Wheat and barley drying

William F. Wilcke; Retired Extension Agricultural Engineer, University of Minnesota
Kenneth J. Hellevang; Extension Agricultural Engineer, North Dakota State University

If grain is harvested at high moisture content to reduce harvest losses or because of wet weather, it needs to be artificially dried to 13 to 14% moisture for safe storage. There are two basic types of grain dryers—those that use no heat (natural-air dryers) or very little heat (low-temperature dryers), and those that heat drying air to temperatures greater than 100° F (high-temperature or high-speed dryers).

Natural-air drying/low-temperature drying

In natural-air and low-temperature drying, grain is dried slowly in storage over a period of 3 to 6 weeks. Recommended equipment for natural-air drying includes a relatively short bin (sidewalls less than 18 feet high), a full perforated floor, a drying fan that can push 0.5 to 1.0 cfm/bu (cubic feet of air per minute per bushel of grain in the bin) up through the grain, and enough vents on top to provide 1 square foot of vent area per 1000 cfm of airflow.

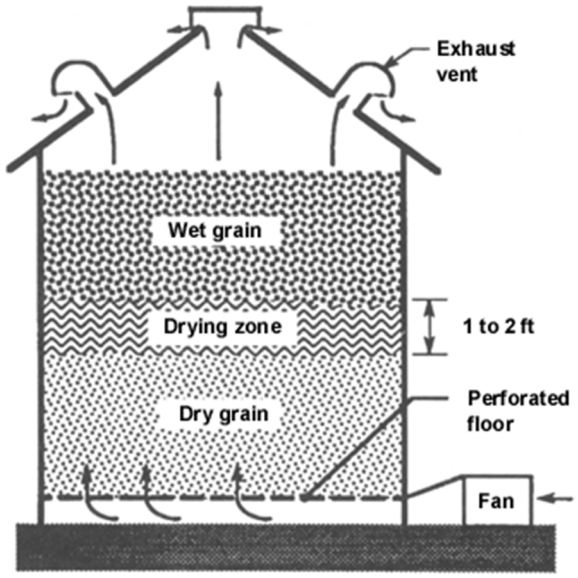

Figure 1. Schematic of natural-air drying bin.

Figure 1 illustrates the natural-air drying process. A 1 to 2-foot thick drying zone develops near the floor and slowly moves up through the bin. Grain below the zone comes to approximate equilibrium with drying air and is usually dry enough for safe storage. Grain at the top of the bin remains at its initial moisture content until the drying zone moves completely through the bin. You need to provide enough airflow (install a large enough fan) so that the top grain dries before it spoils.

Airflow and power requirements

The airflow required for natural-air drying depends on the grain's initial moisture content and weather during drying. Research and on-farm experience indicate that the airflows given in **Table 1** should allow drying without spoilage nearly every year.

Table 1. Recommended airflow for natural-air and low-temperature wheat and barley drying.

Moisture content (% wet basis)	Minimum airflow (cfm/bu)
16	0.5
17	0.75
18	1.0

Contact the University of Minnesota Extension for more information. For help in estimating static pressure and fan power requirements for grain drying, see Selecting Fans and Determining Airflow for Crop Drying, Cooling, and Storage.

Fines (small pieces of weed seeds, soil, and broken kernels) increase grain's resistance to airflow. Larger fans are required to overcome this resistance. Also, fines are more susceptible to attack by molds and insects than are whole kernels. For these reasons, it is better to clean grain, or periodically withdraw some grain during bin filling **(Figure 2)** to remove fines before natural-air drying.

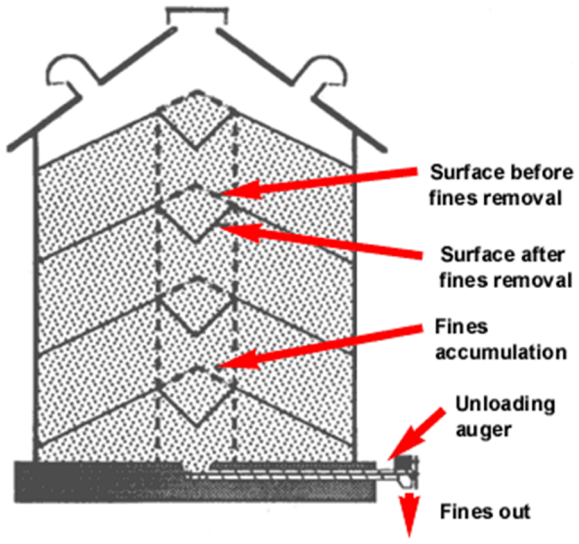

Figure 2. Removing fines during bin filling.

Positive pressure, or upward airflow is recommended for natural-air drying so the wet grain that is vulnerable to spoilage is on top where it can be easily observed. Check the surface grain in natural-air drying bins several times a week for visible mold, heating, or musty odors. If you find problems, remove some grain, relevel the surface, and continue drying. The chance of spoilage in the remaining grain is greatly reduced because the airflow per bushel is increased when some grain is removed.

Should you add heat?

Tables 2 and **3** indicate how dry wheat and barley in natural-air drying bins will get during various weather conditions. Most years, weather in the upper Midwest is such that continuous fan operation (24 hours/day, 7 days/week) will dry either grain to 14% moisture or less.

If you use a fan that has drying air flowing over the motor, the drying potential is actually slightly better than shown in the tables. This type of fan heats the air 2 to 4° F, which reduces the relative humidity 3 to 10%. The increase in temperature and reduction in humidity cause grain to dry an additional 0.75 to 1.0 percentage point.

Table 2. Equilibrium moisture content (% wet basis) for wheat exposed to air at various temperatures and humidities.

Temperature (°F)	Relative humidity (%)			
	20	**40**	**60**	**80**
40	8.5	11.7	14.6	18.0
50	8.2	11.3	14.2	17.4
60	7.9	11.0	13.7	16.9
70	7.7	10.7	13.3	16.5
80	7.5	10.4	13.0	16.0

Table 3. Equilibrium moisture content (% wet basis) for barley exposed to air at various temperatures and humidities.

Temperature (°F)	Relative humidity (%)			
	20	**40**	**60**	**80**
40	6.5	9.4	12.2	15.6
50	6.4	9.3	12.1	15.4
60	6.3	9.2	11.9	15.2
70	6.2	9.1	11.8	15.0
80	6.1	9.0	11.7	14.9

Because average weather conditions are normally adequate for drying grain, it is generally better to operate fans continuously and to use air that is not heated (except by the fan). If you only run the fan during warm, dry weather, grain at the bottom of the bin will be badly overdried and it will take more days to push the drying zone through the bin. Adding extra heat will speed drying slightly, but the main effects of adding heat are to overdry grain at the bottom of the bin and to increase drying costs. In most cases, you would be better off installing a larger fan instead of a heater.

If experience shows that grain in natural-air dryers doesn't get quite dry enough, then adding a small amount of heat might be appropriate. Make sure the heater doesn't increase the air temperature more than about 5° F or overdrying will definitely be a problem.

Advantages of natural-air drying

One advantage of natural-air drying is the high quality of the dried grain. Grain from natural-air dryers has higher test weight and germination, and lower breakage susceptibility than grain from high-temperature dryers. Another advantage is that natural-air dryers require less labor during harvest (but require more labor after harvest for checking drying progress). Also, because grain is dried in storage after harvest, you can fill the bin as fast as you want. You don't have to stop combining to wait for the dryer to catch up as sometimes happens with high-temperature drying.

High-temperature drying

In high-temperature (also called high-speed) drying, large volumes of air are heated to temperatures of 100° F or higher and grain is dried in a few hours or few days. You can use high-temperature corn dryers for wheat and barley, but you might have to reduce the drying air temperature to avoid loss of starch quality and germination. Adjust dryer temperature to keep kernel temperature of grain for milling below 140° F and grain for seed and malting barley below 110° F.

Grain needs to be cooled to outdoor temperature soon after high-temperature drying. This can be done rapidly using high airflow in the high-temperature dryer, but rapid cooling causes stress cracks in kernels that lead to breakage in handling. To reduce stress cracking, you can unload grain while it's still hot and cool it slowly (over a period of 12 to 24 hours) in storage.

Advantages of high-temperature drying

The primary advantage of high-temperature drying is that you can harvest grain at any moisture, dry it quickly, and sell it soon after harvest without moisture discounts. Also, once the dryer is adjusted properly, you have more precise control over final moisture content than you have with natural-air drying.