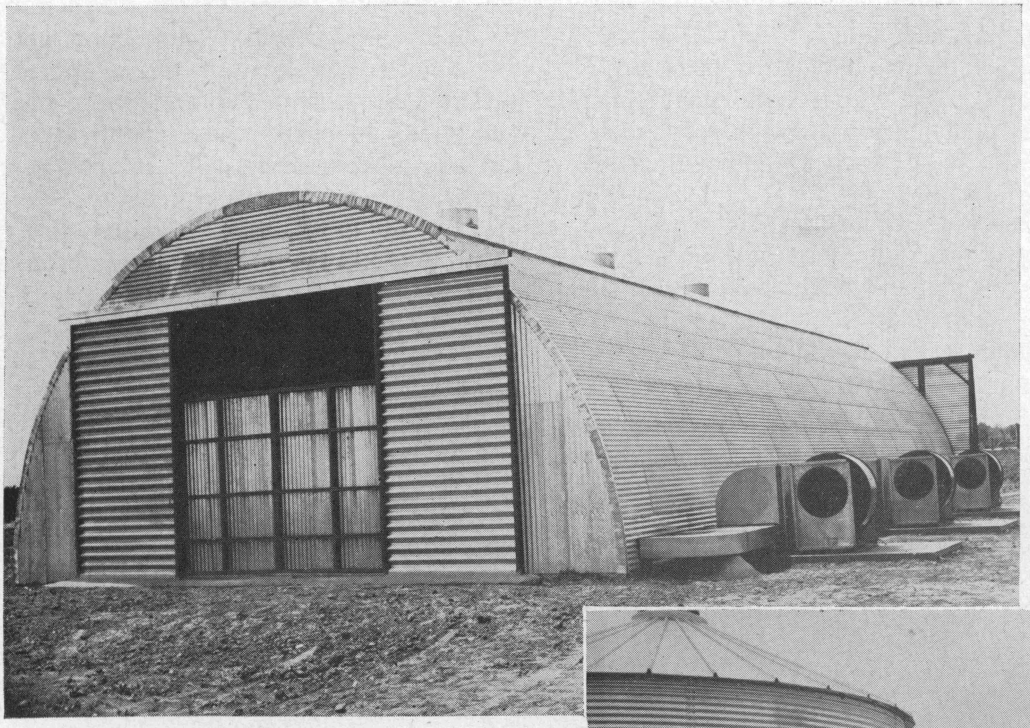
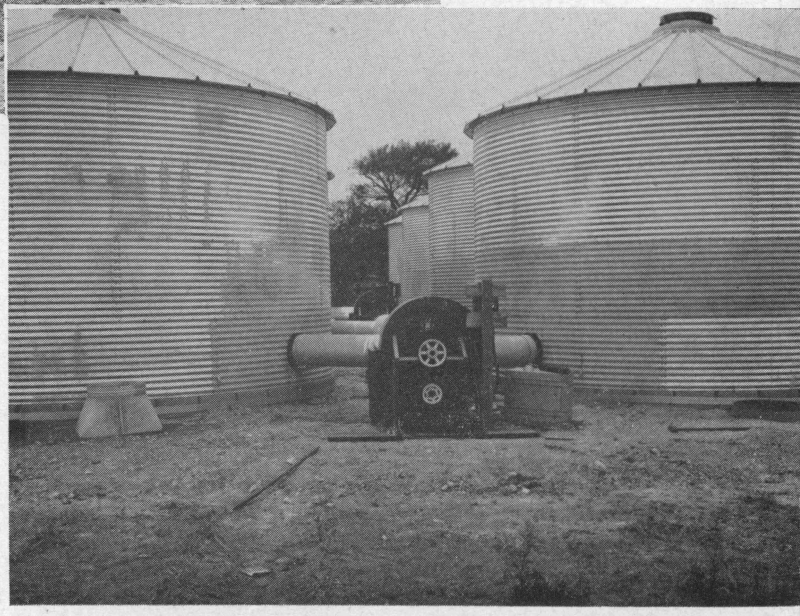
B-246

DRYING GRAIN





with unheated air

TEXAS AGRICULTURAL EXTENSION SERVICE
G. G. GIBSON, DIRECTOR, COLLEGE STATION, TEXAS

COVER PICTURE

The general purpose building (top photo) will hold and dry approximately 11,000 bushels. It can be used for other storage purposes when not needed for the drying and storing of grain sorghum.

The circular bins (lower photo) can be erected quickly. They make excellent storage and drying facilities. Either type should have an adequate fan and duct system to provide the minimum recommendations on air flow contained in this bulletin.

Drying Grain With Unheated Air

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Drying grain mechanically with unheated air is one method of reducing the effect of moisture, the major hazard of storing small grain. In general, the recommendations of this leaflet apply to the coastal area of Texas and to grain sorghum. The recommendations can be applied to other crops in other areas of the State with similar results if conditions approach those encountered in research work at Beeville, Texas. Modifications can be worked out for use in situations where drying is essential to satisfactory grain storage.

The use of unheated air in bin drying has been used successfully in tests conducted the past two years. It has the following advantages over other methods for the average on-farm installation:

Requires less investment in equipment.

Reduces danger of fire.

Is more easily and quickly installed.

However, the following factors must be remembered:

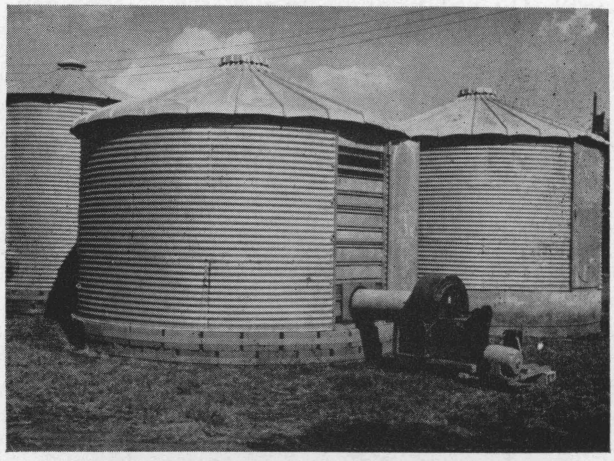
The rate of drying depends on the weather.

A longer drying time is required.

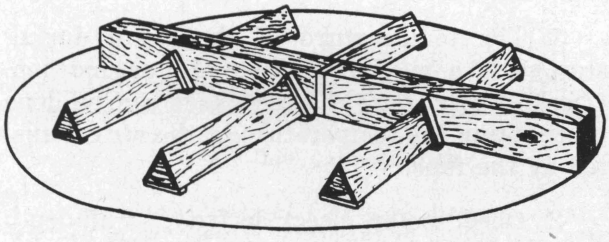
In tests conducted by the TAES in South Texas, grain sorghum with a moisture content above 12 percent was too high for safe storage. Grain with a moisture content above 13 percent usually heated after a few weeks storage and required turning at frequent intervals or aeration with mechanical ventilation to keep it in good condition. Grain sorghum with a moisture content of 11 to 12 percent has been stored successfully for as long as 23 months without serious losses.

The following procedure is recommended in drying and storing of grain sorghum in bins with unheated air:

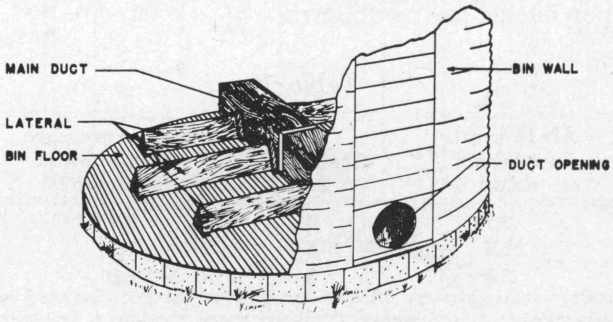
1. Fill the drying bin to a depth of not over 8 feet with grain containing a maximum moisture content of 18 percent.



This bin is equipped to dry grain sorghum by means of the fan and a duct system. This same type of bin can be equipped with a false floor if desired.



Overall view of aeration system



Aeration ducts installed

One type of fan suitable for grain drying (centrifugal with backward curved blades). Selection of a proper fan is important. Note the inlet and outlet sides can be adapted to the duct for pushing or pulling air through the grain. Check with your fan dealer for data on power requirements and static pressures.

2. Do not attempt to dry grain that contains excessive amounts of foreign material or "trash." This material accumulates in pockets causing air to channel, resulting in musty and heat-damaged grain.

3. Distribute grain evenly while the bin is being filled to prevent cracked grain and foreign material from accumulating in spots.

4. Select drying equipment that will provide a recommended air-flow rate of approximately 2.5 c.f.m. per bushel (4.5 c.f.m. per 100#).

Information required by fan manufacturers for figuring fan size for drying grain is total air volume and static pressure. Static pressures to develop required air-flow rates per bushel are as follows:

Table 1.

Air flow rate per bushel c.f.m.	Grain depth feet	Static pressure inches, water column*
2.5	4	0.85
2.5	6	1.7
2.5	8	2.8

*Includes an estimated 0.25-inch pressure drop in duct system.

Procedure During Drying

1. Start the blower as soon as the air distribution system is covered uniformly with grain.

2. Push air through the grain continuously until the moisture content of the top foot of grain is reduced to about 14 percent. Then, complete the drying by operating the fan only when the relative humidity is 75 percent or less (usually during daylight on clear, bright days, or about the same hours that a combine would be operated). Push air through the grain during the entire drying operation until the moisture content is not more than 12 percent in any part of the bin.

3. Take samples for moisture content at least twice a week during the drying operation. The bin should be probed at intervals (a minimum of 8 feet apart) over the surface of the grain and samples drawn from three levels as follows: bottom foot, center foot (halfway between bottom and top) and top foot. The grain from each level should be mixed thoroughly and a moisture check made for each level.

4. Check the grain temperature twice a week. This can be done in conjunction with the moisture sampling operation.

5. Low grain temperatures during *drying* do not always indicate that the grain is in good condition. Therefore, samples pulled for moisture content should be checked also for mold growth.

6. Uniform distribution of air throughout the bin is essential for a successful job of drying.

7. Keep operation records for each bin, including fan operation, grain temperatures and moisture content.

Procedure During Storage

1. The temperature of the grain during storage is a good indication of its condition. Check at least once a week. This can be done by checking the temperature of the air exhausted by the fans.

2. Observe for insect activity. Full-depth probe samples should be taken monthly to de-

termine insect population in all areas of the bin.

3. The following procedure should be used as a guide for operating the fans.

When grain temperature (exhaust air) is:

Above 85 degrees—operate fan continuously when outside air temperature is 10 degrees or more below exhaust air temperature

When grain temperature (exhaust air) is:

From 70 degrees to 85 degrees—operate fan continuously when outside air temperature is 15 degrees or more below exhaust air temperature

When grain temperature (exhaust air) is:

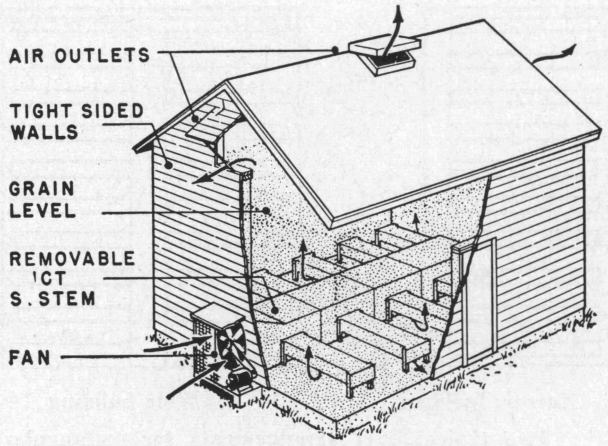
Below 70 degrees—operate fan continuously when outside air temperature is 20 degrees or more below exhaust air temperature.

4. *Pull air down through the grain during periods of forced aeration.*

5. Use at least 0.5 c.f.m. per bushel (approximately 1.0 c.f.m. per 100#) for aeration during storage.

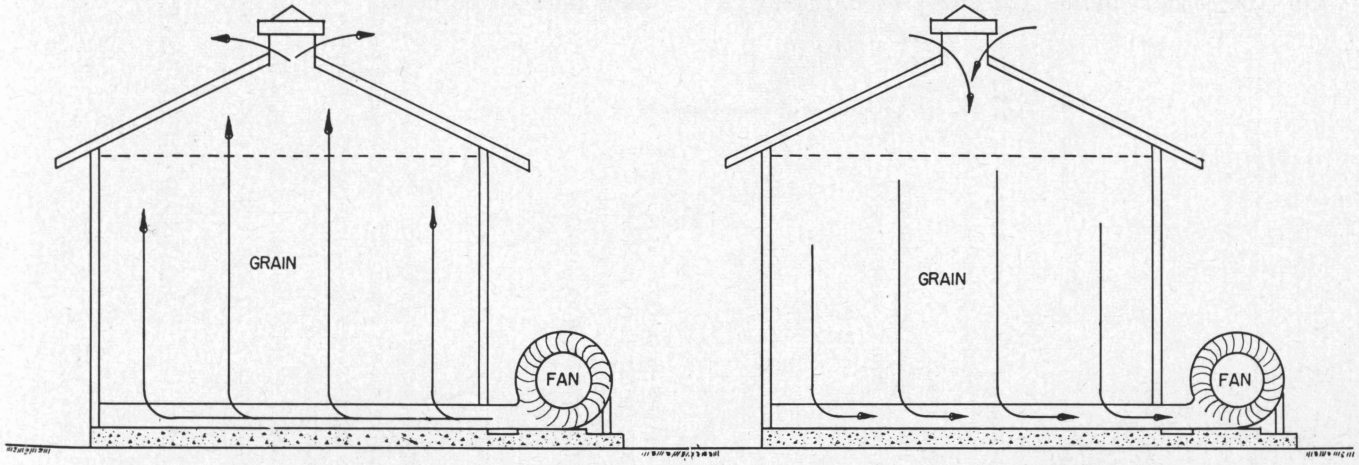
6. The fan should not be operated during rain, fog or other periods of high humidity (80 percent or greater) except to cool hot spots and then only two to three hours a day.

7. Check the moisture content and condition of the grain at least once a month during the storage period. Separate checks should be made at three levels—bottom foot, center foot and top foot.



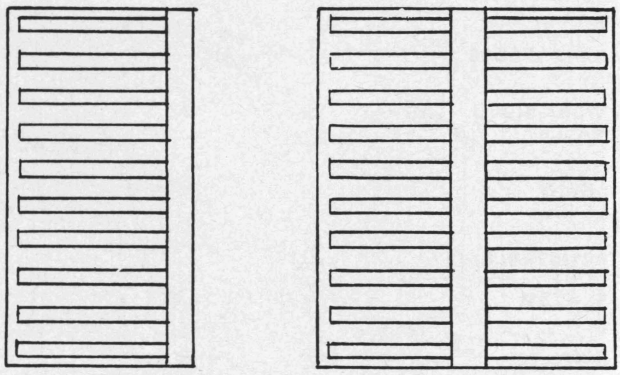
A duct system in a rectangular bin. Such a system may be purchased or designed and constructed by local workmen. Note the main duct and laterals distribute the air to all parts of the bin. Uniform distribution is important in drying and conditioning the grain.

The equipment required for drying grain with unheated air consists of a fan, a power unit, controls and a duct system (or false floor). The fan may be either the propeller or the centrifugal type, and it must deliver the required volume of air against the static pressures indicated in Table 1. Reliable manufacturers will supply air-delivery ratings for the range of static pressures for which their fan equipment is designed. Fans that are unsatisfactory for grain drying include house, attic



Air flow during drying **Air flow during aeration**

These two drawings show how direction of air flow is reversed during drying and aeration of grain. The direction of air flow is important in drying and aeration. Select a fan that can be reversed with a minimum amount of adaptation and trouble. Be sure to pull air through the grain during the aeration period.



Narrow building Wide building

Two typical duct arrangements for rectangular buildings. The main duct can be on the outside wall, inside wall or in the center of the building.

or barn ventilating fans; those for blowing materials, such as silage and grain blowers; and those of the general type used in fanning mills.

Electric motors are recommended for use in drying grains. Gasoline engines may be used, but will require more attention and are not as easy to control. Electric motors selected for use on single phase rural lines usually should not exceed five horsepower. Where three-phase service is available, larger motors can be used. *Consult your power supplier* on selection and installation of motors for powering grain drying facilities.

The number of bushels that can be dried per horsepower or with a rated volume of air is reduced as the depth of grain is increased. On the other hand, the cost of building a structure with a greater floor area, in order to reduce the depth of the grain, usually will be more than the extra cost of the power requirements.

To determine fan size, follow these steps:

1. Determine the number of bushels to be dried. The volume of the building in cubic feet × 0.8 = bushels.
2. The number of bushels × the air required per bushel (2.5 c.f.m.) equals the total volume of air required.
3. Check fan tables of type and make of fan to be purchased to determine hp. required.
4. If the hp. requirements are larger than allowed or practical (5 to 7½) divide the bin into smaller units and add additional drying units.

Design of the duct system can be determined as follows:

Number of bushels in bin × 2.5 c.f.m. per bushel equal total air required.

Total air required in c.f.m. divided by 1500 equal cross-sectional area of main duct in square feet.

Make main duct as nearly square (if to be built of wood) or semicircular (if built of metal) as possible.

Make lateral ducts of recommended shape as shown. Total cross-sectional area of lateral ducts should equal cross-sectional area of main duct plus 10 percent.

TO FIND DUCT SIZE

No. of bushels in bin × 2.5 c.f.m/bu. ≡ total air required
Total air required ÷ 1500 = cross section of main duct
Make main duct square (if built of wood)
Make total cross-section area of lateral ducts equal to area of main duct plus 10%
Select spacing as shown below and set to proper height
To obtain shape and lumber size for cross-section area see Table "A"

TABLE A

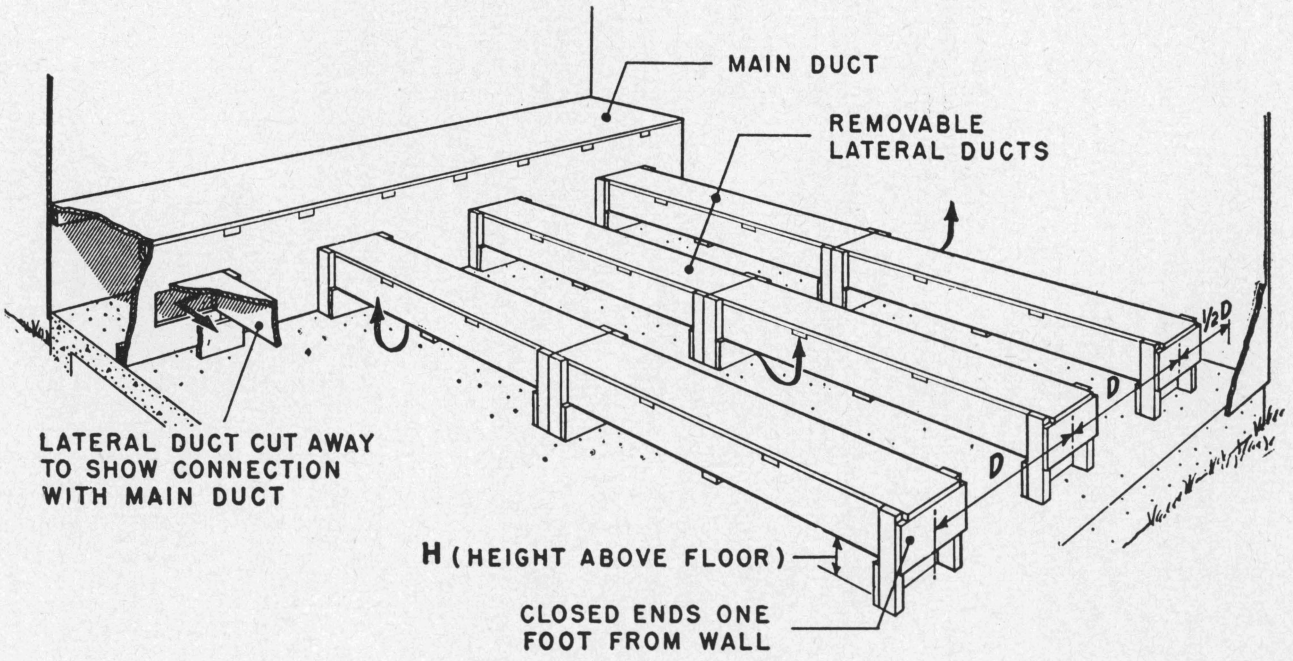
Shape	Lumber size	Free air area
	1 × 8	0.18 sq. ft.
	1 × 10	0.29 sq. ft.
	1 × 12	0.43 sq. ft.
	1 × 8	0.31
	1 × 10	0.53
	1 × 12	0.86

If main duct is in building provide small screen openings in top of main duct 1″ wide. Total area to equal approx. 5% of top surface.

The width of each lateral should be at least twice the height of its bottom edge above the floor.

The height "H" should be approximately as listed for "D" spacing of laterals.

H	D
4″	2′
6″	3′
7″	4′



The following list of publications are available from county extension offices or from the Agricultural Information Office, College Station, Texas:

Bull. 29	Southern Cooperative Series, Recent Research on Drying and Storage of Rough Rice
L-201	Drying Small Grain
Bull. 225	Research on Rice Production in Texas
Bull. 227	Grain Storage in Texas
Blueprint 372	Column-Type Grain Dryer
Bull. 710	Drying and Its Effect on the Milling Characteristics of Sorghum Grain
P.R. 1240	Storing Sorghum Grain in South Texas
P.R. 1262	Storage of Cotton Seed for Planting Purposes
P.R. 1352	Drying and Storing Flax Seed in South Texas
P.R. 1488	Control of Storage Insects in Sorghum Grain in South Texas
P.R. 1670	Bin Drying of Rice at Rice-Pasture Exp. Sta., 1953-54
P.R. 1685	Drying and Storing Sorghum Grain in Farm Storage Bins in Texas

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