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# FARM CROP DRYERS

**A GUIDE FOR  
THEIR SELECTION  
AND INSTALLATION**

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MICHIGAN STATE COLLEGE  
**COOPERATIVE EXTENSION SERVICE**  
EAST LANSING

## FOREWORD

The use of crop-drying equipment on the farm is relatively new, but it is increasing rapidly. To foster the development of minimum standards for selection and use of crop-drying equipment, the "Michigan Committee on Crop Drying and Safety" has been formed. Members of the committee are Earl Hotchin and Leon Corwin, representing the Farm Mutual Fire Insurance Companies; Nolan Mitchell and Chester Appledoorn, representing the Crop Drying Industry in Michigan; William Buchinger, representing the Michigan Committee on Rural Electrification; and C. W. Hall and R. L. Maddex, representing Michigan State College. This guide has been written with their cooperation and assistance, and represents the minimum standards recommended by the Committee.

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## FARM CROP DRYERS THEIR SELECTION AND INSTALLATION

Commercial manufacture of heated air crop dryers for farm installation is a relatively new undertaking. Industry has introduced many improvements in crop dryers the past two or three years, and by forming a manufacturers' association is working through committees to produce fundamentally safe units. Such units are:

1. Provided with adequate safety controls when the dryer is operated correctly.
2. Designed to produce a satisfactory dried product.
3. Economical to operate.

For the present, in lieu of approval by a recognized testing group, the Committee (see Foreword) recommends those units made by members of the Crop Drying Manufacturers' Association, and so stamped, for farm installation.

Extensive experience with heated air crop dryers, however, has indicated that the fire hazard is extremely great with improperly or carelessly constructed devices. Likewise, improper operation introduces a danger of unsatisfactory results, as well as increasing the fire hazard.

### USE OF THE GUIDE

The questions in this guide are so stated that a "Yes" answer indicates correct use or correct selection of equipment. For any crop-drying installation, the great majority of the answers should be "Yes" to the questions in the guide. When the crop-drying installation is such that answers to the questions in the guide are "No", careful consideration should be given to those points from the standpoint of safety and satisfactory equipment operation.

In all cases, it is recommended that the heated air crop dryer be used outside of main buildings. It should never be used on a drive floor, in a main granary, or in a main storage building.

## I. TYPES AND LOCATION

YES NO

### A. FORCED AIR DRYERS (Unheated) (See Fig. 1)

- |  | YES                      | NO                       |
|--|--------------------------|--------------------------|
| 1. Does fan pull drying air from the outside of the building?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Are fan and motor separated by a tight housing from the crop being dried?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Is there a wire-mesh guard on the air intake side of the fan?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Are the fan and motor readily accessible? .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. If the fan is driven by an electric motor, is the motor provided with overload protection? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Is the motor wired properly? (Section IV) .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Is the area where the fan and motor are housed free from chaff, dust, and other debris? .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Does the fan deliver air as specified in Section V? .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Is there at least one square foot of cross-sectional area in the main duct, for each 1000 cfm of air delivered by the fan at 1" static pressure?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Is the fresh-air intake opening to the fan house at least as large as the cross-sectional area of the main duct? .....                               | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Is there at least twice as much area for moist-air discharge as there is cross-sectional area of the duct?.....                                      | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. If a perforated floor is used for drying grain, does the floor have at least 20 percent openings?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. If the motor is driven by a gasoline engine, is there an automatic shut-off to protect against overheating of the engine? .....                      | <input type="checkbox"/> | <input type="checkbox"/> |

### B. PORTABLE DRYERS (On Wheels) (See Fig. 2)

- |   |                          |                          |
|---|--------------------------|--------------------------|
| 1. Is the drying unit made as a complete unit by a manufacturer?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is the drying unit: (answer one)                                   |                          |                          |
| a. Direct-fired .....   | <input type="checkbox"/> |                          |
| b. Indirect-fired .....   | <input type="checkbox"/> |                          |

- |  |                          |                          |
|--|--------------------------|--------------------------|
| 3. Is the drying unit attached to the main building? (It is not generally recommended that a heated air dryer be attached to a large main building. However, where grain or ear corn is stored in a main building and it is desired to dry this crop with heated air, specific arrangements should be made with the insurance company for this purpose.) ..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. If the crop is dried in batches on wagons or in a batch bin, is the heated air drying equipment separated from the main building by 15 feet or more? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. If the crop is dried in a special building, is the drying unit separated from this building by 8 feet?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Is the drying unit connected to the bin by a duct of flameproof canvas or other non-combustible material?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Is the fuel supply properly connected? (Section II) .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Is the burner free from fuel oil, soot, and coke deposits? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Is the manufacturer's recommendation being followed in selecting fuel?.....   | <input type="checkbox"/> | <input type="checkbox"/> |

### C. FIXED HEATED AIR DRYERS

These dryers fall into three groups:

1. **PORTABLE DRYERS WITH WHEELS REMOVED.** Such drying units are satisfactory for farm use if they meet the requirements of Section B, Portable Dryers.
2. **LARGE INSTALLATIONS.** Such units would not be considered farm drying units and should receive special attention in regards to location, safe practices, and insurance requirements.
3. **HOME BUILT INSTALLATIONS.** Such units are not recommended because of lack of safety controls, proper design, and location, unless such installations conform to minimum standards outlined in this guide. In installations which are home-made, the drying unit should be inspected by the insurance company.

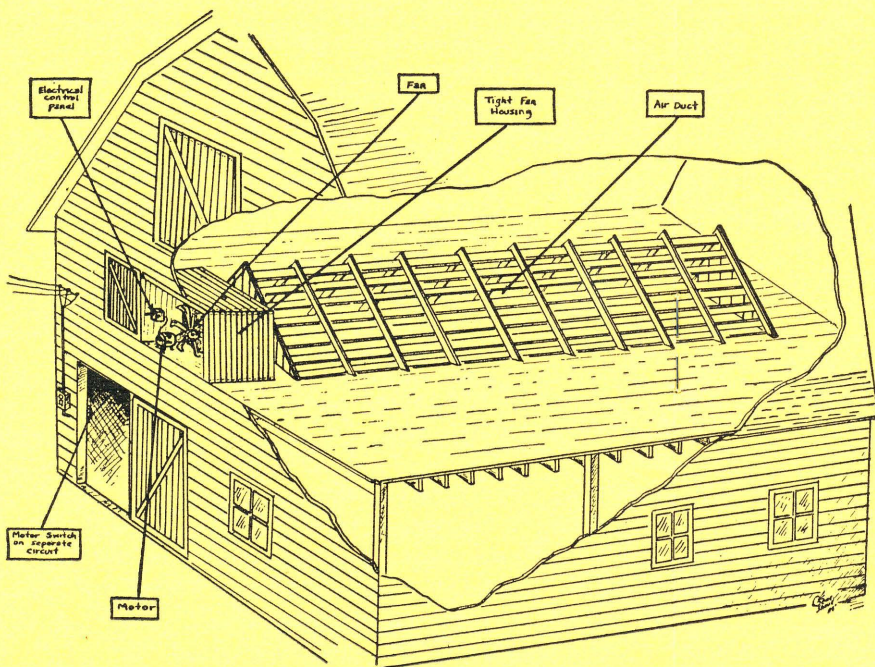
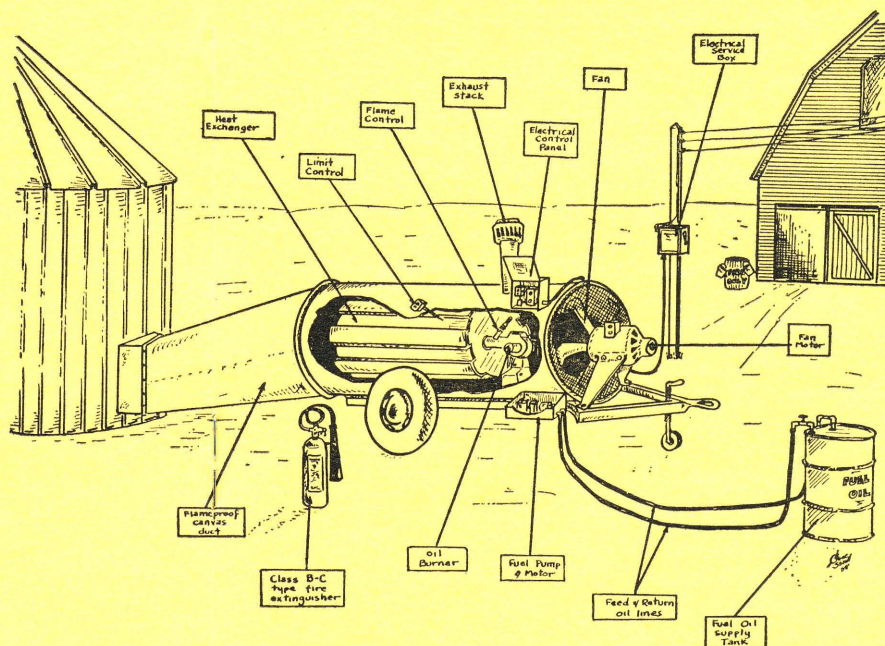


Fig. 1. A forced air drying system (unheated) for hay. The building is cut away to show location of the fan, the motor, a main center duct.

Fig. 2. A portable, heated air drying unit, cut away to show burner and controls. The duct must be of flame-proofed canvas or similar non-combustible material.



## II. HEAT AND FUEL SUPPLY

Answer only the one section which applies to the fuel used: fuel oil, gas, coal.

### FUEL OIL

- |  | YES                      | NO                       |
|--|--------------------------|--------------------------|
| 1. Is a standard furnace oil used?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is the burner of an approved type?<br>(Contact your insurance company or<br>County Agent for approved list).....                                | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Is the burner an atomizing type?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. If not, is it equal in performance to<br>pressure atomizing type?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| a. Free from carbon deposits?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Free from sparks in the com-<br>bustion chamber? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Reliable? .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Does each burner have a rated capacity<br>of not over 12 gallons per hour?....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Is the heating unit adjustable for<br>the required output?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Is the drying air free from smoke or<br>odors which might affect the quality<br>of the product being dried?.....                                | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Is the ignition in burner by electric<br>spark? .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Is the spark hot enough to ignite flame<br>in zero weather?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Is the fuel tank a 55 gallon steel drum<br>type? (Larger storage tanks should<br>comply with state fire regulations for<br>fuel storage) ..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Can air circulate around fuel tank?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Is the fuel oil delivered from tank to<br>burner by pump action?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Is there a positive feed control on fuel<br>supply? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Is there an automatic control interlock<br>with fan control which would shut off<br>fuel supply if fan stops?.....                             | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Is there a filter or strainer provided<br>in the fuel line between tank and<br>burner? .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Is there a manual shut-off valve in the<br>fuel line at the tank end when metal<br>pipe is used?.....  | <input type="checkbox"/> | <input type="checkbox"/> |

YES NO

- |   |                          |                          |
|---|--------------------------|--------------------------|
| 17. Is the fuel pump and fuel piping<br>located away from the flame of the<br>burner? .....                               | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. Is the fuel feed line from tank to fuel<br>pump safe and protected from mechani-<br>cal injury? .....                 | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Is the fuel tank located at least 15<br>feet from bin and other buildings?....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. Are the oil drums refilled away from<br>drying unit, or is the drying unit shut<br>down when drums are refilled?..... | <input type="checkbox"/> | <input type="checkbox"/> |

### GAS FUEL

- |  |                          |                          |
|--|--------------------------|--------------------------|
| 1. Is the gas burner Underwriters Labora-<br>tory or A.G.A. (American Gas Associ-<br>ation) approved? .....    | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is the gas fuel of the liquefied petrole-<br>um type (L.P.G.) or natural gas?.....                          | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Does each gas heater have maximum<br>capacity to add <u>650,000 BTU</u> to the<br>drying air per hour?..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Is gas heater adjustable manually to<br>decrease this capacity to the required<br>amount? .....             | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Is a vaporizer supplied so that this<br>L.P.G. can safely operate in cold<br>weather? .....                 | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Are tanks containing the gas fuel of<br>the standard approved type?.....                                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Are these tanks safely installed on a<br>substantial base, and secured to pre-<br>vent tipping? .....       | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Are the tanks at least 10 feet from<br>the burner? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Is copper tubing from tank to burner<br>safe and protected from mechanical<br>injury? .....                 | <input type="checkbox"/> | <input type="checkbox"/> |

### HARD FUEL

- |   |                          |                          |
|---|--------------------------|--------------------------|
| 1. Does the unit burn coal?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is the fuel fed mechanically?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Is the unit portable (on wheels)?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. If the fan fails, will automatic con-<br>trols stop stoker feed, and close drafts<br>on furnace? ..... | <input type="checkbox"/> | <input type="checkbox"/> |

(If the answer to any of the preceding questions is "No", then the drying unit is not approved for general use.)

### III. SAFETY CONTROLS AND OPERATING TEMPERATURES

#### A. GRAIN DRYERS

- |   | YES                      | NO                       |
|---|--------------------------|--------------------------|
| 1. Is there a flame failure control to shut off the fuel supply in case of ignition failure? _____  | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is there a high limit control to completely shut off fuel supply in case of mechanism failure? (Control is designed to prevent excessive temperatures. Where the high limit control is used as the drying temperature control, the unit should be set approximately 20° F. above drying temperature, but not to exceed 200° F. On dryers using a bin control as well, the high limit control should be set to operate at a temperature not to exceed 250° F.)..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Is there a low voltage and overload protection device on the electric motor? _____   | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. The recommended temperatures for drying grain crops are:   |                          |                          |

Grain	Maximum Drying Temperature of Heated Air
Ear Corn .....	130°
Shelled Corn .....	140°
Shelled Corn (Milling) .....	130°
Hybrid Seed Corn.....	110°
Wheat .....	140°
Oats .....	140°
Barley .....	110°
Rice .....	110°-120°
Grain Sorghum .....	150°-160°
Seed Grains or Brewery	
Grain .....	110°
Soy Beans .....	130°
Navy Beans .....	95°
Pop Corn .....	90°
Onions .....	90°-100°

#### B. HAY DRIERS (Heated Air)

The use of heated air crop dryers for drying hay in the barn is not recommended. If heated air is used for drying hay, the hay should be on wagons away from the barn or in a batch drying shed away from the barn. In general, not more than 15 tons of hay should be placed on a batch dryer at one time. The recommended temperature for drying hay in batches or on wagons is 160° to 180° F.

### IV. ELECTRICAL WIRING

- |   | YES                      | NO                       |
|---|--------------------------|--------------------------|
| 1. Is the main service entrance wired for 100 ampere or larger capacity?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is neutral wire properly grounded at service entrance? (With #6 wire and approved ground clamp) .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Does the building or pole from which the crop dryer is served have an entrance switch with the neutral wire connected to an approved ground?.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Is the service entrance for the building or pole from which the dryer is served of 60 ampere or larger capacity? .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Is the convenience outlet for the crop dryer a three wire "range type" receptacle with the white wire connected to the neutral terminal and grounded at the entrance switch? .....                             | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. If the receptacle for the crop dryer is mounted on a pole or the outside of a building, is it a weatherproof receptacle on which the cover closes automatically when not in use?.....                          | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Is the crop dryer cable which plugs into the receptacle a three-prong heavy-duty "range" type, having #8 or larger conductors with the white wire securely fastened to the frame of the motor or dryer?.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. If a three phase motor is used on the crop dryer, is a fourth or grounded wire connected from the frame of the dryer to the neutral terminal in the entrance switch? .....                                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Are all electrical raceways and enclosures on the crop dryer such as switches, controls, conduit and other devices securely fastened to frame of dryer so as to provide electrical continuity to ground? ..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Is all electrical equipment on crop dryer in good operating condition? (Not excessively rusted) .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Is crop dryer cable protected from severe mechanical injury? (such as vehicles or livestock running over it) .....  | <input type="checkbox"/> | <input type="checkbox"/> |



- |  | YES                      | NO                       |
|--|--------------------------|--------------------------|
| 12. Is all electrical material on crop dryer approved by Underwriters Laboratories? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Is the voltage at the crop dryer when in operation as high as it is at the meter? (If it is over 5 percent lower, the wiring is inadequate) .....                            | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Are the controls on the crop dryer wired so that any interruption of electric power from overload, short circuit, or outage will cause the fuel supply to be shut off? ..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Is there a starting switch and overload protection device on the crop drying unit? .....   | <input type="checkbox"/> | <input type="checkbox"/> |

## V. FAN SPECIFICATIONS

### A. UNHEATED AIR DRYERS

- |  | YES                      | NO                       |
|--|--------------------------|--------------------------|
| 1. If the drying equipment is used for drying hay, does the fan deliver at least 15 cfm per square foot of floor space in the mow, or 500 cfm for each ton of wet hay (35-40 percent) on the dryer, whichever is greater? The air delivery should be against 1 inch of static pressure. (In calculating the amount of wet hay on the hay dryer, one ton of hay will occupy approximately 300 cubic feet of space)..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. If the drying equipment is used for grain, will the fan deliver a minimum of 3 cfm per bushel at the following static pressure? .....   | <input type="checkbox"/> | <input type="checkbox"/> |

Grain	Depth of Bins		
	4'	6'	8'
Wheat, oats, barley	1"	2"	3"
Shelled corn, edible beans	¼"	1"	1½"

- |  |                          |                          |
|--|--------------------------|--------------------------|
| 3. If the drying equipment is used for ear corn, will the fan deliver at least 5 cfm per bushel at ½" static pressure? ..... | <input type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|

The same equipment can be used for drying more than one crop if the equipment is properly selected.

### B. HEATED AIR DRYERS

To prevent uneven drying when using heated air, a maximum depth of 18" for small grain and 24" for shelled corn and an airflow of at least 20 cfm per bushel is recommended. Where grain is to be fed on the farm and uneven drying is not a serious problem, air flow as recommended for unheated air with a limited temperature rise of 20° to 40° F can be used for drying in bins 4' to 6' deep.

## VI. AERATION SYSTEM

- |   | YES                      | NO                       |
|---|--------------------------|--------------------------|
| 1. Does the air supply provide from 0.1 cfm to 1 cfm per bushel at ½" static pressure for the total storage capacity of the bins? .....     | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is the system supplying air to more than one bin? .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. If the air is supplied to more than one bin, is some system of control provided so the air can be forced in each bin individually? ..... | <input type="checkbox"/> | <input type="checkbox"/> |

An aeration system is for the purpose of maintaining the quality of a crop in storage and is not a drying system. To be considered a drying system, a fan should meet specifications of Section V. An aeration system can be depended upon to remove 1 percent of moisture if air flows are between ½ and 1 cfm per bushel. The moisture is removed slowly. With an airflow of 1 cfm, the average moisture removal will be from ½ of one percent up to one percent a week. With exceptionally good drying weather, up to 3 percent of moisture may be removed by operating the fan 4 to 6 weeks.

### REFERENCE BULLETINS

1. *Barn Hay Driers in Michigan*, M.S.C. Extension Bulletin 219
2. *Drying Grain with Forced Air*, M.S.C. Extension Bulletin 316
3. *Drying Shelled Corn and Small Grain with Heated Air*, U.S.D.A. Leaflet 331
4. *Drying Ear Corn with Heated Air*, U.S.D.A. Leaflet 333.

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