# Operations manual

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# Fluidized Bed Dryer

## Non-Automated

Version 1.0 | 1/18/23

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| Fluidized Bed Dryers - Reference Manual Version 2017<br>Revision Table | | |
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| **Section** | **Revision** | **Date** |
| Main Section: Introduction to Installation and Functional Operation<br>Controlling the Machine from Console | 1.0 | 05/2017 |

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# Introduction:

This manual contains two different parts. The first part will describe the safety considerations and installation procedure for the machine. Next, the functional operation and initial setup of the machine will be described and finally, attached appendices will be provided for description of related functions such as programming the parameters into the Variable Frequency Drives and basic troubleshooting.

# Part I

# Safety Considerations and Installation

# Chapter 1

# Safety Considerations

## Important Safety Precautions for using the Fluidized Bed Dryer

- Always shut off and lock-out power when performing maintenance or service.
- Always insure that the dryer and components are electrically grounded.
- Always de-energize the electrical panel before working inside of it.
- Always wear proper Arc Flash PPE when work must be performed in a "live" or energized electrical panel.
- Always wear face and eye protection when inspecting or adjusting the dryer.
- Never operate the dryer with the air filters removed.
- Never operate the dryer with the deck removed.
- Never operate the dryer with missing or worn parts.
- Never operate the dryer with the air chest boot removed.
- Never operate the dryer with worn or damaged decks.
- Never use the dryer as a table or work station.
- Never stand on the dryer.
- Always wear ear protection when operating the dryer.
- Always keep dryer clean and properly adjusted.
- Periodically inspect the dryer for wear and correct operation.

# Chapter 2

# Installation

This section explains the installation requirements for the Dryer. Your Dryer will have been tested for many hours of operation at our facility to ensure the quality of the machine. Take care not to do anything that would damage or compromise it.

## 2.1 Foundation Requirements

A solid, level foundation is required for safe and proper operation of the FBD. Vibrations from flooring can cause damage to the machine. A six-inch concrete slab is ideal but not essential. The FBD is fully counterbalanced to keep external vibrations to a minimum. However, the weight of product on the deck can affect the counterbalancing system. Because that weight is affected by the capacity of a product and the type of product itself, we recommend that the Dryer be firmly attached to the floor. In the case that the mounting surface is not completely level it is required to use shims to provide as level of surface as can be achieved. Please contact the factory or your Oliver representative for further recommendations. When positioning the Dryer, be sure that you leave adequate clearance to operate the controls, open the electrical cabinet and remove the deck for changing or cleaning.

## 2.2 Handling

The Fluidized Bed Dryer can weigh several thousand pounds depending on the model and accessories ordered with it. Be sure that the handling equipment is adequate for the load. While handling the machine, take extra care not to damage the deck, air filters or any other parts of the machine. Your machine may be equipped with fork tubes located in the bottom of the machine mainframe, the fork tubes are designed to be used with 8-foot long forks or fork extensions. Picking up the machine with shorter forks may damage the tubes. The fan motors are mounted on the tubes, so any damage can have serious consequences for machine functionality. The machine is also equipped with lifting lugs at each corner of the mainframe which may be used to hoist the machine into place where fork tubs cannot be used or are not equipped.

## 2.3 Protecting the Deck

The deck is the portion of the machine that actually contacts product during the drying process. Take extra care not to damage it. During construction and installation, it is very

common for contractors to use the surface of the deck as a work space or storage space for items they are not using. Please discourage this practice! The deck is designed to support a relatively uniform load of product over its entire surface. Storage of concentrated loads on the deck has resulted in bent or broken deck frames and damage to the wire overcovers. We recommend that a non-combustible surface such as a sheet of 16-gage steel be placed over the deck to protect it until the Dryer is ready for use. Do not weld anything to the machine, as the sensitive control electronics could be seriously damaged. If it is necessary to weld or cut above the machine during installation, take extra care to prevent damage from falling debris or sparks. Any damage incurred during installation will not be covered under warranty.

## 2.4 Electrical Requirements

The Fluidized Bed Dryer comes with a complete electrical cabinet that is wired to all of the electrical components, such as the motors, reference keypads and dust hood light. Typically, the only wiring to be concerned with during installation is the main source power to the electrical cabinet. Typical voltages would be 230V and 460V, three phase, at 60Hz. Other voltages are possible, but need to be addressed when the order is placed.

| Machine | FBD410 | FBD512 | FBD616 |
|---|---|---|---|
| 208/230V | X Amps | X Amps | X Amps |
| 380V | 37.7 Amps | X Amps | X Amps |
| 460V | 27.8 Amps | X Amps | 62.5 Amps |

**Table 2.1:** Model Voltages and Total Amp Draws

**NOTE: As of November 1st 2012, the warranty covering the VFDs will become void if an electrician penetrates the cabinet from the top. The PLC and VFDs will suffer damage if dust or debris from drilling into the cabinet enters the air vents on the units. The electrician must enter the cabinet either from the bottom, or from the bottom of either side panel, below the vents on the VFD. Failure to do this will result in voiding the warranty on the VFDs.**

## 2.5 Clean Air Source

The FBD requires a clean air source in order to keep the deck from being contaminated by dust blown in through the fans. The air chest comes supplied with air filters for a machine that is going to be bolted down to a solid slab foundation. For those who want to use an external air filtration source, it is also possible to raise the machine or suspend it over a space where air is being pumped in. If you need consultation on how to get clean air to your machine, please call the Oliver team.

# Part II

# Functional Operation and Adjustment of the Fluidized Bed Dryer

# Chapter 3

# Functional Operation of the Fluidized Bed Dryer

This section explains the function of a Fluidized Bed Dryer, how they work, and how they are operated.

The family of Fluidized Bed Dryers (FBD) is based on Oliver's legendary Voyager and Maxi- Cap Gravity Separators. Unlike the gravity separator, which is designed to separate like particles of different specific gravities, the FBD is designed to remove moisture, and possibly heat, from particles on the deck. Though its function is slightly different, the FBD works similarly to the gravity separator.

The FBD operates on a concept discovered by Archimedes, a Greek philosopher and mathematician, who discovered that "All bodies, floating or submerged in a liquid, are buoyed up by a force exactly equal to the weight of the liquid they displace." In the case of the FBD, the liquid is the air blown by the fans, and the bodies are the particles being dried. What Archimedes was getting at is that we can use air to lift the particles on the deck, and that the amount of air needed is related to the weight of the particles that need to be lifted.

As air flows upward through the deck, it passes by the product, evaporating water around the particles. This process is comparable to the function of a basic swamp cooler. Because it takes a large amount of energy to change the state of water from a liquid to a vapor, the surrounding air becomes cooler as it passes the particles on the deck, as the energy needed to switch the state of the water comes from the air, and from the particles themselves. Hotter air from the fans will speed up the drying process because it has more heat that can be dissipated to the water, increasing the rate at which the water changes states. This allows us to monitor how dry the seed is as it passes over the deck. If the air is at the same temperature above and below the particles, then there must not be any evaporation, and the seed is dry.

In order to move the seed along the deck, there must be a process that allows the seed to propagate. This is done via the Deck Shake and the Deck End Raise. The Deck Shake also helps with the lifting of the seed as it gives momentum to the particles, as well as providing a mechanism for separating out the particles that are clumped together from being wet. The Deck End Raise allows gravity to assist or resist the movement of the particles on the deck.

With the combination of the air, the Deck Speed and the Deck End Raise, the particles will enter a quasi-fluidic state, meaning that the particles will almost act like a liquid, moving along the deck. As the air is increased, the particles will start to move more vertically in a layer, and the deck speed and end raise will drive the product down the

deck like a liquid. The faster the deck speed and the steeper the end raise from feeder to discharge, the faster the particles will move. The higher the air speed the faster the product will dry.

For normal use with ambient air, the typical operation of the machine is to set the fans at 100% and then to adjust the deck speed until all of the heavier particles are able to enter into the quasi-fluidic state, and then to adjust the End Raise until the product is just dry at the end of the deck. For example, consider Figure 3.1. Particles, represented by red dots, have been put onto the deck (a), and The FBD has been adjusted to 100% Fan Speed with a deck oscillation of 500 RPM. The particles have entered a quasi-fluidic state and are moving up the deck (b). The particles are dry when tested at the end of the deck, but they are also dry at the deck's mid-point. This means that the deck end raise can be increased, moving the deck towards a flat position and a slope from the Feeder to the Discharge End (c). This will increase the speed of the particles across the deck, decreasing the drying and process time. The Deck Speed can also be increased instead of the Deck Angle.

On the other hand, the particles might be introduced to a deck with the same settings as above, except the deck angle is too steep from the Feed End to the Discharge, keeping the particles from completely drying. See Figure 3.2. The particles are put on the deck (a) and the deck is adjusted but the particles are not drying at the end of the deck. The Deck End Raise should be decreased to hold the particles on longer so that the particles will dry.

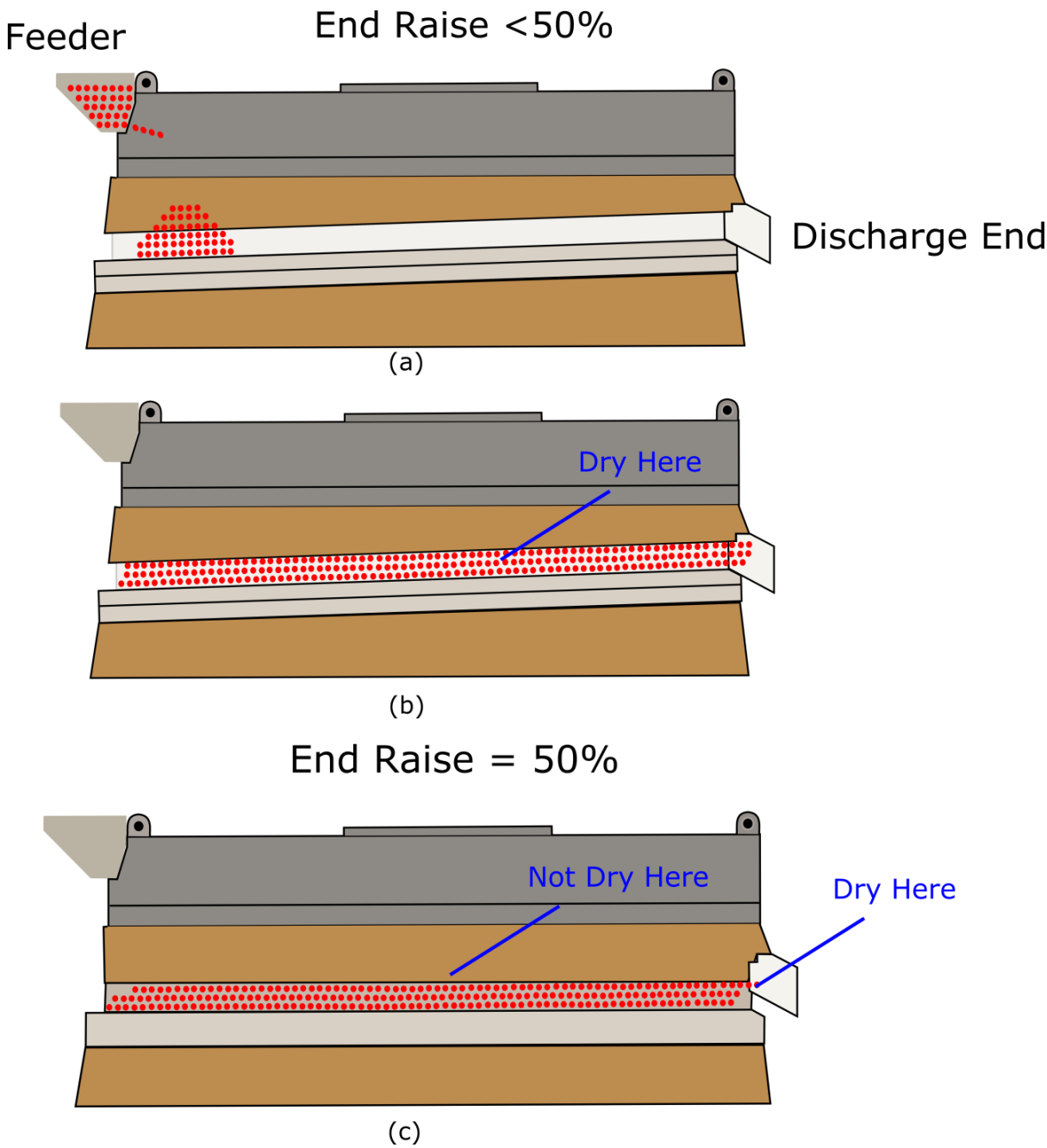


**Figure 3.1:** Putting particles on the deck and adjusting (a) Particles drying early (b) and drying at the end of the deck (c)

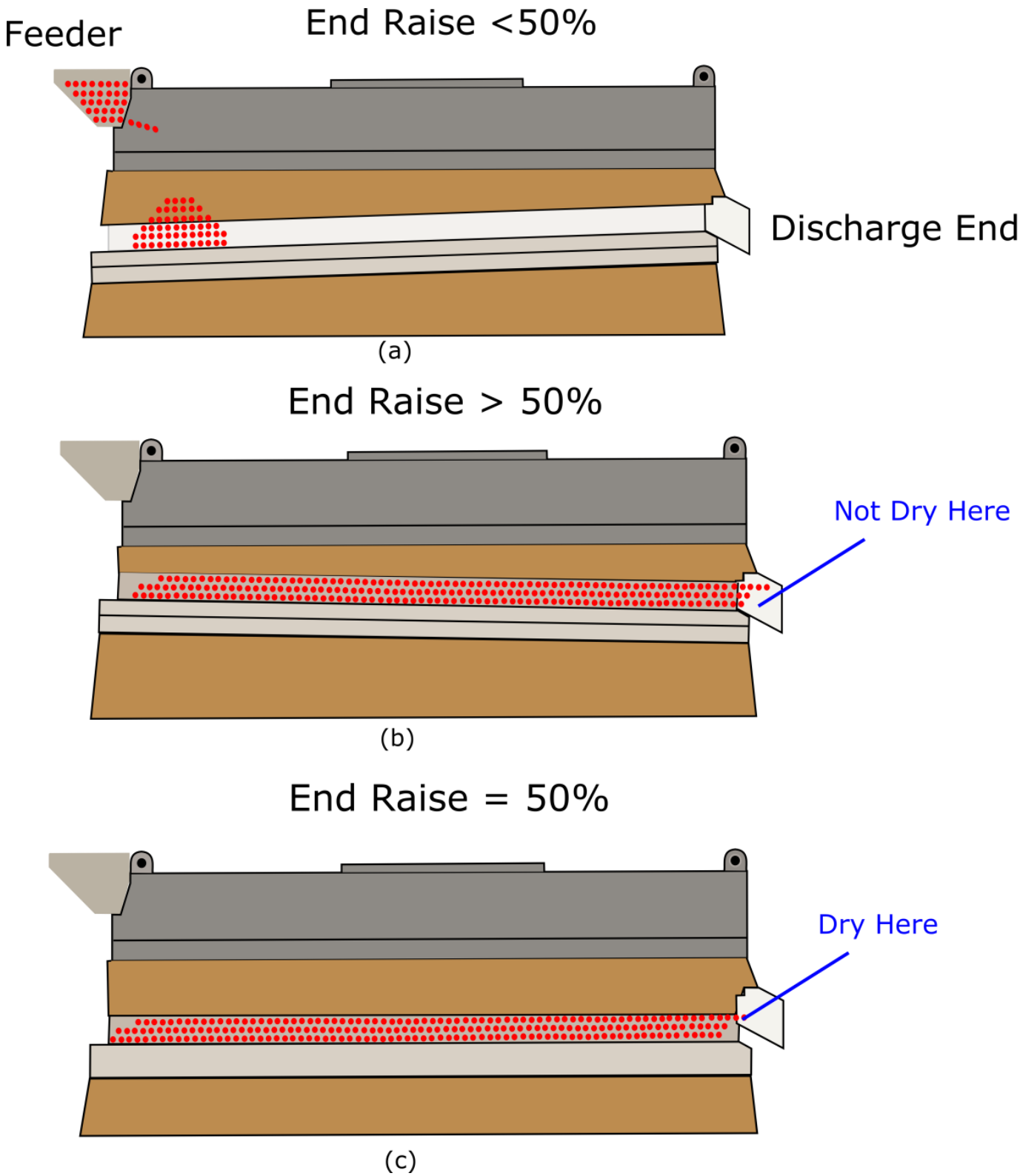


**Figure 3.2:** Putting particles on the deck and adjusting (a) Particles drying early (b) and drying at the end of the deck (c)

# Chapter 4

# Controlling the Fluidized Bed Dryer

The Fluidized Bed Dryer(FBD) is equipped with a control console that makes all operational adjustments of the machine. Lets take a look at the control console.


**Figure 4.1:** The Control Console

## 4.1 Control Components

Now lets take closer look at the components on the control console and how they're utilized.

### 4.1.1 The Reference Keypad

The FBD is a non-automated machine that is controlled via reference key-pads known as HIMs (Human Interface Modules) and a hydraulic lever. The reference keypads have individual buttons for start/stop and also up/down arrows for speed control over the fan motors or deck eccentric motor, as seen in figure 4.2.


**Figure 4.2:** The HIM

### 4.1.2 The Hydraulic Lever

The hydraulic lever seen in figure 4.3 is used to control the current deck angle. It is a two position valve, meaning it has two positions that can be utilized: More End Raise and Less End Raise, as shown in figure 4.4

**Figure 4.3:** Control Console - Operator POV

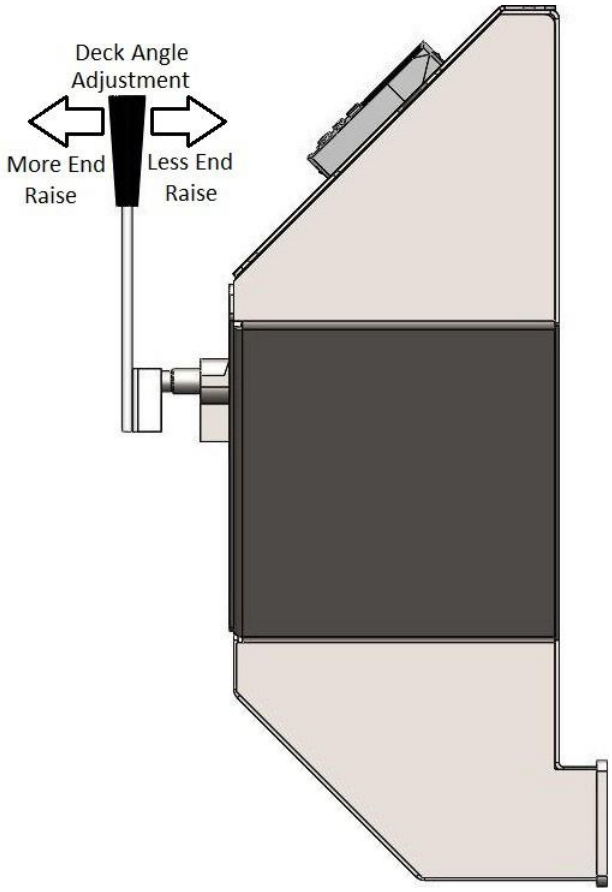


**Figure 4.4:** The Hydraulic Lever

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