Section 3

# PRINCIPLES OF OPERATION EF2203.2

## INTRODUCTION

Discharge Grid Mechanism (See **Figure 3-1**.)

(See also “General Description.”)

The Stationary Top Grid directs the product onto the Middle Grid.

The Grid Drive Brake Motor oscillates the Middle Grid. A Grid Limit Switch stops the Middle Grid in its closed position.

The Bottom Grid position is adjustable, either by means of a threaded handwheel or an optional linear actuator. Adjusting the position of the Bottom Grid varies the feed rate passing through the grid with each stroke.

The Bottom Grid can also be moved over its full stroke with the Air Cylinder or Optional Linear Actuator to clean product off the bottom grid at end of run.

## INTRODUCTION (Continued)

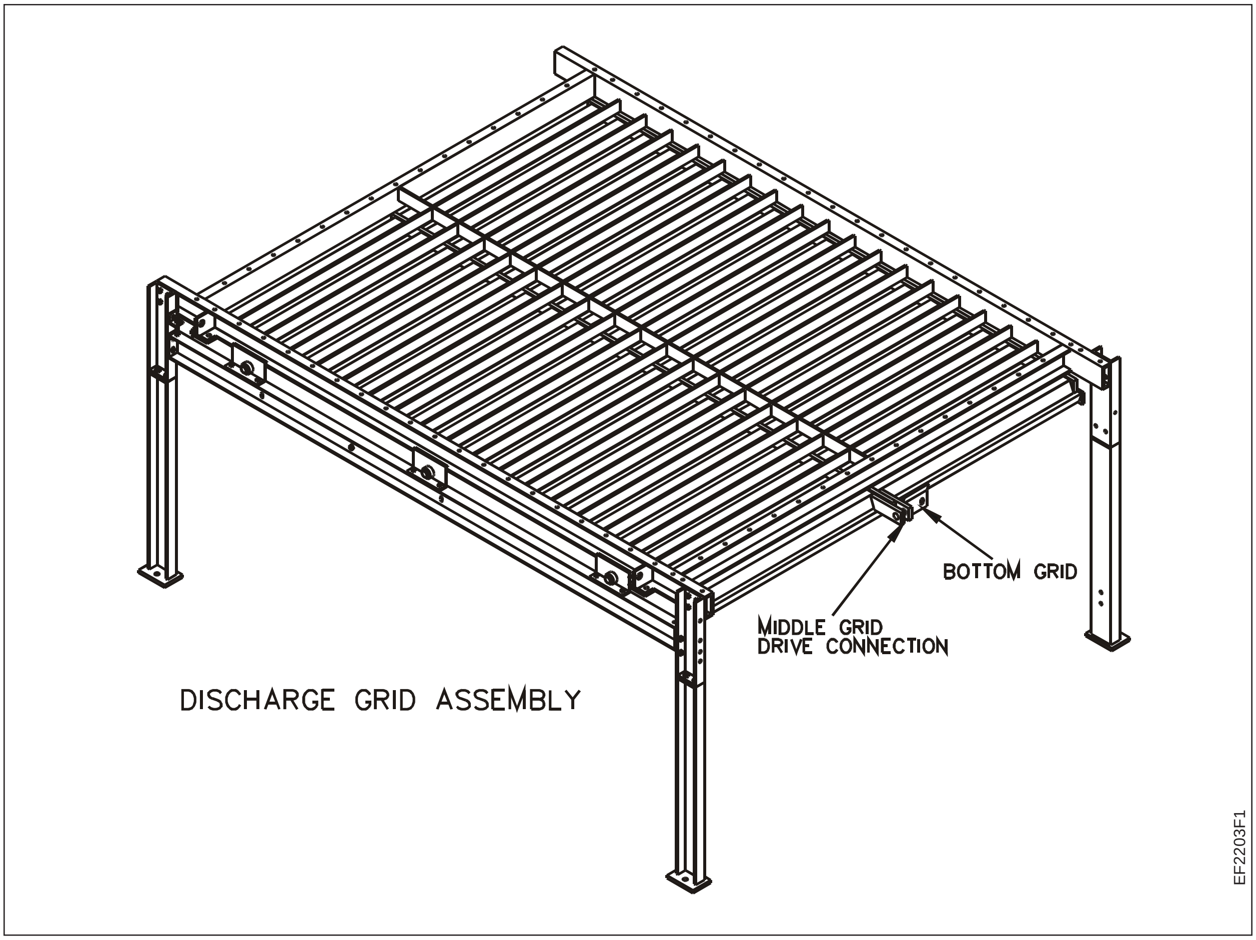


FIGURE 3-1

## BASIC COOLING AND DRYING THEORY

In nearly all pellet and flake applications, the cooler must cool the product and remove moisture. Surface evaporation removes moisture from the pellet. Heat is transferred to the air as it passes over the pellet and by the cooling effect of evaporation. The amount of heat and moisture removed from a pellets will depend on the following factors:

A. Retention Time:

It takes time for heat and moisture to diffuse from the pellet core to the surface. Longer cooler retention time permits more diffusion to take place.

B. Pellet Size:

Small pellets require less retention time because of the short distance for heat and moisture to reach the surface.

C. Pellet Properties:

The pellet formulation, density, and particle size affect how quickly heat and moisture can diffuse to the pellet surface.

D. Initial Pellet Temperature:

The energy in hotter pellets can drive off more moisture. Only limited moisture can be removed from cool pellets.

E. Initial Pellet Moisture:

The higher the pellet moisture content, the easier it is to cool the pellets, since more heat will be absorbed by evaporation. High moisture incoming pellets may still have high outgoing moisture.

F. Air Flow Rate:

Higher air velocities cool the pellets faster. Rapid cooling can actually limit moisture removal, since cool pellets have a greater tendency to retain moisture.

G. Ambient Air Humidity:

Low ambient air humidity allows the pellets to give up more moisture.

Counterflow cooler performance is controlled by adjusting retention time and air flow.

## CONTROLLING COOLER PERFORMANCE

1. Retention Time Control

   The retention time in the cooler is determined by setting the Operating Level Sensor height. The proper height setting is determined as follows:

$$\text{Bed Depth (in)} = \frac{\{\text{throughput (lb./min)}\} \times \{\text{required retention time (min.)}\}}{\{\text{product bulk density (lb./cu. ft.)}\} \times \{\text{cooler floor area (sq. ft.)}\}} \times 12$$

2. Air Flow Control

   Air flow control can be achieved by:

   a. An opposed blade damper.

   b. A variable frequency AC inverter (VF drive) to control fan motor speed.

   c. Fan belt drive adjustments.

      Any of these methods achieves the desired result of changing air flow. Methods 1 and 2 provide continuous variable remote control of air flow. The variable damper has a lower initial cost than does the VF Drive, but has a higher operating cost.

## SYSTEM PLANNING

1. Run Size vs. Cooler Capacity

   Good cooling and drying performance depends on proper matching of run size to cooler capacity. The minimum recommended run size is given by

   $$\text{Minimum run size} = 3 \times (\text{Throughput (TPH)}) \times \frac{(\text{Required Retention Time (Min)})}{60}$$

   For example, the required retention time for 11/64" pellets is about 8 minutes. If the pellet mill capacity is 20 TPH then the minimum run size would be:

   $$\text{Minimum run size} = 3 \times (20 \text{ TPH}) \times \frac{(8 \text{ min})}{60} = 8 \text{ tons}$$

   Smaller runs may result in the Discharge Grid not being fully covered and may require longer retention times for proper cooling.

2. Downstream Capacity

   Because the Discharge Grid is not running part of the time, the discharge rate when the grid drive is running, is higher than the average discharge rate, typically by about 25%. Equipment downstream of the cooler should have a capacity 25% higher than the average cooler throughput.

3. Air System Design

   See S-Memo 139 in Appendix.

## OPERATING INSTRUCTIONS

1. Start of Run

   Cooler is ready to operate when power is applied to fan, rotary airlock, and grid drive, and all upstream and downstream interlock conditions are met.

   Ensure that bottom grid position is set to the correct position for the product being cooled. Set operating bed level sensor height.

   Grid drive will not start until the product bed level rises far enough to cover the Operating Bed Level Sensor.

2. Steady-State Running

   Once the product bed is maintained at desired operating level, verify that the entire Cooler Grid is well covered. Some mounding typically occurs in the middle of the cooler.

   Adjust the air flow rate so that the relative humidity of the cooler discharge air is approximately 90%. If the air flow rate is insufficient, the cooler discharge air will be saturated (100% relative humidity) which can lead to condensation and mud buildup in the ductwork. If the air flow rate is too high, the product will be well cooled but may be too moist. Excessive air flow rates would be indicated by a low discharge air temperature and relative humidity. In a typical feed pelleting application, the proper discharge air temperature is about 130°F.

3. End of Run

   Emptying Cooler

   At the end of the run, the discharge grid drive will stop when the product bed drops below the operating level sensor. To allow the cooler to empty, turn the Discharge Mode switch on the control panel from “Automatic” to “Manual.”

4. Grid Cleanout

   Only after the cooler is empty, cycle the Bottom Grid to sweep off any remaining product. On coolers equipped with manual grid adjust, this is done by momentarily pressing the Pneumatic Cleanout button on the Basic Control Panel. On coolers equipped with remote grid adjust, grid cleanout is performed using the grid actuator controller on the Advanced Control Panel. Place the Actuator Controller in RUN mode and then hit the EXTEND button. The grid actuator will extend completely and then automatically retract to the closed grid position. The Bottom Grid must be repositioned to the correct opening prior to starting the next run.

## OPERATING INSTRUCTIONS (Continued)

5. Bottom Grid Position

   The Bottom Grid position controls the amount of product discharged with each stroke of the grid drive. Different product sizes require different grid position adjustments. The Bottom Grid position is adjusted manually by means of a handwheel or remotely by means of an electromechanical actuator. The grid position should be set when the pellet mill is running at maximum anticipated capacity for that pellet size. The grid position should be adjusted so that the grid drive runs about 80% of the time in order to maintain a constant bed depth.

   a. Handwheel Adjust

      To reduce the grid aperture (decrease the product flow rate), turn the handwheel counterclockwise. To increase the grid aperture, turn the handwheel clockwise. (See **Figure 2-4** and **Figure 3-2**.)

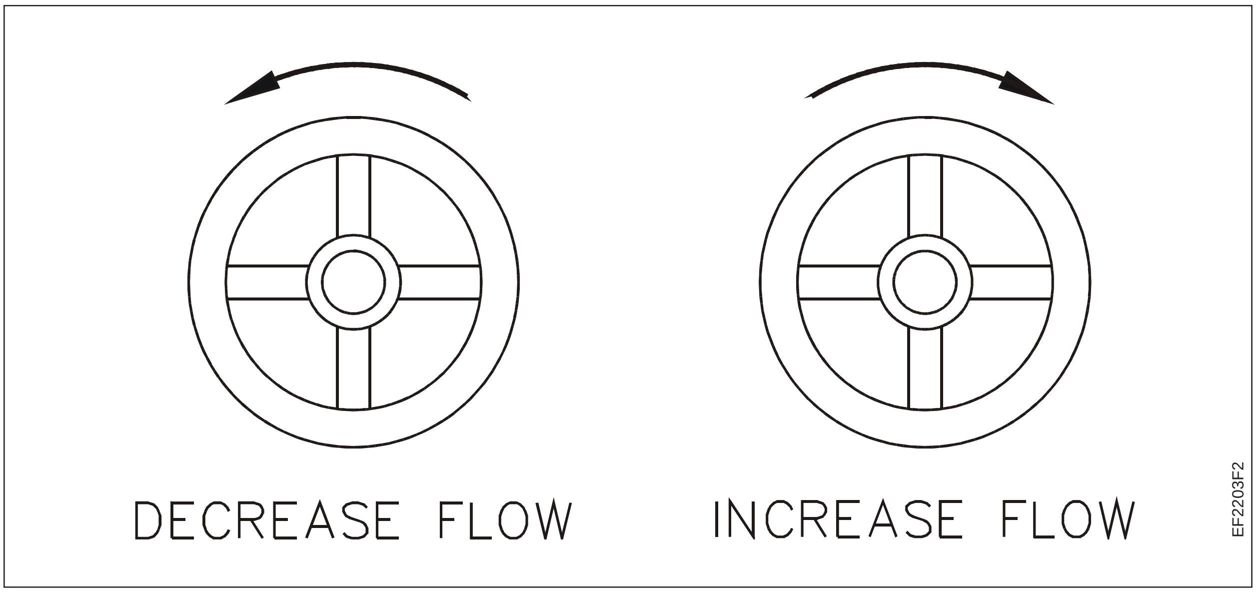


FIGURE 3-2

## OPERATING INSTRUCTIONS (Continued)

b. Optional Remote Grid Adjust (See **Figure 3-3**.)

The Bottom Grid position can be adjusted with the Remote Grid Actuator by using a Controller with the Basic Control Panel. The Controller has the following modes:

1. The Controller Panel face has an Emergency Button. Pressing this button turns off the Controller and Actuator.

2. Remote mode - not used.

3. RUN Mode

   Pressing the RUN Mode Button and momentarily pressing the EXTEND or RETRACT Button will cause the Actuator to travel the limit. This is a quick way to clear product off the Bottom Grid.

4. JOG Mode

   The operating position of the Bottom Grid can be adjusted by momentarily pressing the JOG Button and then pressing the EXTEND or RETRACT switches. The percent stroke meter will indicate the percent position of the Bottom Grid. This value can be used for resetting the Bottom Grid position to various locations.

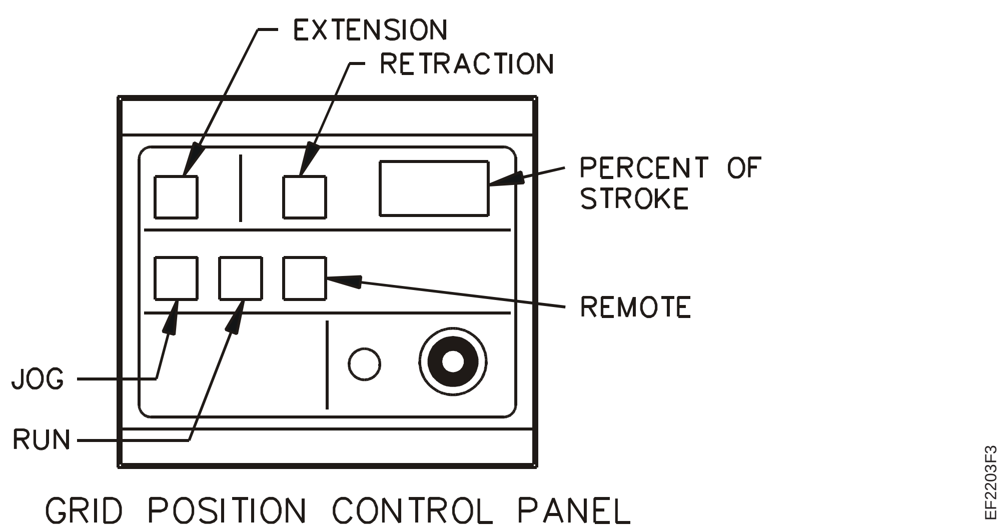


FIGURE 3-3
Grid Control Panel

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