When one hears the phrase "Basic Seed Conditioning," what immediately comes to mind is the process of removing all undesirable contaminants from the seed mass. Just as important, however, and sometimes overlooked are prevention of varietal mixing and unnecessary mechanical damage.

Receiving

Provided the seeds brought to the cleaning plant are of seed quality, Basic Seed Conditioning begins with the receiving operation. The receiving pit should be of such design as to prevent mechanical damage or germination damage and/or varietal mixing of seeds.

Gravity-flow receiving pits are the best type to use for the receiving of seeds. However, gravity-flow pits have to be very deep when designed to hold large quantities of seeds and are the most costly to install.

The most frequently used types of receiving pits for receiving of seeds incorporate vibrating shaker spouts, belt conveyors or drag conveyors in the bottom to transfer seeds to the boot inlet of the receiving elevator(s). Also, the receiving pit grill should not have ledges, cracks or crevices to hold pockets of seeds which would cause varietal mixing and extend clean-up time between receiving of different varieties.

When truck trailers are dumped, "splashing" of seeds sometimes occurs and large amounts of seeds bounce out of the pit and onto the surrounding area around the pit opening. Large pit openings assist in eliminating this type of "splashing" effect which in turn reduces the amounts of time one must spend in pit clean-up between receiving of different varieties.

Receiving bucket elevators for seed plants should be the type especially designed for the gentle handling of seeds. Seed elevators have large diameter head pulleys

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1President, Harden Processing Equipment Sales, Inc., Memphis, TN.
and slow belt speeds which discharge the seeds from the elevator cups directly into
the throat of the elevator (Figure 1). Legs on the elevator boot at least four inches
in height allow additional room for cleaning between varieties. Nylon spacer
washers about 1/2 inch thick placed between the elevator cups and belt give the
proper space to prevent seeds from lodging behind the cups (Figure 2).

Only one receiving elevator is needed if no bulk storage is incorporated in the seed
conditioning facility as the only place to spout from the elevator is to the seed
cleaning plant itself. However, if bulk storage is incorporated into the seed
conditioning facility, then it is recommended that two receiving elevators be used
in the receiving pit.

Two receiving elevators provide much more flexibility in that they allow more than
one function to be performed at a given time. For instance, with two receiving
elevators the seedsman may:

- Receive two varieties of seeds simultaneously without having to
clean out the elevator boots.
- Receive into a pre-cleaner, then spout the seeds directly to bulk
storage or to the seed cleaning plant.
- Receive through the receiving pit for routing to bulk storage bins
while at the same time transferring seeds from another storage bin
to the seed cleaning plant.

When using two receiving elevators, spouts from both elevators need to be to all
points so that in case of mechanical failure of one elevator, the other can be used
without a loss of receiving time.

A primary source of varietal mixing can be eliminated by using seed-type
distributors which have internal locking spouts or leak-proof bucket valves if an
elevator is to be spouted to more than one point.

Precleaning

Precleaning seeds prior to bulk storage is advisable as this process eliminates a
large portion of undesirable foreign contaminants making for better conditions
under which to store and/or dry seeds in bulk tanks or bins. Precleaning also
enhances the actual precision cleaning process because the major portion of
unwanted foreign contaminants have already been removed from the seed mass.

Two different types of precleaners are primarily used in seed conditioning plants:
the reel type which uses a revolving wire mesh cylinder to scalp off the larger
sticks, stems and straw; and the reciprocating screen type which uses both a
Clipper ELEVATOR HEAD SPEEDS

Clipper heads, boots and legging are products of intensive study involving thorough engineering and precise construction. A bucket elevator, properly designed, driven at correct speed, will make a clean discharge directly into the throat assuring no appreciable damage on vulnerable commodities and little or no backlegging or downlegging.

Note: A slight deviation such as 5 r.p.m. above or below optimum speed causes the cups to spill or throw.

Sketches below illustrate commodity discharge patterns of a 24-inch diameter pulley at: TOO SLOW - 35 r.p.m., OPTIMUM - 45 r.p.m. and TOO FAST - 65 r.p.m.

TOO SLOW - spillage

Cups spill the product into the upleg and downleg. Breakage occurs when the kernels strike the cups ahead, when tumbled within the pulley and when re-elevated.

OPTIMUM - recommended speed

Cups fill and carry perfectly, then discharge directly into the throat -- no spillage -- no breakage.

TOO FAST - critical when commodities are damageable by rough or fast handling.

Cups lose all holding and discharge control, resulting in gross inefficiency, excessive breakage and undue head wear of the head liner.

<table>
<thead>
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<th>OPTIMUM SPEED CHART</th>
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<tbody>
<tr>
<td>Pulley Dia.</td>
</tr>
<tr>
<td>R.P.M.</td>
</tr>
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</table>

Figure 1. Some characteristics and criteria for belt-bucket elevators used for seeds (Clipper type).
Figure 2. Spacer washers between bucket and belt - a must in a seed conditioning plant.

ELEVATOR BELT

NYLON SPACER WASHER 1" dia. x 1/2" thick.

ELEVATOR CUP BOLT

ELEVATOR BUCKET
A scalper screen and a sifting screen to remove both large and small contaminants. As the reel type scalper has no bottom screen for removing small particiles, it is used as a scalper only. Both the reel type scalper and reciprocating type precleaners can be equipped with an air separation for removing dust and very fine particles. Although the reciprocating type precleaner would be the best choice under most conditions, the seeds you plan to preclean may be a determining factor as to which type unit is required. For example, if a seedsman is cleaning soybeans, wheat and rice in his facility, the reciprocating type precleaner would be the choice for both soybeans and wheat. However, if the rice coming from the field has a high enough moisture content as to prevent the rice kernels from sliding down perforated metal screens, then the reel type scalper would be the better selection if only one precleaner is to be used. Do not misunderstand my reason for selecting the reel type precleaner. A reciprocating precleaner having a capacity of 4,000 bushels per hour on soybeans and wheat would only have a capacity of about 1,500 bushels per hour on paddey (high moisture) rice. The reduction in capacity for that portion of rice precleaning is my reason for selecting the reel type precleaner for all products: soybeans, wheat and rice in this situation.

The most economical way in which to design a precleaner into a seed cleaning facility is to use a high capacity precision cleaner for the actual cleaning process. Then by using larger openings in the top scalping screens and smaller perforations in the bottom sifting screens, a higher precleaning capacity may be obtained. The clean seed discharge from the high capacity cleaner must be bi-directional, both to the bulk storage system and to the final cleaning process within the cleaning plant. This method would reduce the flexibility of the total facility in that the seedsman would not be able to preclean received seeds and precision clean in his plant simultaneously.

The only disadvantage of a precleaning system is the down time required to clean up the precleaner when more than one variety is being received in alternating loads. A seedsman may choose to program his receiving equipment so that the larger quality of variety being received passes through the precleaning process with the lesser amount going straight to bulk storage, by-passing precleaning at the time of receiving. Seeds by-passing precleaning at time of receiving may then be precleaned at a later date.

**Bulk Storage**

Bulk storage bins are available in many shapes and sizes with each type having its own particular advantage over others. Flat bottom bins are the most economical to install and allow in-bin drying should moisture need to be removed from seeds.
Hopper bottom bins eliminate the need for bin sweeps thereby reducing man hours and time required for removing the last ten to fifteen percent of seed from the bin. Elevated drive-under hopper bottom bins having smooth steel walls are the most expensive to install, but they also are the more flexible for use. They may be used for both bulk uncleaned seed storage and cleaned seed storage. Cleaned seeds may be bulk loaded into trucks or may be bagged directly from the bins with valve bag packers or sewing lines.

Whichever type bulk storage bins the seedsman chooses for his facility, the layout of those bins with regard to loading, unloading, flexibility and maintaining the seed quality is of utmost importance. All seams and cracks need to be filled with sealant and outside bin wall stiffeners should be used where possible instead of inside stiffeners. Also, if possible, the same variety of seed should be stored in the same identical bin as stored in during the previous year. Many seedsmen have found that the difference in soybean seed conditioning "clean-out" to be an average of four percent when the seeds were not stored in properly designed bulk storage facilities. Those loses are directly related to mechanical damage.

Placing bulk storage bins in rows in accordance with bin size then using distributing conveyors over the rows of bins is the choice of bin layout by most seedsmen. Drag conveyors having round-bottom troughs and hipped weather proof covers are your best choice for overhead distributing conveyors when multiple discharge gates must be used. Two-way leak proof bucket valves placed between the conveyor discharge gates and storage bins will help to eliminate the possibility of varietal mixing. The valves are placed in the "out" position at all times unless the bin directly below it is being filled.

E-Z down "bean ladders" attached to the bin sidewall can be used to eliminate splitting of fragile seeds such as low moisture soybeans. In situations where overhead conveyors are not used but instead seeds are spouted directly to storage bins, enclosed E-Z down ladders can be used in place of the more commonly used round spouts provided the seeds are of a dry flowable nature. Table 1 charts shows the velocity obtain by seeds in round spouts.

Both round bottom drag conveyors or belt conveyors are excellent choices of conveyors for reclaim and/or transfer conveyors from bulk storage to the seed cleaning equipment area.

**Air-Screen Cleaning**

Unless a debearding process is required in the conditioning plant, the first seed cleaning process is usually an air/screen cleaner. There are many different manufacturers of this type cleaner, but all use the same principles of air and screen cleaning. Optional features include metering hoppers with variable speed drive, top fan system, size and number of screens in the cleaner, screen flow
Table 1. Grain velocities in spouts.

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This table indicates approximate velocities that will be attained by whole dry grains flowing freely in smooth metal spouts of various lengths and of various angles in relation to the horizontal. The velocities are based on an angle of repose of 28 degrees for grain.
arrangements, variable shoe shake, adjustable pitch, screen rockers, variable bottom blast fan system, brush or ball screen cleaning, steel, wood or wood/steel construction.

Metering hoppers with variable speed drives provides an exact amount of feed to the cleaner. The cleaner hopper is a "feeding device" only and it is recommended that a surge bin of a size to accommodate at least two hours of continuous operation be placed above the cleaner.

The top fan system pulls air through the column of seeds as they are metered from the hopper to the top screen and removes large quantities of undesirable light product such as stems, sticks, weed seeds, pods, dust and hulls. The more off-grade product removed by the top air system, the less amount of cleaning is required for the screening operations of the cleaner. A properly adjusted top fan air separation would produce approximately three to five good seed kernels in a handful of off-grade from the top discharge spout. This check assures the seedsman that he is removing all off-grade types possible with the fan without undue loss of good seed.

If you are unable to remove a few good kernels with the top fan system, or the bottom fan system for that matter, check for back pressure in the air system from the fan outlet discharges through the air piping and to the cyclone or dust collecting system used. Some models of air/screen cleaners have sliding air gates which allow additional airflow directly into the eye of the fan to keep air velocities within the air piping at a sufficient speed to keep heavier dust particles from settling in the air piping system. Should dust particles be allowed to settle and build up in the air piping and dust removal system, increased back pressures from such a situation will not allow for a proper separation at the cleaner.

The size and number of screens in the air/screen cleaner will vary with the model the seedsman selects for his cleaning purposes. Most all precision cleaners have at least four screens which may be arranged in several flow configurations. It is always advisable for the seedsman to select an air/screen cleaner of sufficient size to obtain the desired capacity under the most difficult cleaning situations. Increased capacities are then realized when cleaning seeds having lesser amounts of contaminants to be removed from the seed mass.

**Screen Nomenclature**

Before discussing reasons for selecting specific shapes and sizes of screens for cleaning seed, let us review the numbering system used for numbering the different types of screens available. The size of a round hole screen is the diameter of the perforation. Perforations larger than the size 5-1/2/64th are measured in 64ths of one inch. Therefore, a 1-inch round hole screen is a No. 64;
a 1/2-inch screen is a No. 32, etc. Screens smaller than 5-1/2/64th are measured in fractions of one inch. The next smaller size being 1/12th.

Oblong screens are measured with the same system as round hole screens except that there are two dimensions that must be given. Large oblong or slotted screens have their width measured in 64ths of one inch; for example, the size 11/64x3/4. Slotted screens smaller than 5-1/2/64x3/4 generally have their width measured in fractions of one inch; for example, the size 1/12x1/2. There are some exceptions to this small-slotted-screen numbering system in that the sizes 5/64x3/4, 4-78x3/4, 3/64 x 5/16 and others are numbered with the large-screen numbering system measuring the width of the screen in 64ths of an inch. The final number is the length of the slot in fractions of an inch.

Wire mesh screens are numbered according to the number of openings per inch in each direction. A 10x10 screen has ten openings per inch across and ten openings per inch down the screen. The size 6x22 has 22 openings per inch across the screen and six openings per inch down the screen. Such openings as the 6x22 are rectangular in shape and are the wire mesh equivalents to oblong or slotted perforated screens.

Triangular screens may be measured in two ways. The system which is used most generally in the seed industry is to give the length of each side of the triangle in 64ths of one inch. The sides of the 11-Triangle are 11/64ths of one inch long. Another system used by perforators is to size the triangle as the diameter of the largest circle that can be inscribed inside the triangle. Figure 3 lists the screen sizes which are available to the seedsman for use in his cleaner.

**Screen Selection**

The two basic screens, top and bottom, for cleaning *round shaped seeds* are a round hole top screen and a slotted hole bottom screen. The round hole top screen drops the round seed through the closest-fitted hole that it can go through and lets anything that is larger or bigger be screened over and is referred to as "scalping". The seed pass onto a slotted bottom screen which takes advantage of the shape of the seed to hold up the round good seed and drop split, broken crop seed and many weed seed and is referred to as "sifting".

The basic top and bottom screen for cleaning *elongated seed* should be a slotted top scalping screen and a slotted bottom sifting screen. It may be necessary in some cases to pass seed through a round hole top screens or over some other shape than a slotted bottom screen to effect a special separation; but, when selecting the basic screens for elongated seed, slotted top and bottom screens are most generally used.

Another seed shape is the *lens-shaped seed*. The basic top and bottom screens for lens-shaped seeds are generally a slotted top screen and a round hole bottom
### CLIPPER SCREEN SIZES

#### PERFORATED METAL SHEET SIZES

<table>
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<th>ROUND HOLES</th>
<th>OBLONG HOLES</th>
<th>TRIANGLE HOLES</th>
<th>OBLONG CROSS SLOTS</th>
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In order to complete our service to you, Ferrcll-Ross offers over 200 different size screens in the above listing.


*Notice: Openings illustrated are not scaled to exact size*

"Clipper" perforated and wire cloth screens are the best seed cleaning screens you can buy. Tolerance differences are kept to minimum and the design of each opening is exactly right to make a precision separation.

"Clipper" wire cloth screens are electroplated after weaving with a non-corrosive metal to give the best possible rust protection as well as strong resistance against normal wear.

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Figure 3. Sizes and types of screen perforations available for air-screen seed cleaners.
screen. These shapes allow the best cleaning possible with a minimum of one top and one bottom screen. The lens-shaped seed will turn on edge and drop through a slotted top screen and lie flat and pass over a very large, round-hole bottom screen that will drop from them most weed seed and other crop seed.

Since most commercial processors of seed use cleaners having more than two screens, the general rule most frequently followed for selecting top and bottom screens is to equip the cleaner with round hole and oblong top scalping screens, one each in each shoe, and oblong and round, square or triangular bottom sifting screens, one each in each shoe. With few exceptions this assures the most thorough and complete screening.

Hand testing screens allow the seedsman the advantage of selecting the proper screen openings and shapes for each cleaning problem prior to loading the screens into his cleaner. Twelve-inch square hand testing screens are much easier to handle for test purposes than say a screen which is 54" x 60". Since the actual physical size of some varieties of the same seed types differ, it is usually always necessary to have a selection of different sized scalping and sifting screen sizes from which to choose.

Gone are the days when a seedsman having a four-screen cleaner would have two top scraping screens and two bottom sifting screens marked "BEANS" for the cleaning of soybeans. If large soybeans numbering 2100 to 2500 per pound are to be cleaned, then top scalping screens in round hole sizes 20/64, 21/64 or 22/64 and bottom sifting screens in slotted hole sizes 11/64x3/4, 12/64x3/4 or 13/64x3/4 would be used. However, if very small soybeans numbering 3700 to 4200 per pound are to be cleaned then top scalping screens in round hole sizes 74/64, 18/64 or 19/64 and bottom sifting screens in slotted hole sizes 8/64x3/4, 9/64x3/4 or 10/64x3/4 would be used. Some morning glory seeds are too plump to fall through the smaller sizes of slotted screens. If you encounter this problem, you will have to use a smaller round hole bottom screen such as a 12/64 or 13/64 which will allow the morning glory seeds to drop through but pass the soybeans over.

You can see from this example that if you plan to process different varieties of soybeans having different sizes as shown above, you would need to have on hand all round hole screen sizes from 17/64 through 22/64 plus 12/64 and 13/64 as well as all slotted screens from 8/64x3/4 through 13/64x3/4. You should have a complete set of hand testing screens with these same identical sizes.

**Methods to Increase Efficiency**

Some seedsman having cleaners with only one bottom sifting screen or two bottom sifting screens with a special separating problem may want to consider what are referred to as "combination" screens. That is, they have two or more sections of different screen perforations on one screen frame. If restricted to one bottom
sifting screen for cleaning a medium sized soybean contaminated with morning glory, the seedsman could use one section of 10/64x3/4 slotted hole screen material on one frame as his sifting screen which would allow both morning glory seeds and soybean splits to pass through in one cleaning operation.

Screen dams are objects fastened to a screen to make it sift more accurately than normal. They are used when very close and accurate separations of small round seed must be made or on cleaners having non-adjustable pitch screens. Dams may be made of any sort of material but are commonly strips of wood lath about 1/4-inch high and 2-inches wide. When fastened over the cross braces of the screen with nails or screws, they interrupt the smooth flow of the seed down the screen, cause them to stop momentarily and be thoroughly sifted which gives the seed that should be dropped through the screen plenty of opportunity to contact the perforations. Dams are generally used only on bottom sifting screens and when used on round hole bottom screens, the accuracy of sifting is so increased that a heavier layer of seed may be placed on the screen with a resultant increase of capacity.

Another device that can be used to improve the separation that a top scalping screen makes is a piece of oil cloth or canvas apron with the slick side down and lying flat on the screen. The weight of the apron tends to hold long pieces of straw and stems flat on the screen so that they do not turn on end and go through with the good seed but are separated.

It is often a good practice to blank off the lower portion of a top scalping screen. Once the point at which all of the good seed drop through has been determined, all of the top screen from that point downward to its end can be blanked off with paper, tape or blank screen material so that any foreign materials passing over the top portion of the screen perforations will pass onto the blanked-off section and have not further chance to turn on end and go through with the good product.

**Adjustments**

Variable shoe shake means that the speed of the eccentric shaft can be changed in order to provide the proper speed to clean any given seed type and is recommended if several different types of seeds are to be cleaned. Each type of seed requires a certain amount of agitation to properly separate the seed kernels and seed texture will dictate its flow ability characteristics. For example, fuzzy cottonseed will require a higher eccentric shaft speed than will soybeans.

As the sifting screen portion of the screening process almost always determines the capacity of the cleaning process, it is important to impart the proper agitation to the seed mass which will allow the smaller particles to drop to the sifting screen, find a perforation and drop through to the bottom pan. It is also very important to be sure the eccentric shaft speed is sufficient for proper ball action.
in cleaners having ball tray screen cleaning systems. Too slow a speed and the screen perforations will "blind over" prohibiting the desired sifting separation.

Adjustable pitch screen rockers vary the degree of steepness of the screens. A steep pitch will walk the product over the screen faster with less exposure to the screen surface and is generally the setting for the top or scalping screen. A flat pitch will allow more seed exposure to the screen surface and is the setting for the bottom sifting screens (Figure 4). Variable eccentric shaft speed and adjustable pitch screens work simultaneously to provide the seedsman with the complete range of settings to properly clean any seed type be it the very smallest of seeds such as clovers to the largest of beans.

Ball tray screen cleaning systems have in most cases proven to be the best all around system for all seeds and screen types. Use the number of balls recommended by the manufacturer of your cleaner as ball tray configurations differ with different manufacturers. However, if your cleaner screens seem to be imparting a more violent action to the seed mass than you feel is required, you may want to try using one or two less balls per tray compartment than is recommended. Balls used by one manufacturer's cleaner will not necessarily interchange with another manufacturer's cleaner. Be sure of the size and bounce characteristics of replacement balls.

Variable speed bottom blast fan systems provide one final air separation prior to the seeds being discharged from the cleaner. This fan system will remove any dust or hulls that may have become detached during the screening process and in some cleaning processes will remove lighter undesirable seeds having the same basic physical size but a lesser specific gravity. An example would be "slick" cockleburs from soybeans.

After the basic cleaning by the air/screen cleaner, final finishing separations may be obtained from any number of different types of finishing machines. Included in these types for the seedsman's use are spirals, indented cylinders, gravity separators, precision sizers, disc mills, aspirators, dodder mills, magnetic separators and color sorters.

**Summary**

In closing let me recommend that if you are unsure of the types of cleaning equipment that you should be using in your seed cleaning operation or if you are not sure of the arrangement of these types of equipment, inquire with the manufacturers for their recommendations or consult with a design engineer not only familiar with different types of seed conditioning equipment, but also familiar with the types of seeds and contaminants in your area. After all, the product you put in the bag is a direct reflection upon you as a seedsman.
SOYBEAN CLEANING
Scalping Screens - Medium To Steep Pitch
Sifting Screens - Flat To Medium Pitch

Figure 4. Adjustment of screen pitch.