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## SPECIFIC GRAVITY SEPARATOR

Charles E. Vaughan and G. Burns Welch <sup>1/</sup>

The names "Gravity Separator" or "Gravity Table" are contractions of "Specific Gravity Separator"; the shortened forms are more commonly used.

Crop seeds often contain immature seeds, weed seeds, or foreign material such as particles of soil that are the same size as the crop seed. Because of this, the undesirable material cannot be separated from the crop seeds with air-screen machines, length graders, etc. However, if each individual unit of the undesirable material has a specific gravity different from that of the crop seed the mixture can be separated with a specific gravity separator. Specific gravity of a solid or liquid is the ratio of the weight of the body to the weight of an equal volume of water at some standard temperature. If some material has a specific gravity of 1.5, this means that the material is 1.5 times as heavy as an equal volume of water.

### Operation

Learning to operate a gravity table is like learning to drive a car or ride a bicycle. A person can read all the instructions that have ever been written about how to drive a car, but until he gets a little practice behind the steering wheel he will not be a very good driver. So it is with the operation of a gravity table. After a person understands the principles of operation, if he will spend a few minutes or hours practicing with the various adjustments, it will pay dividends by enabling him to do a better separating job with his machine.

The separation of a mixture of seeds on a gravity table is accomplished in two steps. First, the seed mixture is stratified vertically by air into layers of different specific gravities, the heaviest layer being on the bottom and the lightest on top. After the mixture is stratified the different layers are separated by deck motion and gravity. Both actions occur simultaneously as the seed moves across the deck.

In operation, the deck is vibrating back and forth while currents of air from a fan under the deck are being blown through the deck. The seed mixture that is to be separated is fed onto the deck at the corner farthest from the discharge edge. The strength of the air currents is adjusted to cause the

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mixture to stratify into layers. These layers are then separated by the movement of the deck and by gravity. The heavy seeds that are in contact with the deck surface are pitched up and forward on the forward stroke. The deck then moves backward and downward on the backward stroke and catches the heavy seeds at a point farther up the deck. This fast action keeps the heavy seeds moving up the deck. The light seeds which are being floated on top of the heavy layer of seed by the air currents will flow by gravity to the lowest part of the deck.

### Deck Shape

Based on shape of deck, the separators may be classified as (1) triangular deck gravities and (2) rectangular deck gravities. The deck is covered with a porous material through which currents of air will pass. It is mounted on inclined toggles which gives it an upward-forward and a downward-backward movement when it is in motion. The deck is slanted in two directions. It is slanted up in the direction of the upward-forward motion (this is known as end raise) and down from the back side to the discharge edge (this is known as back raise). On a rectangular deck, the back raise would be from the feed zone to the side where the light material is discharged.

### Deck Coverings

Gravity table decks that are used in the seed industry are covered with a material like oxford cloth or closely woven wire. The cloth-covered deck is used in the separation of small seeds such as the clovers. The wire deck is used when separating large seeds such as beans and corn. It is important that the right deck is used for a given seed species.

Some wire decks have coarse mesh wire about 1/2 inch by 1/2 inch on top of the closely woven wire. The purpose of the coarse mesh wire is to give more traction for smooth seeds. The wire deck also has metal strips about 1/4" high and three or four inches apart on top of the wire. These strips are known as riffles. They serve as dams to prevent the smooth heavy seed from moving toward the discharge edge before they are carried to the highest part of the deck.

### Adjustments

There are five main adjustments provided on a gravity table:

1. Amount of Air: This is controlled by an adjustable damper in the inlet side of the fan housing. If excessive air is used, the strong air currents will keep the seeds mixed, prevent them from becoming stratified, and the heavy seeds will flow toward the low end of the deck with the light material. If insufficient air is used, the seeds will not be stratified and the lighter seeds will travel up the deck with the heavy seeds.

2. End Raise: (Elevation of the deck in the direction of the upward - forward motion.) The purpose of the end slope adjustment is to elevate the end of the deck so that the heavy seeds and the light seeds can be separated after they become stratified.

3. Back Raise: (Elevation of back side.) The purpose of the side slope adjustment is to regulate the rate at which the seeds travel toward the discharge edge of the deck. An increase in the amount of side slope will increase the rate of travel while a decrease in the slope will increase the travel. Seed mixtures with only a slight specific gravity difference require a relatively flat slope in order to give the seed more time to become stratified. A steep side slope can be used for mixtures that have a wide difference in specific gravities and stratify more quickly.

4. Speed of the Eccentric: The speed of the eccentric shaft can be varied by adjusting the variable speed drive. An increase in the eccentric speed will cause the seed to travel faster up the back, while a decrease in speed will result in a slower rate of travel.

5. Rate of feed: It is important that a gravity table be fed uniformly and to its capacity. Feeding the machine too fast will cause an excess of good seed to be discharged with the light material. At no time should any portion of the deck be bare as this causes an uneven distribution of air through the deck.

All of the adjustments on a gravity table must be in balance. Only one adjustment should be made at a time after which the machine should be allowed to run several minutes for the adjustment to show its effect on the flow of seed across the deck. Other adjustments are then made as needed.

#### Recommended Procedure For Setting-Up A Gravity Table

1. Select the right type of deck. A cloth deck is used for small seeds such as the clovers, while a wire mesh deck is used for larger seeds.

2. Close off the air and adjust the side and end tilt for a moderate amount of slope.

3. Start the feed and adjust the speed so that the seed will back up against the back rail until the deck is about one-half covered.

4. Open the air until the seed become stratified and the light material begins to flow downhill.

5. Adjust the feed again and then adjust the air to make the light material flow downhill. This operation is repeated until the deck is completely covered with a layer of seed.

6. The vibration and slope can now be adjusted to increase capacity.

When a gravity table is out of adjustment all material on the deck will tend to move toward the highest or lowest part of the deck.

If all the material tends to move toward the highest part of the deck, it could be caused by one or more of the following:

- a. Insufficient air currents.
- b. Not enough end raise.
- c. Not enough back raise.
- d. Speed of vibration too fast.

If all the material tends to move toward the lowest part of the deck, it could be caused by one or more of the following:

- a. Excessive air currents.
- b. End raise too high.
- c. Back raise too high.
- d. Speed of vibration too slow.

### Installation Tips

The gravity table must be installed properly in order to give the best performance. Some of the mistakes most commonly made when installing a gravity table are:

1. Installing a gravity separator on a weak foundation. The gravity separator is a vibrating machine and should be installed on a firm foundation. A slight vibration at the base of the separator will be multiplied many times before reaching the deck. This is known as false vibration, as opposed to the the eccentric vibration which is built into the machine. If the false vibration becomes synchronized with the eccentric vibrations it will cause the seed to have a tendency to surge across the deck. Should the two vibrations get out-of-step, one vibrating force will counteract the other vibrating force resulting in no forward movement of the seed.
2. Unclean air. A gravity table uses a large amount of air which is blown up through the deck. If dirty air is blown through the separator, some openings in the deck covering tend to become clogged. This condition can be detected by blind areas on the deck where the seeds do not seem to be floating. Some operators have doubled the capacity of their gravities by piping clean air in from the outside.
3. Fan running backward. If the fan is running backward, it will not develop sufficient pressure in the air chest. Most machines have an arrow on the fan housing or motor showing the correct direction of rotation. If no directional arrow can be located, the deck should be removed and the motor started. The fan blade should be rotating toward the discharge opening, if not, it is turning backward. To change the direction of rotation of the three phase motor, the switch should be disconnected and any two of the wires leading to the motor reversed.

4. Loose deck clamps. All clamps should be tight. Loose clamps will cause vibrations.

5. Loose belts. If the drive belts become loose, the machine will not operate at a uniform speed. Irregular speed will cause the seed to surge across the deck.

6. Wrong type of deck. Be sure to use the right type of deck. The general rule for deck covers is: For small seeds use a deck cover with small openings. Conversely, for large seeds use a deck cover with large openings.

There are many more mistakes that can be made in the installation of a gravity table but these are probably the ones most commonly made.