Big-Package Haymaking: Packaging and Handling Equipment Alternatives

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BIG-PACKAGE HAYMAKING
Packaging and Handling Equipment Alternatives

Samuel D. Parsons, Extension Agricultural Engineer

Big-package haymaking is a concept for mechanizing hay harvest as well as handling and feeding. The concept is not new. What is new, however, is the equipment now available for accumulating (packaging) and handling hay in large, efficient, unit quantities.

Currently, there are seven manufacturers offering a total of 14 different models of big-package haymaking machines. The size of hay "package" these machines can produce ranges from less than half a ton to 8 tons; and the shape may be either giant round hay bale, large rectangular stack, or large circular stack. Each type of hay package is designed for outside, unprotected storage and for mechanical handling.

The big-package machines presently available fall into two categories based on package size -- the "under-3-ton" group and the "3-ton-and-over" group. Following is (1) a brief discussion of types of haymaking needs for which the units in each category are best suited; (2) a look at the different machines themselves, their operating principles and early-user reports; (3) a picture summary of various moving and handling equipment that can be used in conjunction with big-package haymaking.*

'Under-3-Ton' Machines

This group of big-package haymaking machines (four models now available) appears to be better suited to the needs of the relatively low-volume hay producer in the Corn Belt. Compared to the "3-ton-and-over" machines, they require less initial investment for the packaging unit itself as well as for handling equipment. They possess greater maneuverability, which is an advantage in the case of small hay fields, rough terrain, or narrow gates and roadways. And the "under-3-ton" hay packages lend themselves more to controlled- or limit-feeding situations, and offer many more alternatives for feeding. Table 1 summarizes selected machine specifications of the four "under-3-ton" units now on the market, as compared with conventional hay balers.

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* The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied.

Cooperative Extension Service, PURDUE UNIVERSITY, West Lafayette, Indiana
Table 1. Selected Specifications of Hay Packaging Machines in the "Under-3-Ton" Category (Compared with Conventional Hay Baling Systems).

<table>
<thead>
<tr>
<th>Specification</th>
<th>Conventional hay balers</th>
<th>Hawk-Bilt 480</th>
<th>Model 605</th>
<th>Model 706</th>
<th>Hesston StakHand 10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rectangular bale</td>
<td>Big, round</td>
<td>Big, round</td>
<td>Big, round</td>
<td>Rectangular,</td>
</tr>
<tr>
<td></td>
<td>Round bale</td>
<td>untied</td>
<td>twine-tied</td>
<td>twine-tied</td>
<td>compressed stack</td>
</tr>
<tr>
<td>Nominal weight</td>
<td>50-80 lbs.</td>
<td>1200 lbs.</td>
<td>1500 lbs.</td>
<td>2500 lbs.</td>
<td>2500 lbs.</td>
</tr>
<tr>
<td>Package cross-section</td>
<td>14 in. x 18 in.</td>
<td>6 ft. dia.</td>
<td>6 ft. dia.</td>
<td>7 ft. dia.</td>
<td>7 ft. x 8 ft.</td>
</tr>
<tr>
<td></td>
<td>18 in. dia.</td>
<td>maximum</td>
<td>maximum</td>
<td>maximum</td>
<td>base</td>
</tr>
<tr>
<td>Package length</td>
<td>3-4 ft.</td>
<td>7 ft.</td>
<td>5 ft.</td>
<td>6 ft.</td>
<td>8 ft. high</td>
</tr>
<tr>
<td>Density * (lbs./cu. ft.)</td>
<td>8-12</td>
<td>6, 1</td>
<td>10, 5</td>
<td>10, 8</td>
<td>5, 6</td>
</tr>
<tr>
<td>Minimum tractor **</td>
<td>----</td>
<td>35 hp</td>
<td>45 hp</td>
<td>60 hp</td>
<td>40 hp</td>
</tr>
</tbody>
</table>

* Computed from package dimensions and nominal package weight.
** Recommended by the manufacturer.

HAWK-BILT MODEL 480 BALER
(Figures 1 - 5)

This machine is the simplest of the three types of units available in the "under-3-ton-package" category. It has basically one moving part, the raddle, and a self-contained hydraulic system, which is power-take-off (pto) driven from the tractor. When the hydraulic control rope is pulled, the raddle becomes "free wheeling" and the tailgate automatically opens. Likewise, when the hydraulic control rope is released, the tailgate begins to close. The raddle is automatically engaged when the tailgate reaches its full-down position. The idler arm (shaft and sprocket assembly) is spring-loaded to maintain the appropriate raddle tension on the bale.

In operate position, the tractor may straddle the windrow (wide front-axle recommended) or be offset to the left side. With normal-size windrows, the unit must be "weaved" back and forth to form the full 7-foot length of the bale. No special windrowing procedures are needed, but a "square-sided" windrow will be of help in "squaring-out" the ends of the bale.

To properly form the Hawk-Bilt bale, raddle speed must be timed to the particular ground speed being used. Raddle speed is infinitely variable through a flow-divider valve in the self-contained hydraulic system. Once this is set, it should not have to be adjusted again for that particular ground speed.

Since the field surface forms the bottom side of the "bale chamber" (the bale is actually rolled along on the ground), turning sharp corners with this unit can be a problem since the outer end of the bale must travel farther than the inner end. Some operators say the solution is to intermittently pull the hydraulic control rope as the turn is being made.

Another consideration with the unique Hawk-Bilt "bale chamber" is that the bale cannot be transported long distances in the baler once it is made. This need not be a serious limitation, however, since other means of bale transport are available (see "Handling Ideas for Big-Package Hay," pages 13-14). Since the bale is not tied, the outer 6- to 10-inch layer of hay initially may be relatively loose and fluffy. Because of this, it is recommended that bales be allowed to "settle" for a week or so before being moved.
User-experience indicates the Hawk-Bilt baler is basically trouble-free. Although it has been noted that long-stemmed material bales "better" than short-stemmed, this baler has proven functionally sound under a variety of operating conditions, including "high-moisture" baling—which is not a recommended practice. Both grasses and legumes have been successfully baled. And baling capacity does not appear to be a limitation, with user-reports ranging from 5 or 6 bales per hour up to 12 bales per hour, with an average somewhere in between.

VERMEER MODEL 605 AND MODEL 706 BALERS (Figures 6 - 10)

The Vermeer balers use spliced belts to form the bale. The upper belts are about 4 inches wide, whereas the bottom belt extends the full width of the bale chamber. Tension in the upper belts, and thus density of the bale, is controlled hydraulically through cylinders connected to the idler arm and a pressure control valve on the baler. The belts are pto-driven from the tractor.

In operate position, the tractor straddles the windrow (wide front axle recommended).

Figure 1. Components of Hawk-Bilt baler.

Figure 2. Hawk-Bilt bales stored outside.

Figure 3. Hawk-Bilt baler in operation.

Figure 4. Full-sized Hawk-Bilt bale.
Figure 5. OPERATING CYCLE OF THE HAWK-BILT BALER

Bale starts (1) with raddle on bale chamber guides, idler arm in full-forward position. Idler arm pivots (2) as bale size increases. When bale is full size (3), idler arm is near full-rear position. Forward travel is stopped (4) and tailgate raised, which disengages raddle. Raddle is free to rotate as bale is pulled clear of the bale (5, 6). Tailgate is lowered (7) and baler backed-up to get hay immediately in front of the bale. Raddle starts when tailgate reaches down position, and the next bale is started (1).
As with the Hawk-Bilt machine, the Vermeer balers must be "weaved" back and forth on the windrow to properly form the bale. Likewise, a "square-sided" windrow helps in producing square corners at the ends of the bale.

When the bale reaches the maximum size desired, the operator uses a pull rope to swing the twine delivery tube into position. When the twine starts into the bale, forward travel is stopped, and the tying operation is completed by manually directing the twine delivery tube from one end of the bale to the other. The belts are then stopped and the twine cut using a second pull rope. Once the tailgate is raised (using the tractor's hydraulic system), the bottom belt is engaged just enough to eject the bale.

Though the twine-tying operation is not an absolute necessity, most Vermeer operators have used it. The amount of twine required depends on the number of "wraps," -- usually between 5 and 10 per bale. With the Model 605 baler (6-foot diameter bale), each twine wrap requires about 19 feet of twine; with the Model 706 baler (7-foot diameter bale), each wrap requires about 22 feet of twine.

![Figure 6. Components of Vermeer balers.](image)

![Figure 7. Vermeer 605 bales stored outside.](image)

![Figure 8. Vermeer 605 baler in operation.](image)

![Figure 9. Full-sized Vermeer 605 bale.](image)
Figure 10. OPERATING CYCLE OF THE VERMEER BALERS

Bale starts (1) with idler arm in full-down position. Idler arm pivots (2) as bale size increases. As bale approaches full size (idler arm near full-up position), twine fed into outer bale layer, then forward travel stopped (3) to complete twine wrap around the bale. Belts are disengaged (4) and tailgate raised. Lower belt ejects bale (5) from bale chamber. If bale does not roll clear of tailgate, baler pulled forward (6) until it does. Tailgate is lowered (7) and idler arm takes up slack in upper belts. Belts are engaged, and the next bale started (1).
Having the bale tied probably improves the weather-resistance characteristics of the Vermeer bale as well as its handling characteristics, at least initially. But note also that a firm, tied bale will roll - so on hilly terrain the operator must be somewhat selective in where bales are to be ejected from the baler.

Since the bale is formed above the ground, it can be transported short distances in a Vermeer baler. Some users position bales at the perimeter of the field, along one end of the field, etc., as opposed to ejecting the bales randomly over the field as they are made. This capability need not be over-emphasized, however, since a number of simple, inexpensive bale moving techniques are available (see pages 13 and 14).

A few mechanically problems have been reported by Vermeer baler owners. These usually have been minor and might be attributed to the fact that the baler has been in existence for only 2 years (at this writing). Some owners suggest that a simple belt-splicing kit, available from Vermeer, is a good investment.

Functionally, the Vermeer balers have performed up to expectations. Some problems have been reported in getting the bale started (started rolling) when hay moisture is above normal baling moisteres; but this is not a recommended practice anyway. Both legumes and grasses have been successfully baled. Baling capacity appears to be as high or slightly higher than conventional baling capacity, i.e., ground speed may be faster than conventional baling, but the baler is stopped for tying and bale ejection.

HESSTON STAKHAND 10 STACKER
(Figures 11 - 15)

The Hesston stacker uses a compression canopy at the top of the stacking chamber to "press" each stack. This results in a stack density (lbs./cu. ft.) higher than that obtained with long, loose hay stacking systems. The higher density plus the "topped-out" shape provided by the canopy improves the weather-resistance characteristics of the stacks.

The compression canopy is hydraulically operated. When in the full-up position, the hay deflector is flat against the canopy. Lowering the canopy 3-4 inches also lowers the hay deflector, which allows the operator some directional control of the hay entering the stack chamber.

During the stacking operation the tractor straddles the windrow (wide front axle recommended). The pickup paddles are powered from the tractor. The entire pickup assembly--steel paddles, driveshaft, delivery spout--is carried by a full-length gauge roller that adjusts for operating height. The pickup assembly is hydraulically raised and safety-locked for transport.

The operator uses two pull ropes during stack unloading. The first is pulled when the canopy is in the down position. This swings a spring-loaded rocker-shaft into position so that, as the canopy is raised, the tailgate is mechanically unlatched and swung open. The second pull rope tightens the drive belt to the unload chain. The tractor and stacker should be moving slowly forward when the unload chain is engaged. Matching ground speed at this point with the speed of the unload chain is critical. (Mis-matching in one direction tends to pull the stack apart when it contacts the ground, while mis-matching in the other may cause the stack to topple over.)

Hesston stacks need not be unloaded in the field where made. Some users move them in the stacker to a feeding site or concentrated storage area if not too far. Others prefer to unload them as made, and then use a special stack mover at a later date (see page 14). Some operators suggest the stacks should "settle" for a few days before moving them; others say this is not necessary.

Mechanical problems reported by users of the Hesston StakHand 10 have been few. Occasionally, one tries to put too much hay
in a single stack and has trouble unloading the stack—this usually happens just once to a given operator. The same problem can occur when the hay moisture is higher than normal baling moisture, which is not a recommended practice.

Stacking capacity, as reported by Hesston, is in the range of 4-6 tons per hour. This, of course, will depend on a host of factors: how the hayfield is raked, tractor and ground speed used, number of "presses" per stack, unloading method (where made vs. hauling elsewhere), etc. Both grasses and legumes have been stacked successfully with the StakHand 10. If stacks are to be moved soon after made, they will tend to hold together better if some legume is present, requiring less settling time before moving.

Because of the paddle pickup, the Hesston stacker can be used for direct, single-pass packaging of cornstalks and other crop residues. Preliminary investigations indicate that cornstalks should not be packaged until after the first killing freeze in order to insure good storage or keeping characteristics in the stack. Some dairymen also report using the Hesston stacker successfully for green chopping. When this is done, the "pressing" cycle with the compression canopy is omitted.

![Figure 11. Components of Hesston 10.](image1)

![Figure 12. Hesston 10 stacks stored outside.](image2)

![Figure 13. Hesston StakHand 10 in operation.](image3)

![Figure 14. Unloading a Hesston 10 stack.](image4)
Figure 15. OPERATING CYCLES OF THE HESSTON STAKHAND 10.

Stacking. Hay is delivered to the stack chamber (1, 2) with the canopy in the UP position. Forward travel is stopped (3) when the chamber is full, so that the compression cycle (4, 5, 6) may be completed. More hay is delivered (2) to the stack chamber.

Unloading. On the final compression (5), the tailgate is raised (7) as the canopy goes up. Stacker is backed up 25-30 feet, then moved slowly forward with the floor chain engaged to unload stack (8). When tailgate clears stack, canopy is lowered until tailgate latches (9). Canopy is raised to the UP position (10) to start new stack (1).
'3-Ton-and-Over' Machines

This group of big-package haymaking machines (10 models now available) appears more suited to the needs of hay producers in the Great Plains and farther west. These machines could all be classified as hay stackers or stack wagons. Some units may be converted to trail-type stack movers. With others, a separate trail-type stack mover must be purchased if the stacks are to be moved (see Figure 28). A summary of selected machine specifications for all ten "3-ton-and-over" units is given in Table 2, followed by a photograph and short discussion of each one.

Table 2. Selected Specification of Hay Stackers in the "3-Ton-and-Over" Category.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Farmhand 800</th>
<th>Haybuster Stack-Eze 1400</th>
<th>Haybuster Stack-Eze 1600</th>
<th>Haybuster Stack-Eze 1800</th>
<th>Hesston Staklhand 30</th>
<th>Mc Kee Stack-n-Mover 816</th>
<th>Mc Kee Stack-n-Mover 1000</th>
<th>Moeller Stack Wagon 1200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal weight</td>
<td>6 tons</td>
<td>4 tons</td>
<td>6 tons</td>
<td>8 tons</td>
<td>3 tons</td>
<td>6 tons</td>
<td>4 tons</td>
<td>6 tons</td>
</tr>
<tr>
<td>Stack width</td>
<td>12 ft.</td>
<td>14 ft.</td>
<td>16 ft.</td>
<td>18 ft.</td>
<td>8 ft.</td>
<td>9 1/3 ft.</td>
<td>9 1/2 ft.</td>
<td>9 1/2 ft.</td>
</tr>
<tr>
<td>Stack length</td>
<td>16 ft.</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>14 ft.</td>
<td>20 ft.</td>
<td>16 ft.</td>
<td>24 ft.</td>
</tr>
<tr>
<td>Stack height</td>
<td>11 ft.</td>
<td>15 ft. *</td>
<td>15 ft. *</td>
<td>15 ft. *</td>
<td>10 ft.</td>
<td>12 ft.</td>
<td>11 ft.</td>
<td>11 ft.</td>
</tr>
<tr>
<td>Density** (lbs./cu ft.)</td>
<td>5.7</td>
<td>4.3</td>
<td>5.4</td>
<td>6.1</td>
<td>5.4</td>
<td>5.4</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Min. tractor***</td>
<td>70 hp</td>
<td>35 hp</td>
<td>35 hp</td>
<td>50 hp</td>
<td>60 hp</td>
<td>80 hp</td>
<td>65 hp</td>
<td>75 hp</td>
</tr>
</tbody>
</table>

* Approximate "topped out" stack height.
** Computed from stack dimensions and nominal stack weight.
*** Estimated for Farmhand; others recommended by manufacturer.
FARMHAND 800 STACKER

Figure 16. Hay is lifted from the windrow by a 66-inch tine-type (finger) pickup and delivered to a three-paddle, 4-foot diameter blower. The hay enters the stack chamber through a 12-inch diameter oscillating spout. Unloading is accomplished by opening the tailgates, tilting the stack chamber, and engaging six endless floor chains. Unit can be converted to a stack mover by removing the stack chamber and blower/pickup module, and then putting on another tongue.

HAYBUSTER STACK-EZE
(Models 1400, 1600 and 1800)

Figure 17. Hay is lifted from the windrow by a 66-inch tine-type (finger) pickup and delivered to feeder fingers, which push it up a vertical rectangular tube. The hay is pushed through a shorter horizontal section of rectangular tubing and drops into the rotating stack cage. The horizontal section of the hay chute and the packer drum at its outer end may be moved hydraulically to shape and "top-out" each stack. Unloading is accomplished by opening the circular cage, tilting the platform, and using a chain-driven push-off.

HESSTON STAKHAND 30

Figure 18. Hay is lifted from the windrow by a 60-inch flail-type paddle pickup and delivered to the stack chamber through a full-width rectangular delivery spout. The compression canopy at the top of the stack chamber may be used to hydraulically compress each stack three to six times. Unloading is accomplished by opening the tailgate, and using two endless floor chains connected by channel iron cleats.
Figure 19. Hay is lifted from the windrow by a tine-type (finger) pickup and delivered to an eight-paddle, 5-foot diameter blower. The hay enters the stack chamber through an oscillating delivery spout. The compression canopy at the top of the stack chamber may be used to compress each stack three to six times. Unloading is accomplished by opening the tailgate, tilting the bed, and engaging the push-off. Model 60A may be optionally equipped with a flail-type paddle pickup similar to the Model 10 and 30.

MCKEE STACK-N-MOVER
(Model 816, 1000 and 1200)

Figure 20. Hay is picked up from the windrow by a tine-type (finger) pickup and blown into a trailing stack-former. Unloading is accomplished by opening the tailgates, tilting the stack chamber, and engaging seven endless floor chains. The trailing unit can be converted to stack mover by removing the stack chamber and gooseneck hitch.

MOELLER STACK WAGON

Figure 21. Hay is lifted from the windrow by a flail-type paddle pickup and delivered to the stack chamber through a full-width rectangular delivery spout. The compression gate located at the front of the stack chamber may be used to hydraulically compress each stack during the stacking operation. Unloading is accomplished by opening the tailgate, tilting the stack chamber, and using the compression gate for push-off.
Handling Ideas for Big-Package Hay

Figure 22. Tractor-mounted Hawk-Bilt bale mover.

Figure 23. Tractor-mounted Vermeer bale mover.

Figure 24. Home-made bale mover.

Figure 25. Trail-type Vermeer bale mover.

Figure 26. Front-end loaders adapted for handling big, round bales made by the Hawk-Bilt Model 480 and Vermeer Model 605 balers.

CAUTION: To counter-balance front-end load, use wheel weights or carry another bale on a rear-mounted bale mover. Keep the bucket low when tractor is moving.
Big round bales can be transported on trucks, wagons, or trailers. If the unit is equipped with a bed hoist or a self-unloading silage bed, then the need for a tractor and front-end loader at the unload point may be eliminated. Other ideas include sleds and "lay-down" implement trailers.

Figure 27. Bale transport with more conventional hay equipment.

Figure 28. Trail-type stack mover for 3-ton and larger stacks.

Figure 29. Tractor-mounted stack mover for Hesston 10 stacks.

List of Manufacturers

The big-package haymaking machines and handling equipment cited in this publication are manufactured by:

Farmhand, Inc., 201 Third Street, South, Hopkins, Minn. 55343.
Hawk-Bilt Company, Vinton, Iowa 52349
Haybuster Distributing, Box 1008, Jamestown, North Dakota 58401.
Hesston Corporation, Box 545, Hesston, Kansas 67062.
McKee Brothers, Ltd., Highway 85, Box 70, Elmira, Ontario, Canada.
Moeller Manufacturing, Inc., Mead, Colorado 80542.
Vermeer Manufacturing Company, P. O. Box 190, Pella, Iowa 50219.

Because of the newness of this haymaking practice, additional offerings of both packaging machines and handling equipment can be expected over the next several years from the above manufacturers and others. As of this writing, only the equipment cited is commercially available. Any omission is unintentional.