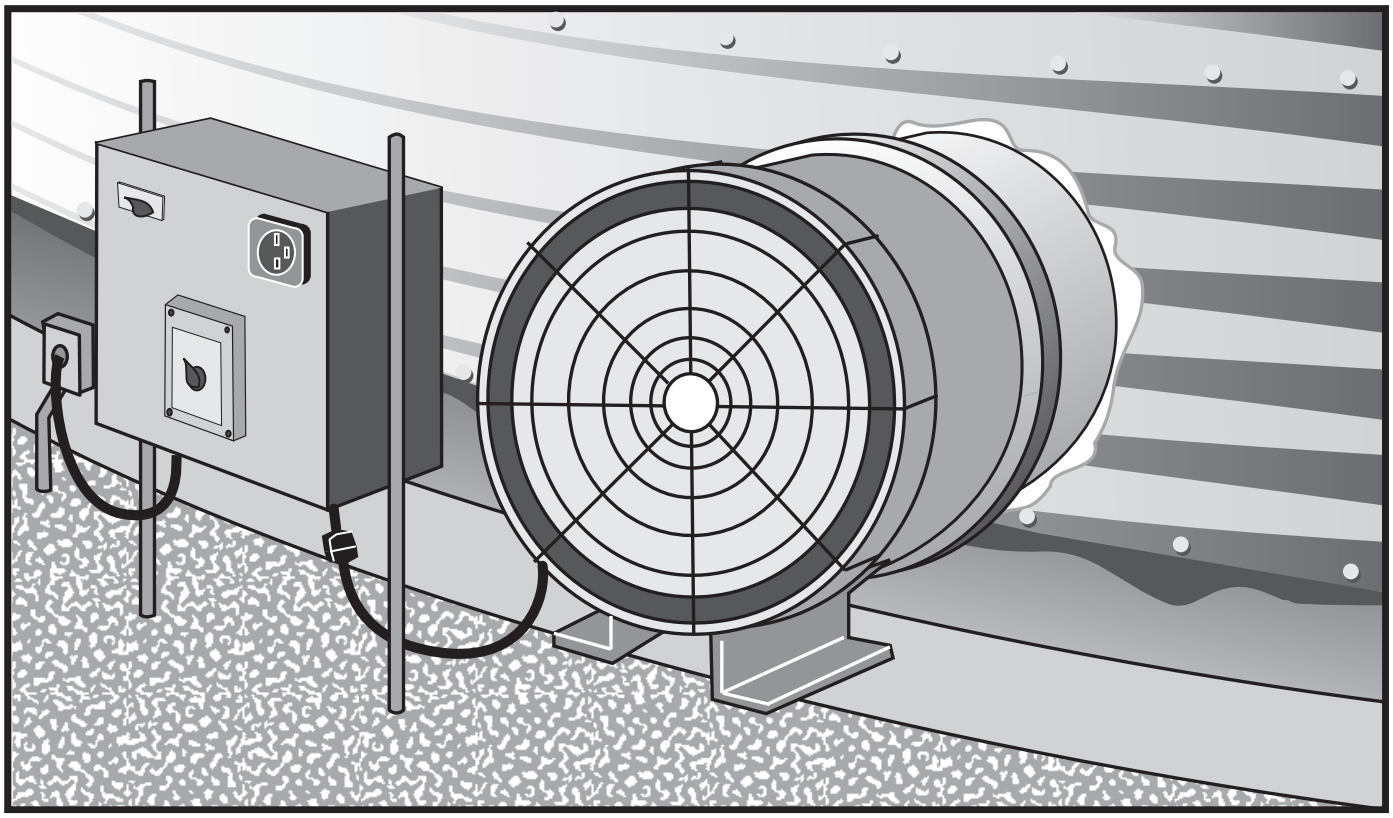
K-STATE Kansas State University

# Questions & Answers About

# AERATION CONTROLLERS



Kansas State University Agricultural Experiment Station and Cooperitive Extension Service

# AERATION CONTROLLERS:

*A powerful tool for insect control in farm-stored grain.*

Inexpensive aeration controllers have been field-tested in Kansas farm-stored wheat for several years by Kansas State University researchers. This publication addresses many of the most common questions about how these devices are used to maintain grain quality. It focuses on the simple controller as an aide to proper aeration management of hard red winter wheat in Kansas and surrounding areas, and contains information about other applications of this technology.

**Q What is an aeration controller?**

A It is a device that helps you use your aeration system to cool and condition grain. Aeration controllers range from simple to very sophisticated. Simple controllers have a thermostat that senses air temperature and must be periodically reset. Sophisticated controllers are programmed at the beginning of the storage season, and typically sense grain temperature as well as air temperature and relative humidity. **The simple controllers can not be used for grain drying.**

**Q What is the advantage of a simple controller over a sophisticated controller?**

A Price. A simple controller should cost less than 15 percent of the cost of the typical sophisticated controller.

**Q When is a simple controller helpful?**

A A simple controller is an inexpensive way to use cooling, rather than chemicals, as the basis of insect control in dry grain, especially grain that must be stored through several months of warm weather before cool weather arrives. It is most helpful when grain is harvested in early summer and stored past October. This technology is ideally suited for wheat storage in metal bins in the southern plains. The controller can help you cool the grain as much as is possible early in the storage season. By doing this, you control the rate at which insects can develop in the grain.

**Q Are there other uses for simple controllers?**

A Yes, they are helpful for any cooling (not drying) application when daytime temperatures during the cooling cycles are likely to be higher than you want. University studies at elevators have shown automatic management of fall cooling is so much more efficient than operating fans manually that the energy saved in the first year is sometimes greater than the cost of the controller.

**Q What does the aeration controller do?**

A The controller turns on the aeration fan when the temperature of the outside air falls below the point set on the thermostat, turns it off when the temperature rises to above the set point, and records how many hours the fan has run.

**Q How do I use the aeration controller?**

A The controller is installed between the power source and the aeration fan. Immediately after harvest, you set the thermostat to the appropriate temperature and check the hour meter every few days. When the appropriate number of hours has been logged (or, if you have temperature sensors, when you observe that the cooling front has moved completely through the grain), reset the thermostat to a lower temperature. Repeat until the desired grain temperature has been achieved. In Kansas, it will usually take three cycles between July and November to cool grain to the final, safe temperature (50° F or colder).

**Q How does just moving air through the grain control insects?**

A It is not the air movement as much as the cool temperature that is primarily responsible for controlling insect growth. In the southern part of the hard red winter wheat belt, the most damaging stored-grain insects are best able to grow and cause grain damage in dry wheat when the grain temperature is about 100° F. Reducing the grain temperature from this optimum point slows the population growth by increasing the development time for each new generation of insects. In this way, populations are kept small until October or November, when very cold air is available to stop the population growth. The most cost-effective strategy is to operate the fan only the number of hours required to completely cool the grain at a given setting. The controller is then reset to wait for cooler temperatures.

**Q Will I have to modify my bin to use an aeration controller?**

A Not unless your bin is extremely tight around the eaves, or has been caulked around the eaves. In this case, roof vents should be installed.

**Q Must I have a large fan and full-floor aeration?**

**A** No. Most farm bin aeration systems deliver more than enough air to successfully use this strategy. If you can find your fan and bin size in the table below, you have enough capacity to use this insect-control strategy. However, most aeration systems for upright concrete silos do not provide this much airflow.

**Q How do I determine how many fan-hours each cycle will take?**

**A** Use the guide below. First locate your fan, by horsepower and fan diameter, in the fan columns. Then locate your bin diameter and the approximate grain height. The number that appears in the table is the estimated number of fan-hours required for each aeration cycle.

## AERATION FAN-HOUR GUIDE FOR FARM-STORED WHEAT

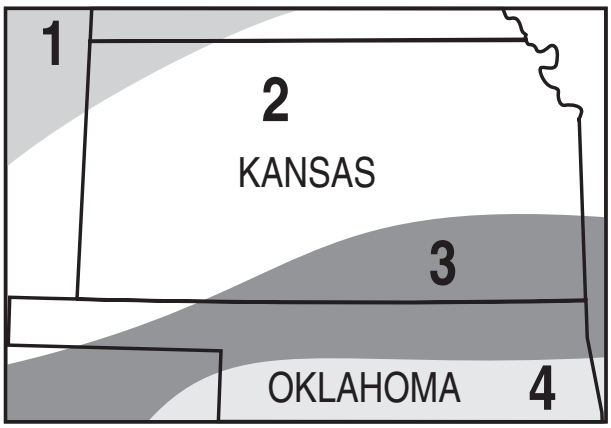
**(Required Fan-Hours)**

| Fan | Bin Diam. (ft.) | Grain Depth (ft.) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **13** | **15** | **17** | **19** | **21** | | |
| 12" dia., | 18 | 80 | 80 | 85 | 90 | 95 | | |
| ½, ¾ | 21 | 85 | 90 | 90 | 95 | 100 | | |
| or 1 hp | 24 | 90 | 95 | 95 | 100 | 100 | | |
| | 27 | 95 | 100 | 100 | 100 | 105 | | |
| | 30 | 100 | 100 | 105 | 105 | 105 | | |
| 14" dia., | 18 | 65 | 70 | 75 | 85 | 90 | | |
| 1 or | 21 | 70 | 75 | 80 | 85 | 90 | | |
| 1½ hp | 24 | 80 | 80 | 85 | 90 | 95 | | |
| | 27 | 85 | 85 | 90 | 95 | 95 | | |
| | 30 | 85 | 90 | 95 | 95 | 100 | | |
| 16" dia., | 18 | 60 | 65 | 70 | 80 | 85 | | |
| 1½ hp | 21 | 65 | 70 | 75 | 80 | 85 | | |
| | 24 | 65 | 70 | 80 | 85 | 90 | | |
| | 27 | 70 | 75 | 80 | 90 | 90 | | |
| | 30 | 70 | 80 | 85 | 90 | 95 | | |
| | | **13** | **15** | **17** | **19** | **21** | **23** | **25** |
| 18" dia., | 18 | 60 | 60 | 65 | 70 | 80 | 85 | 90 |
| 1½ or | 21 | 60 | 65 | 70 | 75 | 80 | 90 | 90 |
| 2 hp | 24 | 60 | 65 | 70 | 80 | 85 | 90 | 95 |
| | 27 | 60 | 70 | 75 | 80 | 85 | 95 | 95 |
| | 30 | 60 | 70 | 80 | 85 | 90 | 95 | 95 |
| | 34 | 65 | 70 | 80 | 85 | 90 | 95 | 100 |
| | | **15** | **17** | **19** | **21** | **23** | **25** | **27** |
| 18" dia., | 21 | 60 | 65 | 70 | 75 | 80 | 85 | 90 |
| 3 hp | 24 | 60 | 65 | 70 | 75 | 80 | 85 | 90 |
| | 27 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
| | 30 | 65 | 70 | 80 | 85 | 85 | 90 | 95 |
| | 34 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| 24" dia., | 24 | 60 | 60 | 60 | 65 | 70 | 75 | 80 |
| 5-7 hp | 27 | 60 | 60 | 65 | 65 | 70 | 75 | 80 |
| | 30 | 60 | 60 | 65 | 70 | 75 | 80 | 85 |
| | 34 | 60 | 60 | 65 | 70 | 75 | 80 | 85 |
| | 37 | 60 | 65 | 70 | 75 | 80 | 85 | 85 |

If your fans or bins are larger than this or you have more than one fan, call the fan manufacturer or your K-State Research and Extension Agricultural Engineering Specialist at (785) 532-5813 for estimated fan-hours. If you have a severe reduction in the duct between the fan and the bin, multiply the estimate by two.

**Q How do I know to what temperature I should set the thermostat?**

A Use the chart to the right and table below as a guide. For example, a person in Hutchinson, Kansas (zone 2) should set the controller to 70° F after harvest. Once the first aeration cycle is complete, the controller should be reset to 60° F for the second cycle and again to 40° F for the third cycle.




## RECOMMENDED THERMOSTAT SETTINGS FOR AUTOMATED AERATION OF FARM-STORED WHEAT IN KANSAS*

| | Zone | First Cycle | Second Cycle | Third Cycle |
|---|---|---|---|---|
| Set-Point[a] | 1 | 65° F | 55° F | 40° F |
| Months[b] | | July, August | September | October |
| Grain Temp[c] | | 75° F | 60° F | 42° F |
| Set-Point | 2 | 70° F | 60° F | 40° F |
| Months | | July, August | September | October |
| Grain Temp | | 80° F | 65° F | 47° F |
| Set-Point | 3 | 75° F | 65° F | 45° F |
| Months | | July, August | September | October |
| Grain Temp | | 83° F | 68° F | 49° F |
| Set-Point | 4 | 75° F | 65° F | 45° F |
| Months | | June, July | August, September | October, November |
| Grain Temp | | 84° F | 72° F | 46° F |

*Outside Kansas, consult with your state Cooperative Extension Service for recommendations on the use of aeration controllers.

[a]Set-Point. The recommended thermostat setting.

[b]Months. Time of year when this cycle is likely to be completed.

[c]Grain Temperature. Estimated grain temperature after the cooling cycle is complete. (Based on average temperature and relative humidity of air cooler than the set-point, in equilibrium with hard red winter wheat at 11 percent moisture content).

**Q What happens if I run the fan more or fewer hours than needed?**

A If you allow fewer hours at a given setting than is needed to complete a cooling cycle, the cooling front may not be moved all the way through the grain, leaving warm grain in the bin. If you run the fan more hours than required, you consume more electricity than needed and get little or no additional cooling done.

**Q Wouldn't it be better to measure the grain temperature than to depend on estimates of hours required to complete a cooling cycle?**

A Yes. Temperature monitoring devices are a better way to determine when the cooling cycle is complete than relying on the guides, which provide only an approximation. Temperature sensors are also very helpful for detecting hot spots in fall crops. However, it is not absolutely necessary to have temperature sensors in order to use aeration controllers.

**Q Will the aeration controller turn the fan on when it is raining?**

A Yes. The simple controller senses only air temperature, not relative humidity.

**Q Does that damage the grain?**

**A** No. The small amount of water that may be temporarily deposited on the grain in this way will not lower its quality. The net result of the cooling will be to dry the grain slightly.

**Q If I set the thermostat to 75°F, will the grain cool to 75°?**

**A** No. Setting the thermostat to 75° F merely tells the controller to activate the fan only when the outside air is cooler than 75°. The temperature to which the grain will cool depends on several factors, including the temperature and relative humidity of the cooling air, and the moisture content of the grain. For example, if air at exactly 75° F is passed through wheat containing 14 percent moisture, the grain cools to about 75° F if the air relative humidity (R. H.) is 60 percent, but only to about 82° F if the R. H. is 80 percent. In 10 percent moisture content wheat, the same temperature air cools the grain to only about 86° F at 60 percent R. H., and to about 94° F at 80 percent R. H. Fortunately, when the controller is set to 75° F, the air usually becomes much colder than 75° F sometime during the period of fan operation, so the grain often cools to 85° F or lower even if the grain is very dry and the air is moist.

**Q Should I <u>push</u> or <u>pull</u> the air through the grain?**

**A** Pull (negative pressure) systems appear to provide an advantage when automated aeration is used specifically for insect control, since these systems cool the top of the grain first. Insects tend to be found at or near the grain surface in summer and early fall. Nevertheless, many people have good results pushing air with automated aeration systems. The one case where push systems definitely should be used is bins that are only partially full (e.g. where the grain surface is more than a couple of feet below the top of the sidewalls). In half-full bins there is so much hot air above the grain surface that it is best to push this air out the top of the bin instead of pulling it through the grain.

**Q Must I always level the grain surface?**

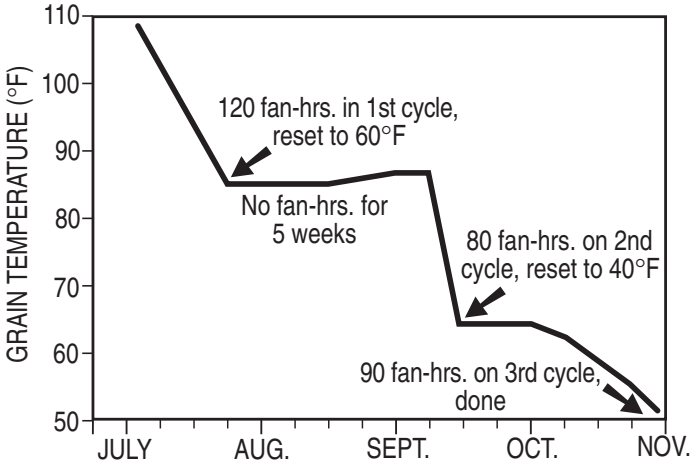
**A** A level grain surface should be the goal. All insect control measures, including grain protectants, fumigation, and aeration are more effective when the grain surface is level, or nearly so. Do not leave grain peaked.

**Q Does the use of an aeration controller guarantee there will be no insects in the grain?**

**A** No, neither does chemical treatment. However, some Kansas studies have shown fewer insects in bins of untreated wheat cooled by automated aeration than in nearby bins where the grain was treated with chemicals. **Aeration should always be used in an integrated program of sanitation to limit the rate insect migration into new grain** from nearby areas, and **monitoring (sampling) to determine if the grain is in danger** of deterioration. Automated aeration greatly reduces the likelihood of having to fumigate to avoid grain damage.

**Q What is the normal pattern of cooling and fan-hours?**

**A** Here is what happened in a wheat bin near Salina, Kansas in 1994.



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This, and other information, is available from the Department of Grain Science at www.oznet.ksu.edu/grsiext, or by contacting Tim Herrman, Extension State Leader
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**Kansas State University Agricultural Experiment Station and Cooperative Extension Service**

MF-2090 May 2002