Alberta Farm Machinery Research Centre

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Evaluation Report 747

BALE PROCESSORS

Bale King Vortex 2000 Bale Processor
Jiffy Model 920 Bale Shredder
Highline Bale Pro 7000 Cattleman Series
Highline Top Gun
Boss Two Square Bale Processor
Hesston BP25 Bale Processor
Patz Model 9184 Bale Chopper

A Co-operative Program Between
ALBERTA FARM MACHINERY RESEARCH CENTRE
PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

INTRODUCTION

There has been an increase in the demand for bale handling and processing equipment in recent years due to the growth of the livestock industry. Feed quality, ability to mix rations and the need for larger, faster and more efficient chopping/mixing distribution equipment was needed. Industry responded with numerous makes and models of bale processing equipment. The equipment ranges in different processing abilities and types of material they can handle. The use of bale processors is widespread throughout the cattle, dairy and horse industries. Other applications include covering open manure lagoons with straw to reduce odors and shredding and spreading bales on hilltops to prevent wind and water erosion on highly erodible soils.

The Alberta Farm Machinery Research Centre (AFMRC) evaluated a broad range of bale processors to better understand the operations of the various units on the market. The intent of the testing and report is to help producers determine which bale processor would best work for their operation, not to compare processors.

TYPES OF PROCESSORS

There are several significantly different types of bale processors. The types of processors are determined by the material handled, material feeding mechanisms and by the chopping and distribution system.

The material handled by processors ranges in sizes from:

- Big square bales (8 x 4 ft) (2.44 x 1.22 m)
- Small square bales (4 x 2 ft) (1.22 x .62 m)
- Small round bales less than 5 ft (1.52 m) diameter
- Large round bales greater than 5 ft (1.52 m) diameter
- Loose materials

Material types are straw, grass, silage, hay, solid manure or wood chips. Another difference is some processors self-load and others require another tractor.

The tub or chamber size and style is the limiting factor in the size and shape of material to be processed. The chamber comes in various diameters and can either be enclosed or open for baled or loose material.

The material feed mechanisms range from:

- One or two smaller slow turning rotors which are above or infront of the chopping rotor or disc
- A feeder chain or push gate
- A chamber which rotates around the chopping rotor, disc
- and/or fan
- A material chamber may cradle back and forth across the chopping rotor

The material feed mechanisms control the processing speed and feed material into the processing rotor. The processing speed depends on:

- the feeding rotors speed
- rotor disc and/or fan rpm
- feeder chain or push gate speed
- chamber rotation speed
- cradle cycling speed
- or by the amount of exposed flail/hammer or disc/fan knife out of the processing chopper/chamber guard bars

The chopping and distribution systems limit the material that can be put through the unit. The different chopping systems are:

- Open or closed rotor with flail or fixed knives
- Horizontal rotating disc with vertical knives
- Large fan with cutting knives
- Rotor drum in combination with a large fan

The discs are located either at the bottom half area on vertical chamber processors or at the end on horizontal chamber processors. The large fan with cutting knives are usually located at the end or side of the material chamber. The rotor drum chopping systems either run along the whole or part length of the chamber and are either located at the end, middle or side of the processing chamber. The distribution system is either through a large enclosed chamber directly off the end or side of processing chamber, a small deflection chute, or into a large fan and deflection chute.

PROCESSORS EVALUATED

Seven processors representative of the different types available were evaluated. The following are a list of the models and participating dealers:

1. **Bale King Vortex 2000 Bale Processor**
   Flaman Sales
   4009 Mayor Magrath Drive South
   Lethbridge, AB Canada T1K 6Y7 (403) 317-7200

2. **Jiffy Model 920 Bale Shredder**
   Westward Products Ltd.
   6517 - 67th Street
   Red Deer, AB Canada T4P 1A3 (403) 340-1160

3. **Highline Bale Pro 7000 Cattlemen Series**
   Highline Mfg. Inc.
   Box 307
   Vonda, SK Canada S0K 4N0 (306) 258-2233

4. **Highline Top Gun**
   Highline Mfg. Inc.
   Box 307
   Vonda, SK Canada S0K 4N0 (306) 258-2233

5. **Boss Two Square Bale Processor**
   Falcan Industries Ltd.
   Box 1178
   Fort Macleod, AB Canada T0L 0Z0 (403) 553-2114

6. **Hesston BP25 Bale Processor**
   Flaman Sales
   4009 Mayor Magrath Drive South
   Lethbridge, AB Canada T1K 6Y7 (403) 317-7200

7. **Patz Model 9184 Bale Chopper**
   Lethbridge Dairy Mart Ltd.
   3610 - 8th Avenue North
   Lethbridge, AB Canada T1H 5E2 (403) 329-6234

SCOPE OF TEST

The processors were evaluated on their processing ability based on material flow, shredded material size, distribution and plugging due to different types of material. Quality of work also included the distribution ability of each processor to spread material for bedding, windrowing for feeding, or spreading uniformity of cover. The size and type of bales determined processing time. Ease of operation and adjustment and type of material or distribution was assessed for each unit. Mechanical history of units was recorded as well as power take off (PTO) and hydraulic horsepower requirements. Power draw is an indication of ease of operation of the processors with different materials at various machine settings.

Due to the significant differences in the design of each machine a direct comparison should not be made. The report on each machine takes into account the design differences and identifies applications best suited to that design.

Several different material types were used for each processor. Parameters were set and measured for each material type to ensure uniform test conditions. All processors had several adjustment settings for different material types and applications. Multiple runs were completed at various settings with each material and processor. All runs were documented and observations recorded. The manufacturer's recommended settings for rotor speed, material processing speed and any other specified adjustments were used for each machine. The same testing conditions (wind speed and ground speed) were maintained for each processor during the distribution measurements. Wind had a significant effect on distribution measurements so tests were done at a zero wind speed.

The different material types used were 6 ft (1.83 m) diameter hard core wet and dry wheat straw and alfalfa hay bales, 4 ft (1.22 m) diameter hard core winter wheat silage bales at 40-45% moisture content, 8 x 4 ft (2.44 x 1.22 m) big square wet and dry wheat straw and alfalfa hay bales. The wet bales were tempered equally with water using a 3 speared bale liquid injector. A moisture probe was used to measure the moisture content of all bales. Each bale was weighed prior to processing.

Quality of processing related to material flow, distribution and plugging due to different material types was determined by the distance and uniformity of spread of each material type for each machine. Samples were taken at 1/4, 1/2, 3/4 and at the end of the spreading distance measured from the distribution starting point of the bale processing for 3 replicated samples. The 4 samples taken represented 33% of the spreading distance area for all runs measured. The samples were collected on square meter mats and weighed in the field immediately following the run of each material type. Silage bales are not commonly used as bedding and therefore were not used for all distribution tests. Some distribution tests included silage bales only as another type of material to distribute and/or as a feed bunking material. An average length of cut material at each machine setting was measured after each run. Bunk feeding measurements were completed for each processor.

The size and type of bales processed have an effect on processing time and ease of operation of the machine. The time of the material processing was measured for each run. The adjustments and ease of operation for each processor was observed and recorded.

Observations and power requirements were recorded for each processor at various machine settings and materials. Each processor was connected to a specially built power cart mounted with sensors to record forces, torque and PTO speeds. A flow meter, pressure gauge and thermocouple measured hydraulic horsepower and temperature. A radar gun measured ground speed.

The mechanical history of all processors was recorded throughout testing. An extended durability test was not the intent of the evaluation.

EVALUATION SUMMARY

Depending on the size, shape and design of the bale chamber or table the processors processed round bales and/or big square bales and/or loose material all. All round bale processors handled big round bales easily. The big square bale processors held the square bales easily. Sometimes processors without a fully enclosed chamber had some material loss that dropped out of the chamber opening as the bale broke up near the end of processing. The material type and moisture content was a limiting factor of all processors. All processors handled dry hay and straw bales at all machine settings available. All processors required slowing the material feeding rate, to minimal settings, to reduce power requirements, plugging and stress on the machine when processing high moisture materials. Processors with a secondary fan and deflection spout were not designed to process wet material due to plugging. Some processors with deflection chutes could process wet material at the maximum PTO speed, minimum material feeding speed and with the proper deflection chute and attachments. On processors with secondary cutting knives, the rotor jammed at times when silage material plugged the fully extended knives. Some units had difficulty feeding the round bales into the processing rotor under certain circumstances. The processors that fed the bale by a revolving tub and bale gripper arms sometimes lost hold of the bale or would tear pieces off the bale without turning the whole bale. Eventually the arms would clutch the bale and continue processing. At times the processors with 2 bale feed rotors above and to either side of the processing rotor were not able to clasp smaller round bales. The bale would lodge on the rotor guard rods and the rotor chewed a piece out of the bale center. Eventually the processor would bounce enough to realign the bale and the feed rotors would start processing again. If for any reason the operator is required to enter the bale processing area the power supply unit should be shut off completely. Processors with a material push gate caused the bale to jam at times between the feed rotor, processing rotor and push gate at excessive feed speeds. The push gate and feed rotors are easily reversed remotely from the tractor cab and processing was able to continue when a bale jam occurred.

All processors were easy to operate once the operator gained experience, and the manuals for each machine were simple and easy to follow. A detailed operators manual is required for the more complex machines. Processors with adjustments for feed rotor speed and spacing, material cutting length, aggressiveness, material deflection and bunk feeding were simple to operate. Some processors had adjustable feed rotors by loosening bolts and raising/lowering the rotors in slotted tracks. Processors with cradling chambers had simple adjustments for the cradle speed (material feeding speed), and processing aggressiveness. Some processors required raising or lowering the rotor by manually adjusting the bolt tensioners on each rotor bearing to change the amount of exposed flail to adjust material cutting length and aggressiveness. Processors with adjustments for feed rotor and bale push gate speed, material cutting length and bunk feeding were simple to operate. Processors with adjustments for chamber rotation speed (material feeding speed) and direction, material cutting length, distribution and material deflection were simple to operate. Some processors required adding/removing or raising/lowering individual knives on the rotary disc to adjust the material cutting length and aggressiveness.

The main material cutting length and processing aggressiveness settings varied with all processors and are listed as follows:

- Changing the rotor guard rod clearance above the rotor flails
- Raising or lowering the rotor clearance
- Changing the number and height of cutting knives
- Controlling the speed and direction of the tub rotation
- Controlling the material feeding speed of the bale pusher, cradle cycle or feed rotors into the processing rotor

Secondary adjustments to control material cutting length and processing aggressiveness were:

- Varying the height of a secondary cutting knife assembly
- Varying the PTO speed

The distance and uniformity of processed material spread varied with the settings of each processor. All machines worked sufficiently for their purpose. Some processors are designed more for spreading feed or finely cut bedding material, which takes more time, less power and results in smaller distribution patterns. Other processors are designed for aggressive round bale processing to spread material far distances for covering hog lagoons, sugar beet piles, hilltops, etc. resulting in high power requirements. Some processors are designed for very quick and aggressive big square bale processing for feeding or heavy bedding. Again the power requirements are higher and the spread pattern is limited. The majority of processors are designed for aggressive round bale processing for feeding or controlled bedding and spread straw more evenly at greater distances.

Power take off speed (rpm), torque (ft-lbs), hydraulic flow (gpm) and pressure (psi) were measured during each run to determine maximum and average horsepower (hp). The maximum horsepower occurred when wet or hard clumps were processed or the material feeding and processing rate was too high and aggressive. The maximum horsepower numbers were only for short time periods unless the feeding and processing rate settings were incorrect for the type of material.

All the processors had PTO shear bolts or a slip clutch assembly to prevent major damage if plugging occurred. Only two shear bolts broke and the slip clutch disengaged a couple of times throughout all tests and was likely due to operator error.

BALE KING VORTEX 2000 BALE PROCESSOR

Manufacturer:
Bridgeview Mfg. Inc.
P.O. Box 4Hwy. 22 West
Gerald, SK Canada S1A 1B0
Ph: (306) 745-2711 Fax: (306) 745-3364

Participating Dealer:
Flaman Sales 4009
Mayor Magrath Drive South
Lethbridge, AB Canada T1K 6Y7
Ph: (403) 317-7200 or 1-800-883-8081

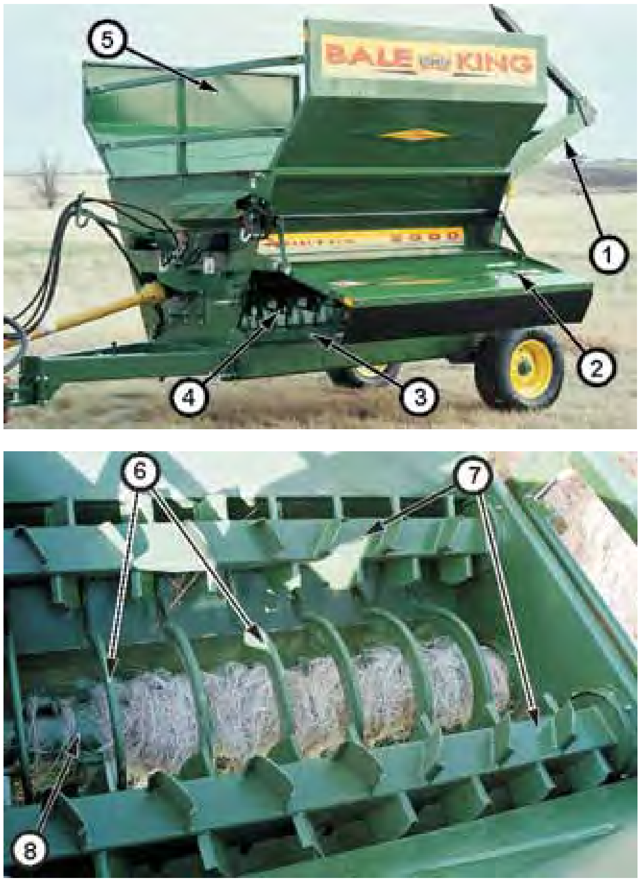

Figure 1. (1) Hydraulic bale fork, (2) Upper side deflector, (3) Lower side deflector, (4) Distribution chamber, (5) Tub/chamber, (6) Hoop grate, (7) Hydraulically driven bale feed rotors, (8) Processing rotor and flail hammers.

DESCRIPTION

The Bale King is a round bale or loose material processor with an enclosed material chamber. The processor has hydraulic ram driven bale forks for self-loading and carrying a second bale. The processor has 2 hydraulically driven bale feed rotors which are located above each side of the processing rotor.

The feed rotors are controlled by the tractor's hydraulic flow control system and are reversible. Each feed rotor has 4 rows of angled plates to assist grabbing, turning and feeding of the bale into the processing rotor and to keep the bale centered over the processing rotor. The processing rotor is a closed drum with flail hammers driven directly off the PTO shaft. The rotor is covered by a 1 in (2.5 cm) hoop grate with various settings for adjusting the amount of flail exposed out of the hoop grate bars to control the rate of bale feed and material cutting length. The processing rotor is located in the center of and along the entire length (front to back) of the chamber. The distribution chamber runs along the entire length of the rotor and directs processed material out the left side of the processor. A lower side deflector has 3 settings and is located at the end of the distribution chamber to deflect processed material upwards. An upper side deflector is present to allow for various bunk feeding applications or to control bedding with eight setting adjustments. The processor is equipped with twine guards and PTO shear bolt features.

EASE OF OPERATION AND ADJUSTMENTS

The Bale King was simple to operate and the manual was very thorough explaining the different adjustment settings. For easy operation, self-loading bale forks were hydraulically controlled from the tractor. The adjustment for feed rotor speed and direction depends on the tractor's hydraulic flow. Tractors with flow control levers allow for easy adjustment of feed rotor rpm (Table 1). A low hydraulic flow results in the slowest feed rotor rpm, lowest power requirements and slowest material feeding rate into the processing rotor. The Bale King had an easy to operate manual adjustment lever for the hoop grate (Table 1) to control material cutting length, aggressiveness, and corresponding power requirements (Figure 2 and Table 2). Separate levers controlled the lower material deflector and the upper bunk feeding deflector (Table 1). The top 3 settings on the upper deflectors had no effect on material deflection because they set the deflector too high. The manufacturer recommended cutting the bale twines off the processing rotor after a day of extensive use to reduce wear and increase processing abilities. While processing high moisture materials the feeding rate and hoop grate should be adjusted to minimal settings to reduce power requirements, prevent plugging and excessive wear. The processor should be operated at a level position. The double tongue hitch had various adjustment settings to accommodate any height of tractor hitch.

Table 1. Processor test settings

Feed Rotor Speeds		Hoop Grate Adjustment			Deflector Position					
			Hammer Height		Lower			Upper*		
Hydraulic Flow Setting	Speed rpm	Settings	in	cm	Settings	Height in	Height cm	Settings	Height in	Height cm
Minimum	12.7	1	0	0	1	1-1/4	3.17	1	49	124
		2	1/16 - 1/4	0.16 - 0.63				2	41	104
Medium **	56.5	3	1/4 - 7/16	0.63 - 1.10	2	2-3/4	7.00	3	34	86
		4	7/16 - 9/16	1.10 - 1.43				4	27	69
Maximum	49.3	5	9/16 - 11/16	1.43 - 1.75	3	4.00	10.20	5	21	53
		6	11/16 - 13/16	1.75 - 2.06				N/A	N/A	N/A
		7	34 - 1	1.90 - 2.54	N/A	N/A	N/A	N/A	N/A	N/A

* The upper deflector measurement is from the ground to the bottom edge of the deflector.
** The medium tractor flow control setting was the limit for the feed rotor rpm.

HORSEPOWER REQUIREMENTS

The power required to operate the Bale King processing rotor was between 19-64 hp (14-48 kW). See Figure 2 for horsepower requirements with different materials at various machine settings. The average power to operate the rotor under no load was 6 hp (5 kW). More horsepower was required at the faster rotor feeding rate and at the more aggressive hoop grate setting. The type of material had no effect on power requirements. The power requirements for dry hay was higher than with wet hay because the feeding rotors had difficulty turning the heavier wet material, resulting in a slow feeding rate, at aggressive settings, into the processing rotor. While processing silage bales at 40-45% moisture, 45% more power was required than for dry material at the fast feeding rate and aggressive hoop grate setting. The silage bale almost stalled the 130 hp (97 kW) tractor while processing at the most aggressive settings. The power requirements were similar for processing the silage bale and dry material at the slow feed rotor speed and #2 hoop grate setting. The peak horsepower requirements ranged between 40-172 hp (30-128 kW).

The average hydraulic power required to operate the feeding rotors under no load was 3 hp (2 kW). Material type and moisture content did not affect the horsepower required to operate the feed rotors. The average power to operate the feeding rotors with all materials at the medium tractor hydraulic flow control setting (2100 psi and 15 gpm flow), was 18 hp (13 kW). The maximum power draw at the medium flow control setting was 20 hp (15 kW). The average power required at the maximum tractor hydraulic flow control setting (2300 psi and 16.6 gpm flow) was 20 hp (15 kW) to 23 hp (17 kW).

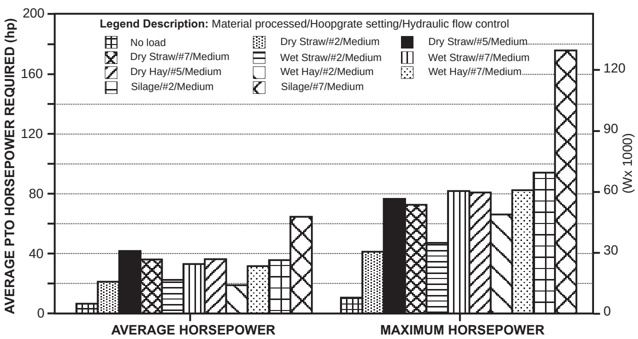

Figure 2. PTO horsepower requirements at various machine settings with different materials.

MATERIAL DISTRIBUTION

The Bale King handled all round bale types available for evaluationon the various adjustment settings. While processing bales for bedding or feeding there were gaps in the material flow because the feed rotors occasionally stopped turning the bale at which point the rotors needed to be reversed. Reversing the rotors required reversing the tractor's hydraulic lever in the cab and the action did not always start turning the bale immediately. When the bale was near the end of processing the feed rotors had difficulty clutching the small bale, causing more distribution gaps. The second bale on the loading forks can be loaded into the chamber on top of the small bale to assist completion of processing. The material feed speed and the hoop adjustment setting controlled the length of cut, processing time and material spreading distance (Table 2). The spinning feed rotors would assist loose material mixing, if several material types were processed together.

The distance and uniformity of spread varied with the different settings. The Bale King processor was aggressive and quickly processed round bales for feeding or controlled bedding (Table 2). Material spreading of the processor was uniform as long as a steady supply of material was put through the rotor (Figure 3). Spreading distance was controlled by the lower or upper deflector. The lower deflector position #3 was the most aggressive setting, throwing the material high into the air. Air velocity created by the processing rotor assisted in distributing the material. The distribution was most uniform when the lower deflector was set to throw the material at the highest elevation, but the spread distance was reduced.

The majority of straw (89%) was spread between 15-25 ft (4.6-7.6 m) from the processor at the low aggressive processing and deflection settings and 79% was spread between 10-40 ft (3-12.2 m) at the high aggressive processing and deflection settings. Straw bale distribution uniformity was best between 10-40 ft (3-12.2 m) at the higher aggressive processing and deflection settings as shown in Figure 3. A 921 lb (418 kg) dry straw bale required 234 ft (71.3 m) for processing at 1.5 mph (2.4 km/h) at the most aggressive setting, and 468 ft (143 m) the least aggressive setting.

The majority of hay (75%) was spread between 10-20 ft (3-6.1 m) at the lower aggressive mid-hoop setting and 15-25 ft (4.6-7.6 m) (71%) at the higher aggressive mid-hoop and deflector settings. A 1630 lb (739 kg) dry hay bale required 545 ft (166 m) for processing at the most aggressive setting and 1640 ft (500 m) at the least aggressive setting. Most of the material beyond the 25 ft (7.6 m) mark was hay dust and finely chopped material.

The Bale King bunk feeding was very simple and was only limited by operator's abilities. A 1630 lb (739 kg) dry hay bale required 308 ft (94 m) with a bunking rate of 1.5 mph (2.4 km/h) at the mid-range processing rate.

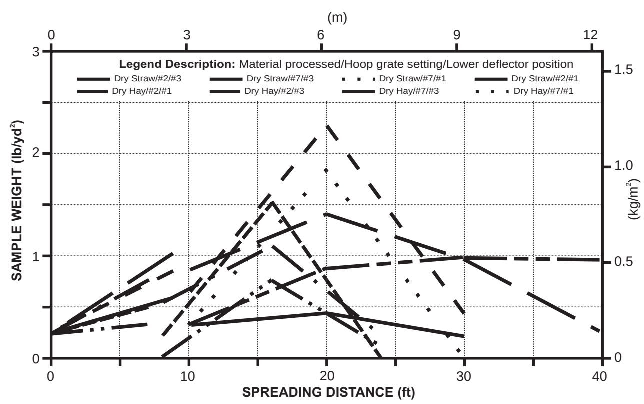

Figure 3. Average material spreading uniformity. All distribution runs were completed at the 56.5 rpm feed rotor speed (Most aggressive feeding rate).

Table 2. Processed material spreading results and times.

Adjustment Settings			Processed Material	Average Processing Time Minutes*	Average Material Length Cut		Maximum Spreading		Average Spreading	
Hoop Grate #	Hydraulic Flow Settin	Lower Deflector			in	cm	feet	meters	feet	meters
2	Medium	1	Dry Straw	2.14	4-6	10-15	24.0	7.3	N/A	N/A
2	Medium	3	Dry Straw	N/A	6-8	15-20	30.0	9.1	N/A	N/A
7	Medium	1	Dry Straw	1.68	8-13	20-33	40.0	12.2	N/A	N/A
7	Medium	3	Dry Straw	N/A	12-14	30-36	40.4	12.3	N/A	N/A
7	Maximum	0	Dry Straw	1.14	N/A	N/A	N/A	N/A	N/A	N/A
2	Medium	1	Dry Hay	N/A	N/A	N/A	25.0	7.6	12-22	3.6-6.7
2	Medium	3	Dry Hay	N/A	N/A	N/A	26.0	7.9	10-23	3.3-7.0
7	Medium	1	Dry Hay	N/A	N/A	N/A	29.0	8.8	10-24	3.3-7.3
7	Medium	3	Dry Hay	N/A	N/A	N/A	34.0	10.4	11-26	3.3-7.9
2	Medium	0	Wet Straw	N/A	8-14	20-36	N/A	N/A	N/A	N/A
7	Medium	0	Wet Straw	N/A	8-14	20-36	N/A	N/A	N/A	N/A
2	Medium	0	Wet Hay	N/A	7-12	18-30	25.0	7.6	6-25	1.8-7.6
7	Medium	0	Wet Hay	1.51	7-12	18-30	29.0	8.8	6-16	1.8-4.9
2	Medium	0	Silage	N/A	6-12	15-30	45.0	13.7	10-37	3.3-11.3
7	Medium	0	Silage	1.45	10-14	25-36	52.0	15.8	11-44	3.3-13.4

* The processing time is the time to process a complete bale.

JIFFY MODEL 920 BALE SHREDDER

Manufacturer:
Westward Products Ltd.
6517 - 67th Street Red
Deer, AB Canada T4P 1A3
Ph: (403) 340-1160 Fax: (403) 335-4580

Participating Dealer:
Vanee Farm Center Inc.
510 - 36th Street North
Lethbridge, AB Canada T1H 5H6
Ph: (403) 327-1100 Fax: (403) 327-1632

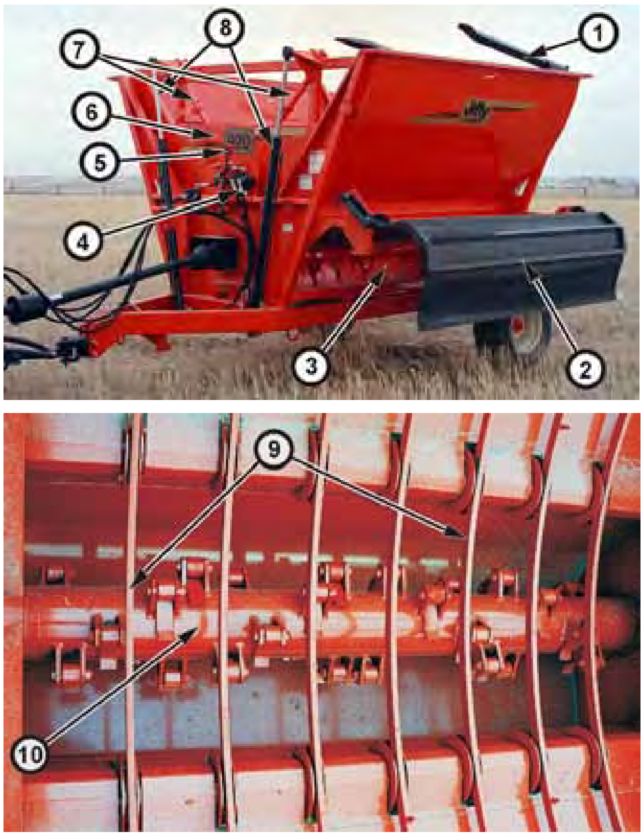

Figure 1. (1) Hydraulic bale forks, (2) Upper side deflector, (3) Distribution chamber, (4) Hydraulic flow control, (5) Valve shifting mechanism, (6) Tub/Chamber, (7) 2 Actuator bars, (8) 2 Hydraulic rams, (9) Cradle bar guards, (10) Processor rotor.

DESCRIPTION

The Jiffy 920 processor has an enclosed material chamber that handles round, big and small square bales, and loose material. The processor has hydraulic ram driven bale forks for self-loading and carrying a second bale. The chamber cradles side-to-side to assist feeding a bale into the processing rotor. Tub cradling is controlled by 2 hydraulic rams, 2 actuator bars, hydraulic flow control and a valve shifting mechanism. The actuator bars engage the valve shifting mechanism to control the cradle's travel. The flow control valve controls the cradling cycle speed, which controls the feeding rate of material into the rotor. The processing rotor, driven from the PTO shaft, is an enclosed drum with hammer knives. The rotor height can be adjusted to vary the amount of hammer knives exposed out of the cradle bar. The cradle bar guards the rotor from excessive material flowing into the rotor. The processing rotor is located in the center along the entire length of the chamber. The large distribution chamber runs along the entire length of the rotor and directs processed material out the left side of the processor. An upper side deflector has 6 position settings which allows for various bunk feeding applications or to control bedding. The processor is equipped with twine guards and PTO shear bolt features.

EASE OF OPERATION AND ADJUSTMENTS

The Jiffy processor was simple to operate and the manual thoroughly explained the different adjustments. Self-loading bale forks were hydraulically controlled from the tractor. The adjustment for cradle cycle speed was controlled by a Jiffy flow control valve (Table 1). The rotor height can be adjusted to vary the amount of hammer knives exposed out of the cradle bar. Bolts securing the bearings on each end of the rotor were loosened and an adjusting bolt set the height of the rotor (Table 1). The bolts were not secured from turning and two people were required to make any adjustments. Newer models have rotor bearing bolts secured on one end for easy adjustment by one person. Changing the rotor height took 1 person 30 minutes. The cradle cycle speed and rotor height controlled the cut length of the material aggressiveness (processing speed) and corresponding power requirements. A manual adjustment lever made it easy to operate and controlled the upper bunk feeding deflector (Table 1). The manufacturer recommended cutting twines off the bale before processing to reduce wear and increase processing abilities. If the twines were cut while the bale was on the loading forks, some material was lost on the ground before being loaded in the cradle. The twines were difficult to retrieve if cut when the bale was in the cradle. The processor should be operated at a level position. The double tongue hitch had various adjustment settings to accommodate any height of tractor hitch.

HORSEPOWER REQUIREMENTS

The PTO power required to operate the Jiffy Bale Shredder was between 20-69 hp (15-51 kW). See Figure 2 for horsepower requirements with different materials at various machine settings. Average horsepower to operate the rotor under no load was 7 hp (5 kW). The cradle feeding speed had no affect on power requirements except with wet material. Wet hay processed at the maximum cradle cycle required 20% more horsepower than at the medium cycle speed. The kind of material had an effect on horsepower requirements. Dry hay bales took less horsepower to process than dry straw and silage bales took more horsepower at the same settings. Moisture content of hay affected horsepower requirements. Wet hay bales at 19% moisture and the mid-cradle cycle speed required an average of 32% more horsepower for processing compared to dry hay. Wet hay bales processed at the maximum cradle cycle speed required an average of 56% more horsepower compared to dry hay. While processing silage bales at 40-45% moisture, 45 and 67% more horsepower was required compared to straw and hay at the mid-range cradle cycle and maximum aggressive hammer knife setting. Processing silage bales was a significant load for a 130 hp (97 kW) tractor. The rotor hammer knife height should be set to the minimum 7/8 in (2.2 cm) to process silage bales.

The average power to operate the processing rotor at the least aggressive rotor height and medium hydraulic flow control setting

Table 1. Processor adjustments and settings. The cradle cycle is the time it takes the cradle

Cradle Speed		Rotor Position		Upper Deflecto Position**		
Flow Control Setting	Cycle Time Seconds*	Processing Aggressiveness	Hammer Height	Setting	Height	
					in	cm
#5	14.4	Least	7/8 in (2.2 cm) Rotor all the way down	1	37.0	94
#5.5	14.0			2	33.5	85
#8.25	10.5			3	30.0	76
#9.5	9.0	Most	1-3/4 in (4.4 cm) Rotor all the way down	4	26.5	67
#10	7.2			5	23.5	60
N/A	N/A			6	21.0	53

* The cradle cycle is the time it takes the cradle to rock from level all the way to the right, then all the way left and back to level.
** The upper deflector measurement is from the ground to the bottom edge of the deflector.

(1400 psi) was 45% less horsepower than at the most aggressive setting. The total power required ranged between 40 hp (30 kW) for dry straw for the least aggressive processing and to 127 hp (95 kW) for silage at the most aggressive processing.

The average hydraulic power required to operate the chamber cradling under load at the medium flow control setting (1400 psi and 12 gpm) was 11 hp (8 kW). The average power required at the maximum hydraulic flow control setting (1550 psi and 13 gpm flow) under load was 12 hp (9 kW) and maximum of 16 hp (12 kW).

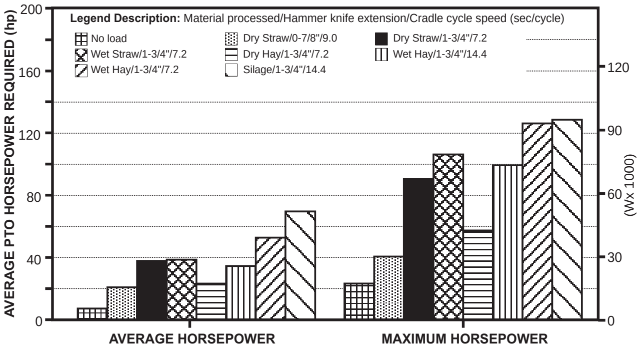

Figure 2. PTO horsepower requirements at various machine settings with different materials.

MATERIAL DISTRIBUTION

The unique high side to side rocking motion of the cradle allowed for complete mixing and processing of materials. While processing high moisture materials the feeding rate and rotor height adjustment should be set to reduce power requirements, machine wear and plugging. While processing bales at slow cradle cycles for bedding or feeding, gaps occurred in the flow. At high cradle cycles and maximum hammer exposure out of the cradle bar, the processor was very aggressive and large piles of material collected at times. Near the end of processing, bale contact with the rotor was intermittent (due to the cradle cycle) causing more distribution gaps. Loading a new bale on top of the remaining bale assisted in the complete processing and elimination of distribution gaps. The cradle cycle speed and the rotor hammer height out of the cradle bar, control the length of cut, processing time and material spreading distance (Table 2).

The distance and uniformity of material spread varied with the different settings and material. Material spread was uniform as long as a steady supply of material was being put through the rotor (Figure 3). The Jiffy processor was aggressive and quickly processed round bales for feeding and controlled bedding (Table 2). Spreading distance could be controlled by the upper deflector. Air velocity created by the rotor also assisted in distributing lighter material further.

The majority of straw (86%) was spread between 15-30 ft (4.6-9.2 m) at the most aggressive processing settings. A high amount (63%) of the total material processed was deposited 30 ft (9.2 m) from the processor. A 911 lb (413 kg) dry straw bale required 173 ft (52.7 m) for processing at 1.5 mph (2.4 km/h) at the most aggressive setting.

The majority of hay (82%) was spread between 15-25 ft (4.6-7.6 m) at the most aggressive processing setting. A 1560 lb (708 kg) dry hay bale required 82 ft (25 m) at 1.5 mph (2.4 km/h) for processing at the most aggressive setting. The majority of deposited material past the 25 ft (7.6 m) distance was pulverized hay and dust.

The majority of silage material (96.2%) was spread between 7-33 ft (2.1-10 m) at the recommended processing settings. Distribution uniformity was best between 15-25 ft (4.6-7.6 m) as shown in Table 2. A 1712 lb (777 kg) silage bale required 306 ft (93.4 m) for processing at 1.5 mph (2.4 km/h) at the moderate aggressive processing setting.

Bunk feeding with the Jiffy was very simple and was limited only by the operator's ability. A 1841 lb (835 kg) dry hay bale required 750 ft (228 m) at the most aggressive rotor height, mid-range cradle cycle and ground speed of 1.5 mph (2.4 km/h).

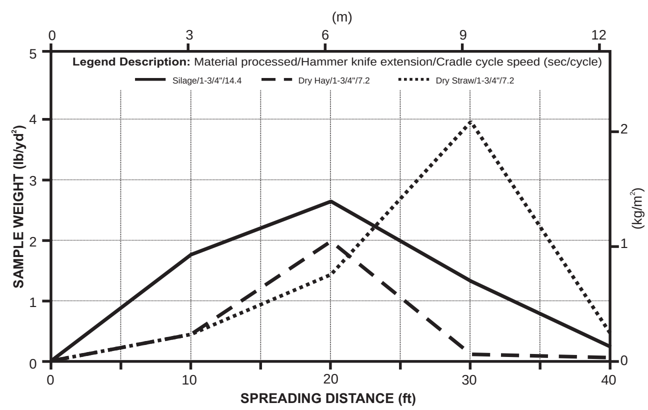

Figure 3. Average material spreading uniformity. All distributiouns were completed with the hammer knives extended 1-3/4 in (4 cm) (most aggressive) out of cradle bars.

Table 2. Processed material spreading results and times.

Adjustment Settings			Processed Material	Average Processing Time minutes*	Average Material Length Cut		Maximum Spreading		Average Spreading Distance	
Hammer Exposure		Cradle Cycle (flow control setting)								
in	cm				in	cm	feet	meter	feet	meter
7/8	2	#5	Dry Straw	2.46	4-9	10-23	47.0	14.3	19-36	5.8-11.0
7/8	2	#9.5	Dry Straw	2.28	4-9	10-23	47.0	14.3	19-36	5.8-11.0
1¾	4	#5	Silage	1.45	8-11	20-28	39.0	11.9	7-33	2.1-10.1
1¾	4	#5	Wet Straw Wet Hay	1.59 2.86	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
1¾	4	#8.25	Dry Straw	1.31	7-13	18-33	40.5	12.3	15.5-39	4.7-12.0
1¾	4	#10	Dry Straw Dry Hay Wet Hay	1.06 2.51 3.08	N/A N/A	N/A 8-15 N/A	N/A 30.0 N/A	N/A 9.2 N/A	N/A 8-26 N/A	N/A 2.4-7.9 N/A

* The processing time is the time to process a complete bale.

HIGHLINE BALE PRO 7000 CATTLEMEN SERIES

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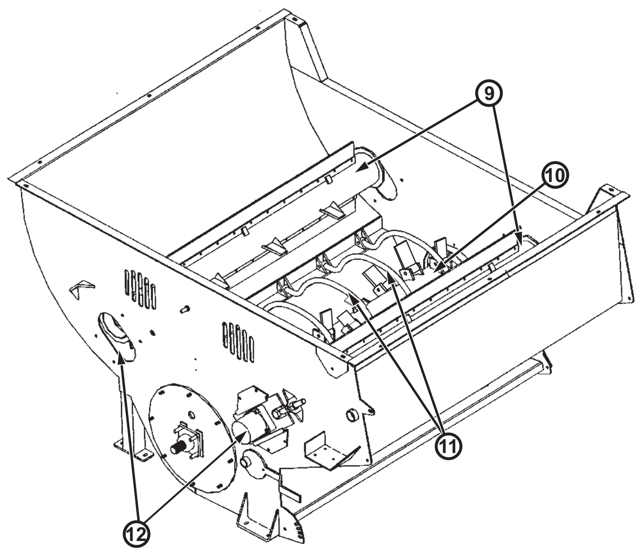

Figure 1. (1) Hydraulic bale forks, (2) Upper side deflector, (3) Auger system, (4) Distribution chamber, (5) Lower side deflector, (6) Processing rotor, (7) Side mount feed tank, (8) Tub/ Chamber, (9) Bale feed rotors, (10) Flail knives, (11) Flail guard rods, (12) Feed rotor adjustment.

DESCRIPTION

The Highline Bale Pro 7000 is a round bale or loose material processor with enclosed material tub/chamber. The processor has hydraulic bale forks for self-loading and carrying a second bale. The processor has 2 hydraulically driven bale feed rotors located above and on each side of the processing rotor. The feed rotor speeds are controlled by the tractor's hydraulic flow control and are reversible. The feed rotors can be adjusted higher or lower to handle different bale sizes. Each feed rotor has 2 rows of rubber belts and 2 rows of steel cup plates for clutching and turning the bale. The processing rotor is a closed drum with flail knives and is directly driven off the PTO shaft. An adjustable flail guard rod with 4 settings controls the bale feed rate by adjusting the amount the flail is exposed above the guard rods. An additional guard rod setting is available for processing silage or high moisture bales. The processing rotor is located in the center and along the entire length of the chamber. The distribution chamber is large and runs along the entire length of the rotor and directs processed material out the left side of the processor. A lower side deflector has 4 settings and is located at the end of the distribution chamber to deflect processed material upwards. An upper side deflector is used for bunk feeding applications or to control spreading distance during bedding. The upper deflector can adjust from 17 in (43 cm) off the ground to completely vertical. The processor is equipped with twine guards and PTO shear bolt features. The test unit was equipped with an optional side mount feed tank and auger system to place supplement feed with the processed bale.

EASE OF OPERATION AND ADJUSTMENTS

The Highline Bale Pro 7000 was simple to operate and the manual thoroughly explained the different adjustments. For easy operation self-loading bale forks were hydraulically controlled from the tractor. At times the Highline had difficulty loading the 4 ft (1.2 m) diameter silage bales because the loading forks were spaced at 43 in (109 cm) and the bales would jam halfway between the forks. The adjustment for feed rotor speed relied on the tractor hydraulic flow (Table 1). Tractors with flow control levers allowed for easy adjustment of feed rotor speed to control material feeding rate, cutting length, processing aggressiveness and corresponding power requirements (Table 2 and Figure 2.) An adjustable lever was used to set the amount of flail exposed (Table 1) above the guard (Table 2). The #1 setting was for fine cutting length, low power requirements and slow feed rate. The #4 setting was for coarse material cutting and aggressive feeding rate. Manual adjustment levers controlled the lower material deflector and the upper bunk feeding deflector (Table 1). The optional feed tank auger was hydraulically controlled and turned on/off from a lever in the tractor cab. The auger feeding rate was controlled by a flow control valve supplied by Highline. The feeding rotors were aligned up/down or wider/narrower in slots on the chamber by adjusting bolts on the bearing housings at either end of the rotors. Hay caused the flail knives to hammer (backslapping) when hard parts of the bale were encountered at moderate to aggressive processing settings. The bale twine should be cut off of the processing rotor regularly to reduce wear and increase processing abilities. The processor should be operated at a level position. The double tongue hitch had various adjustment settings to accommodate any height of tractor hitch.

HORSEPOWER REQUIREMENTS

The power required to operate the Highline Bale Pro 7000 was between 36-60 hp (27-45 kW). See Figure 2 for horsepower requirements with different materials at various machine settings. The average power to operate the rotor under no load was 6 hp (4.5 kW). Less horsepower was required at the higher feeding rotor speeds and the most aggressive flail guard setting because the bale was turning fast in the chamber and the flails could not contact the bale as easily. The kind of material had a slight effect on horsepower draw. Dry hay bales required 13% less horsepower and silage bales (45% moisture) required 30% more horsepower to process at the same settings compared to wet or dry straw or wet hay. The moisture content of the bales had no significant effect on horsepower

Table 1. Processor adjustments and settings.

Feed Rotor Speeds		Flail Guard Rod Adjustment			Deflector Position*			
			Hammer Height		Lower			Upper
						Height		
Hydraulic Flow Setting	Speed rpm	Settings	in	cm	Settings	in	cm	
Minimum	14.1	1	0	0	1	-1/8	-0.32	Up-Vertical
Medium	59.9	2	1	2.5	2	1-5/8	4.1	
Maximum	91.7	3	1-5/8	4.1	3	3-1/4	8.2	Down 17 in (43 cm)
		4	2-1/4	5.7	4	5	12.7	

* The upper deflector measurement is from the ground to the bottom edge of the deflector.

requirements except with high moisture silage bales. The silage bales were a heavy load for a 130 hp (97 kW) tractor while processing at the most aggressive settings. The maximum required horsepower range for all materials was 84-153 hp (63-114 kW).

The average hydraulic power required to operate the bale feeding rotors under no load was 7 hp (5 kW). Material type and moisture content had little effect on the horsepower required to operate the feed rotors. The average hydraulic power requirements for all material, except hay, at the medium flow control setting was 10 hp (7 kW). On average the power requirements for hay were 23% less at the medium processing settings compared to wet or dry straw. The average power required at the maximum tractor hydraulic flow control setting (2000 psi and 21 gpm flow) was 26 hp (19 kW).

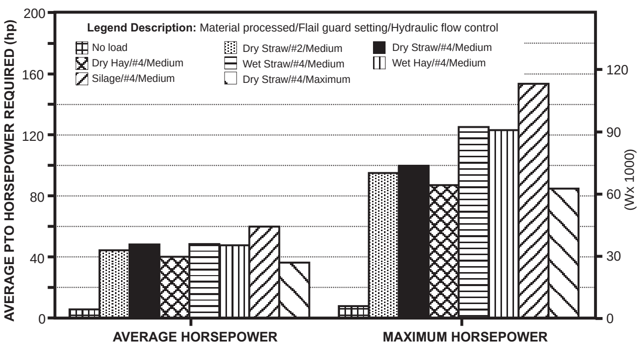

Figure 2. PTO horsepower requirements at various machine settings with different materials.

MATERIAL DISTRIBUTION

The Highline Bale Pro 7000 handled all types and sizes of round bales. The Highline processor was aggressive and quickly processed round bales for feeding or controlled bedding. While processing high moisture materials the material feeding rate and flail guard rods should be adjusted to minimal settings to reduce power requirements, excessive wear and plugging. Feed rotor adjustment and size of the bale was a factor in processing aggressiveness. The feed rotors would assist in mixing several types of loose material. Material feeding into the processing rotor was very consistent and gaps in material flow were minimal. Gaps in material flow occurred during the reversing motion of the feed rotors. The reversing motion allowed for consistent processing of the bale from the tractor. Reversing did not continually need to be performed. As the bale was processed and torn apart the feed rotors and flails became more aggressive. Near the end of processing the bale would tend to hang up. Adding a second bale to the chamber assisted in completion of processing. The material feed speed into the rotor and the guard rod adjustment setting, controlled the length of cut, processing time and material spreading distance (Table 2). The distance and uniformity of processed material spread varied with different settings. Material spreading was uniform as long as a steady supply of material was put through the rotor (Figure 3). Material spreading distance was controlled by the upper and lower deflector. The lower deflector #4 position was the most aggressive setting, throwing the material high in the air for the greatest spreading distance. Lighter and finer material projected farther due to the high air velocity created from the rotor (Figure 3). The distribution was most uniform when the lower deflector was set at the highest elevation because material appeared to fan out more evenly. Aggressive bale processing reduced spread distance due to greater material flow. The denser material in the first half of the bale consistently resulted in less spread distance until the bale loosened up and then the rotor distributed the loose material very aggressively.

The majority of straw (83.3%) was spread between 13-53 ft (4-16.1 m) at both the lower and higher aggressive processing settings. Distribution uniformity was best between 20-30 ft (6.1-9.1 m) at the low aggressive and between 20-50 ft (6.1-15.2 m) at the high aggressive processing settings as shown in Table 2. The processor required 172 ft (52.6 m) to process a 895 lb (406 kg) dry straw bale at the less aggressive setting and 126 ft (38.4 m) at the high aggressive setting at 1.5 mph (2.4 km/h).

The majority of hay (84.9%) was spread between 14-40 ft (4.3-12.2 m) at the higher aggressive processing setting. Distribution uniformity was best between 20-30 ft (6.1-9.1 m) at the higher aggressive processing settings. The processor required 164 ft (50 m) to process a 1439 lb (653 kg) dry hay bale at the high aggressive setting at 1.5 mph (2.4 km/h).

The majority of silage (73%) was spread between 11-35 ft (3.3-10.7 m) at the higher aggressive processing setting. Distribution uniformity was best between 15-35 ft (4.6-10.7 m) at the higher aggressive processing settings. The processor required 143 ft (43.5 m) to process a 1700 lb (771 kg) silage bale at the high aggressive setting at 1.5 mph (2.4 km/h).

Bunk feeding was very simple and only limited by the operator's abilities. A 1439 lb (653 kg) dry hay bale required 251 ft (77 m) to process at the mid-range processing rate and bunking rate at 105 mph (2.4 km/h).

The supplement material feed tank and auger placed the grain directly on top of the processed material. The hydraulic drive feed auger had a variety of speed ranges controlled by a flow control valve (Table 3). The flexible auger spout was only 23 in (58.4 cm) from the ground and therefore would not work with the feed bunks used. Removing the spout allowed for a 36 in (14.2 cm) discharge height. The manufacturer upgraded the auger system on new models to accommodate a broader range of feed bunks.

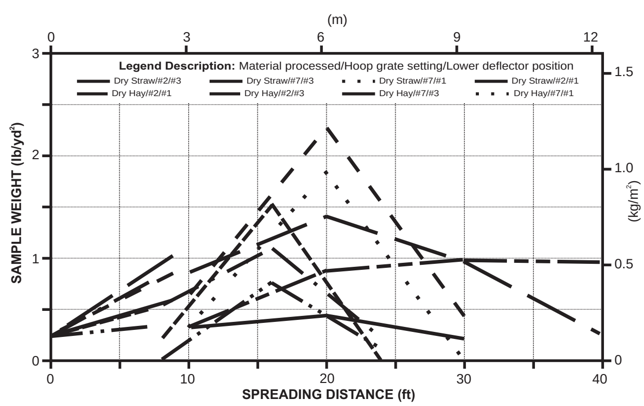

Figure 3. Average material spreading uniformity.

Table 2. Processed material spreading results and times.

4Adjustment Settings			Processed Material	Average Processing Time (minutes)	Average Material Length Cut		Maximum Spreading Distance		Average Spreading Distance	
Flail Guard #	Hydraulic Flow Control	Lower Deflector #			in	cm	feet	meter	feet	meter
2	Medium	0	Dry Straw	1.13	4-7	10-18	58	17.7	4-51	1.2-15.4
2	Medium	2	Dry Straw	0.93	5-11	13-28	56	17.1	9-48	2.7-14.6
2	Maximum	3	Dry Straw	N/A	8-12	20.30	3-63	0.9-19.2	13-48	4.0-14.6
2	Medium	4	Dry Straw	0.90	4-10	10-25	3-70	0.9-21.3	13-56	4.0-17.1
4	Minimum	2	Dry Straw	N/A	N/A	N/A	5-60	1.5-18.3	N/A	N/A
4	Medium	2	Dry Straw	1.39	5-10	13-25	5-73	1.5-22.3	11-53	3.3-16.1
4	Medium	4	Dry Straw Wet Straw Wet Hay	0.99 1.50 1.72	7-13 3-8 10-16	18-33 8-20 25-41	62 46 4-59	18.9 14.0 1.2-18	14-49 9-35 10.44	4.3-14.9 2.7-10.7 3.0-13.4
4	Maximum	2	Dry Straw	N/A	N/A	N/A	5-51	1.5-15.5	7-43	2.1-13.1
4	Medium	3	Dry Hay Silage	1.32 1.10	4-8 N/A	10-20 N/A	2-55 5-49	0.6-16.8 1.5-14.9	14-37 11-35	4.3-11.3 3.3-10.7

Table 3. Feed tank and auger speeds and feeding rates.

Flow Control Setting	Feeding Rate of Barley			Feeding Rate of Oats/Barley/Molasses		
	lbs/min	kg/min	bu/min	lbs/min	kg/min	bu/min
1 full turn open	121	55	2.4	20.0	9	0.41
2 full turns open	337	153	6.7	33.6	15	0.67
3 full turns open	417	189	8.3	21.5	10	0.43
4 full turns open	455	206	9.1	29.6	13	0.59
5 full turns open	467	212	9.3	28.1	13	0.56
6 full turns open	448	203	8.9	34.9	16	0.70
7 full turns open	473	215	9.5	29.3	13	0.58
7¾ full turns open	N/A	N/A	N/A	23.5	11	0.47

* The barley used for auguring was 50 lbs/bu (40.2 lbs/ ft^3) density.
* The steam rolled oats/barley mixture with molasses was 60 lbs/bu (48.2 lbs/ ft^3) density.
* The oats/barley and molasses mixture was very sticky and did not auger easily but maintained a constant feeding rate at all auger speed ranges.

HIGHLINE TOP GUN

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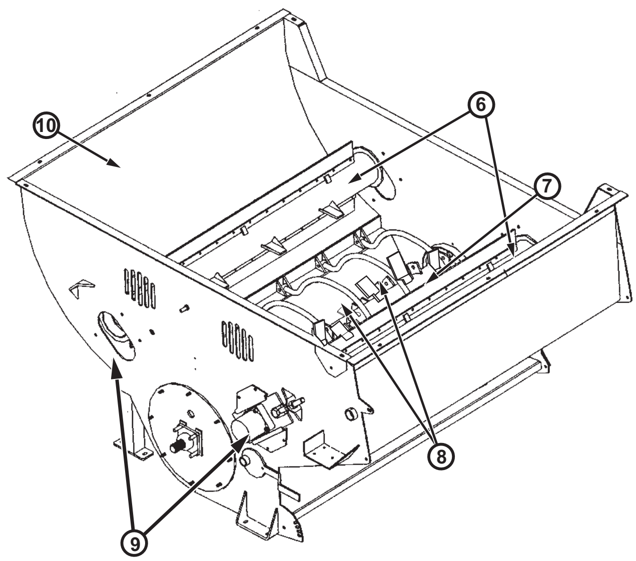

Figure 1. (1) Hydraulic bale forks, (2) Distribution spout, (3) Fan/chopper, (4) Distribution chamber, (5) Belt driven jack shaft, (6) Bale feed rotors, (7) Flail knives, (8) Flail guard rod, (9) Feed rotor adjustment, (10) Tub/Chamber.

DESCRIPTION

The Highline Top Gun is a round bale processor with an enclosed material chambers. The processor has hydraulic driven bale forks for self-loading and carrying a second bale. The processor has two enclosed material chambers. The processor has hydraulic driven bale forks for self-loading and carrying a second bale. The processor has two hydraulically driven bale feed rotors located above and on each side of processing rotor. The feed rotor speeds are controlled by the tractor hydraulic flow control system and are reversible. The feed rotors can be adjusted higher or lower to handle different bale sizes. Each feed rotor has two rows of rubber belts and two rows of steel cups for grabbing and turning the bale. The PTO driven processing rotor is a closed drum with flail knives. Located over the rotor is an adjustable flail guard rod with 6 settings to control the rate of feed of the bale by the amount of flail exposed above the guard rods. The processing rotor is located in the center and along the entire length of the chamber. The distribution chamber tapers down in size from the rotor chamber into the side and bottom of a large fan which acts as a chopper for further processing. The fan is driven by a belt off a 90o gear box driven by the PTO shaft. The fan distributes the processed material through a large adjustable distribution spout for bedding or distribution of straw to reclamation sites or manure lagoons. The fan and distribution chamber are equipped with clean out doors. The processor is equipped with twine guards and PTO shear bolt features.

EASE OF OPERATION AND ADJUSTMENTS

The Highline Top Gun was simple to operate. The manual from the Highline Bale Pro was used to explain the basic operations and adjustments. The Top Gun manual provided details on the fan assembly. The self-loading bale forks were hydraulically controlled from the tractor. At times the Highline had difficulty loading 4 ft (1.2 m) diameter bales because the loading forks were spaced at 43 in (109.2 cm) and the bales would jam halfway between the forks. The adjustment for the feed rotor speed relied on the tractor's hydraulic flow (Table 1). Tractors with flow control levers allow for easy adjustment of feed rotor speed to control material feeding rate, cutting length, processing aggressiveness and corresponding power requirements (Table 2). An adjustable lever was used to set the amount of flail exposed above the guard (Table 1 and Table 2). The #1 setting was for fine material cutting length, low power requirements and slow feed rate. The #6 setting was for coarse material cutting and aggressive feeding rate. The feeding rotors were aligned up/down or, wider/narrower in slots on the chamber by adjusting bolts on the bearing housings at either end of the rotors. The distribution spout was controlled side-to-side and up or down by a hydraulic motor and a hydraulic ram (Figure 2). The distribution spout adjustments, feed rotors and loading fork controls operated on two hydraulic remotes. The hydraulic flow was directed by electric flow control valves operated from the tractor cab. Hay caused the flail knives to hammer (backslapping) when hard parts of a bale were encountered at moderate to aggressive processing settings. A silage bale caused the tapered distribution chamber and spout to plug and stall the tractor. The removable covers allowed easy access to unplug the chamber and spout. The bale twine should be cut off the processing rotor regularly to reduce wear and increase processing abilities. The processor should be operated in a level position. The double tongue hitch had various adjustment settings to accommodate any height of tractor hitch.

HORSEPOWER REQUIREMENTS

The power required to operate the Highline Top Gun while processing dry hay and straw was between 79-96 hp (60-71 kW). See Figure 2 for horsepower requirements with different materials at various machine settings. The average power to operate the rotor and fan under no load was 47 hp (35 kW) and 62 hp (46 kW) to engage the PTO. Most of the load is due to operating the fan. Less horsepower was required to process dry straw at the moderate feeding rotor speeds and the most aggressive flail guard setting than at the minimum processing aggressiveness settings. The

Table 1. Processor adjustments and settings.

Feed Rotor Speeds		Flail Guard Rod Adjustment			Spout Adjustments
Hydraulic	Speed	Settings	Hammer Height		
Minimum	14.4	1	1-1/8	2.8	**Lowest/Highest 2.9-12.6 ft (0.9-3.8 M) from ground** **Forward/Backward 180° Rotation**
		2	1-1/4	3.2	
Medium	59.9	3	1-3/8	3.5	
		4	1-1/2	3.8	
Maximum	91.7	5	1-9/16	4.0	
		6	2	5.1	

fan operated more efficiently as more material flowed through the fan. Dry hay bales required 15% less horsepower and silage bales (45% moisture) required 24% more horsepower to process at the same setting compared to wet (19% moisture) or dry straw. High moisture silage bales required an average of 117 hp (87 kW) and a maximum of 154 hp (115 kW) to process. The Top Gun required 24 hp (18 kW) average and 38 hp (28 kW) maximum to process a dry hay bale at medium aggressive processing setting and 600 PTO rpm.

The average hydraulic power requirement to operate the bale feeding rotors under no load was 4.5 hp (3 kW). Material moisture content had little effect on the power requirements of the feed rotors. The average power required to operate the feeding rotors for materials at the medium tractor hydraulic flow control setting (1300 psi and 13 gpm flow) was 7 hp (5 kW). Dry straw required 38% more horsepower to operate the feed rotors than hay or wet straw at all processing settings. The average power to operate the feed rotors while processing silage material at the medium hydraulic flow control was 15.5 hp (12 kW). The average power requirements to operate the distribution spout was 7 hp (5 kW) and 13 hp (10 kW) maximum.

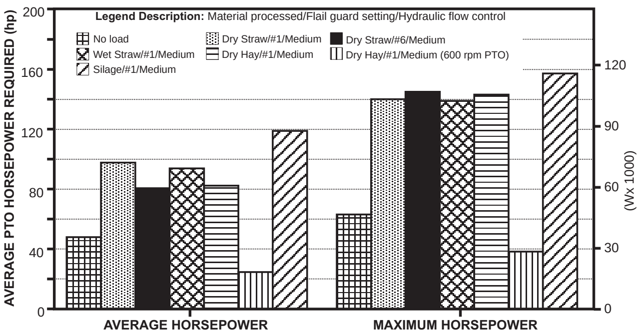

Figure 2. PTO horsepower requirements at various machine settings with different materials.

MATERIAL DISTRIBUTION

The Highline Top Gun handled all types and sizes of dry round bales. While processing high moisture (40%) materials the distribution chamber and spout consistently plugged. A wet straw bale (19% moisture) could be processed with caution. Material feeding into the processing rotor was very consistent and gaps in material flow were minimal. The reversing of the feed rotors allowed for consistent processing of the bale, but would interrupt material flow. The reversing motion was controlled from the tractor and did not continually need to be performed. The #1 guard setting was not very aggressive and resulted in non-uniform flow of material. A second bale could be loaded on top the first bale near the end of its processing to assist completion of processing. The material feed speed into the rotor, the guard rod setting and the fan controlled the length of cut, processing time and material spreading distance (Table 2).

The Highline Top Gun was aggressive and quickly processed round bales but required high horsepower. The distance and uniformity of processed material spread was controlled by the distribution spout (Table 2). Material spreading of the processor was uniform as long as a steady supply of material was put through the rotor. The material deposition per square foot was completely affected by the spout angle adjustment. The fan created high airflow. The distribution uniformity of straw was difficult to measure due to the high variation of uniformity related to spout direction. A similar test was done in dry hay but the material was pulverized and blown widely due to the high air velocities. To get any kind of accumulation of material required stationary operation of the processor.

The spout outlet could be raised 12.6 ft (3.8 m) above the ground. When the spout outlet was raised all the way, straw could easily be blown over beet piles, hilltops or lagoons. The processed dry straw could be blown up to 28 ft (8.6 m) high and to a maximum distance of 183 ft (56 m) (Figure 4).


Figure 3. Distribution of dry hay directly onto ground at 540 rpm PTO speed.


Figure 4. Highline Top Gun distributing dry straw at the maximum height.

Bunk feeding was not possible with the Highline Top Gun. The high airflow from the fan blew the material out of the feed bunks. The material could be blown directly onto the ground in a 15-20 ft (5-6 m) area at a reduced PTO rpm (reduced airflow). Even after the material hit the ground the high airflow blew the material farther along the ground (Figure 3).

Table 2. Processed material spreading results and times.

Adjustment Settings			Processed Material	Average Processing Time (minutes)	Average Material Cut Length		Maximum Spreading Distance		Average Spreading Distance	
Flail Guard	Hydraulic Flow Setting	Spout Direction			in	cm	feet	meter	feet	meter
#1	Medium	straight back and 72 in (183 cm) above ground	Dry Straw	N/A	4-7	10-18	16-97	5-30	34-73	10-22
#1	Medium	straight back and 72 in (183 cm) above ground	Dry Straw	2.14	3-6	8-15	25-105	8-32	44-81	13-25
#1	Medium	straight sideways and 151 in (383.5 cm) above ground	Dry Straw	1.91	3-6	8-15	32-183	10-56	61-127	19-39
#1	Medium	straight out 72 in (183 cm) above ground & 180° rotation	Dry Straw	1.37	3-7	8-18	0-93	0-28	42-81	13-25
#6	Medium	straight sideways and 35 in (79 cm) above ground	Dry Straw	1.24	N/A	N/A	16-31	5-9	N/A	N/A
#1	Medium	straight sideways and 35 in (179 cm) above ground	Dry Hay	3.96	0.5-3	1-8	16-36	5-11	N/A	N/A
#1	Medium	straight sideways and 72 in (183 cm) above ground	Wet Straw	N/A	3-5	8-13	14-75	4-23	37-67	11-20

* The spreading distance is measured from the processor frame. The spout extends 12 ft (3.6 m) from the processor frame.
* The height is measured from ground up to end of spout. The spout direction is in relation to material spreading direction from processor.
* The processing time is the time required to process a complete bale.
* The spout is level to the ground at 72 in (183 cm) above ground.

BOSS TWO SQUARE BALE PROCESSOR

Manufacturer and Participating Dealer:
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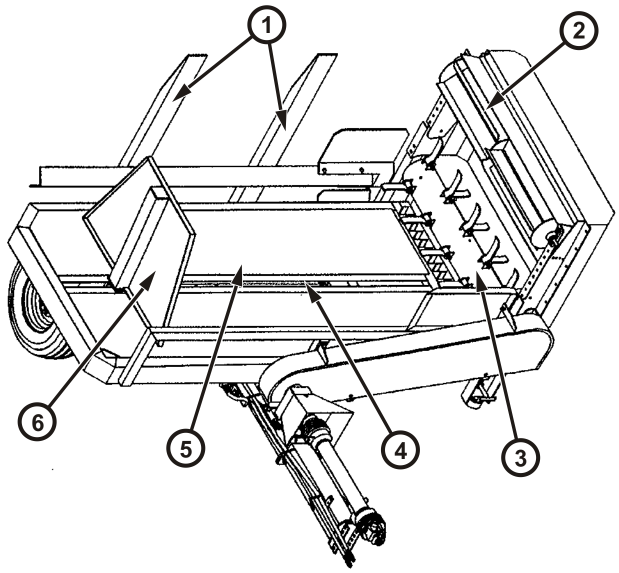
Box 1178
Fort Macleod, AB Canada T0L 0Z0
Ph: (403) 553-2114 Fax: (403) 553-2527
Email: falcan@telusplanet.net
Website: http://www.falcan.com



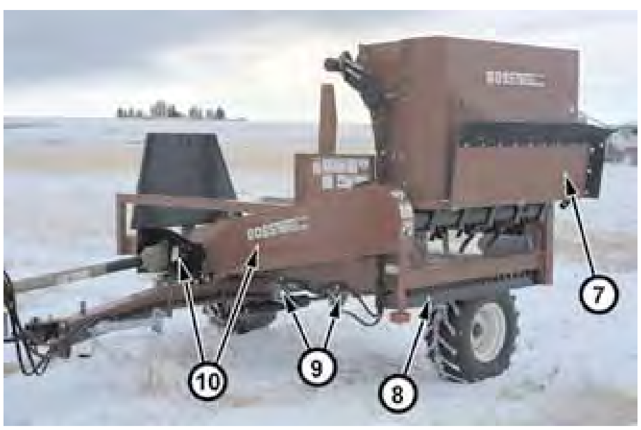


Figure 1. (1) Hydraulic bale forks, (2) Upper feed beater, (3) Processing rotor and flail knives, (4) Pusher plate drive chain, (5) Bed table, (6) Bale pusher plate, (7) Upper side deflector, (8) Secondary cutting knife assembly,(9) Hydraulic flow control valves, (10) Processing rotor PTO belt drive assembly.

DESCRIPTION

The Boss Two Square Bale Processor is a big square bale processor with an open bale bed table and is built to process any square bale from 5 to 9.5 ft (1.52 to 2.90 m) in length. The processor has hydraulic driven bale forks for self-loading and carrying a second bale. The bed table has a bale pusher plate which runs across the entire table toward the processing beater. The pusher plate is driven from the processing side of the table by a hydraulic motor and chain running across the length of the table. An upper hydraulically driven beater above and in front of the rotor is used to guide a bale down and into the processing rotor. The upper beater can be adjusted vertically and horizontally to accommodate various bale sizes. Two flow control valves hooked up in series control the bale pusher plate and upper beater speeds. These two settings determine the material feeding rate into the rotor. The processing rotor with flail knives is located at the left side of the bale table and is driven by a power belt off the PTO shaft. An adjustable secondary cutting knife assembly protrudes through the table and is located directly under the processing rotor for more aggressive processing of material. A side deflector allows for various bunk feeding or bedding applications.

The processor is equipped with twine guards, PTO shear bolt and a hydraulic flow bypass safety feature.

EASE OF OPERATION AND ADJUSTMENTS

The Boss Two square bale processor was simple to operate with experience. The manual explained most adjustments. For easy operation, hydraulic driven self-loading bale forks were controlled from the tractor. The rate adjustment for the bale pusher and upper beater speed and direction was controlled by two in-series flow control valves (Table 1). The proportional flow valves were set up so a change in flow on either valve affected the speed of the pusher plate and upper beater for easy adjustment and fine tuning. The upper beater was adjusted by removing two bolts securing each end bearing and moving the beater up or down in pre-drilled holes. The processing rotor was small in diameter allowing for a fast rotation and easier material flow around the rotor resulting in very aggressive and fast processing. The secondary knife exposure out of the bale table was raised or lowered by adjusting two tighteners on either end of the knife assembly (Table 2). The bale pusher speed, upper beater speed, secondary knife setting and the rotor speed, controlled the material cutting, processing aggressiveness and corresponding power requirements. A manual adjustment lever with 5 position settings (Table 2) controlled the side deflector. The manufacturer recommended cutting the twines before processing if bales were used for feeding. The twines on the bale should face the front of the processor for easy removal. Cutting the twines while the bale was on the loading forks resulted in loss of some material. For bedding, the twines could be left on the bale and the manufacturer recommended cutting the twines off the rotor after processing 20 bales. The processor table should be operated at a level position. The double tongue hitch had various adjustment settings to accommodate any height of tractor hitch.

Table 1. Bale pusher plate and upper feed beater speeds at various hydraulic flow control settings.

Flow Control Setting		Bale Pusher Speed		Upper Feed Beater
#1	#2	ft/min	m/min	rpm
2.5	2.0	2.4	0.7	18.4
2.5	2.5	7.1	2.1	18.5
2.5	3.8	9.3	2.8	18.7
2.5	5.0	11.9	3.6	18.8
2.5	6.0	12.0	3.6	19.0
2.5	5.5	13.3	4.0	18.9
2.5	7.0	14.1	4.3	25.0
3.0	5.0	16.0	4.9	26.0
3.5	5.5	20.1	6.1	33.0
3.5	9.5	31.3	9.5	51.0
5.0	8.0	32.0	9.7	53.0
6.0	9.5	38.2	11.6	60.0
9.5	9.5	38.2	11.6	57.0

Table 2. Processor adjustments and settings.

Setting	Upper Deflector		Secondary Knife Exposure Out of Table Bed	Deflector Clearance From	
	in	cm		in	cm
1	41.5	105	Any setting from 1/8 - 3-3/4 in (0.3 - 9.5 cm)	N/A	N/A
2	30.5	78		18.75	48.0
3	30.5	78		15.75	40.0
4	30.5	78		10.50	27.0
5	30.5	78		6.00	15.0

*The upper deflector measurement is from the ground to the bottom edge of the deflector.

*The deflector clearance is measured from the bale table end to the deflector end to indicate the distribution clearance for processed material.

HORSEPOWER REQUIREMENTS

The power required to operate the Boss was between 30-95 hp (22-71 kW). See Figure 2 for horsepower requirements with different materials at various machine settings. The power to operate the rotor under no load was 10-23 hp (7-17 kW). The kind of material had an effect on horsepower requirements. At the least aggressive settings, hay bales required 9 hp (7 kW) more to process than straw. At the most aggressive settings and slow feed rate dry straw required as much as 60 hp (45 kW) more than dry hay. Moisture content of the material affected horsepower requirements. Wet hay bales at 16% moisture required as much as 37 hp (28 kW) more than dry hay at the same settings. The feeding rate affected the horsepower requirements significantly. Dry straw at the high feed rate required as much as 90 hp (67 kW) more than at the slowest feed rate. Even at high processing rates, overall horsepower requirements were consistently lower regardless of material type and moisture content. Flail knife backslapping occurred at high processing speeds, but no problems were encountered. With dry straw the maximum power requirements ranged from 82 hp (61 kW) at the slow feed and least aggressive cutting and 173 hp (129 kW) at the slow feed and high aggressive cutting. The maximum horsepower requirements were instantaneous and did not affect the tractor engine speed.

The average hydraulic power requirements to operate the bale pusher plate and upper beater under no load was 0.8 hp (0.6 kW). Material type did not significantly affect the horsepower required to operate the processor hydraulics. The average power requirements were between 1 and 1.8 hp (0.7 and 1.3 kW). The maximum power to operate the bale pusher plate and upper feed beater was 2.6 hp (1.9 kW) at the slow processor hydraulic flow control setting (2000 psi and 3.3 gpm flow).

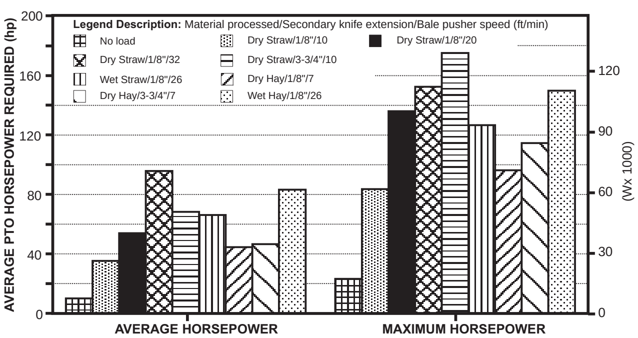


Figure 2. PTO horsepower requirements at various machine settings with different materials.

MATERIAL DISTRIBUTION

The Boss processed wet or dry square bales at the most aggressive settings with no problems. The upper beater and bale pusher plate disengaged at times when the bale jammed between the upper beater and rotor at aggressive settings. By reversing thehydraulics the bale could be easily unplugged. For high moisture materials, the material feeding rate and secondary cutting knife height should be at the minimum setting to reduce power requirements and bale jamming. Material feeding into the processor was very consistent and gaps in material flow were minimal. Large piles of material accumulated unless the proper ground and material feeding speeds were used. The bale pusher plate speed, rotor speed, and the secondary cutting knife setting determined the length of cut, processing time and material spreading distance (Table 3). Material spreading of the processor was uniform as long as a steady supply of material was put through the rotor. The Boss quickly processed big square bales for feeding or bedding (Figure 3 and Table 3). Material spreading distance could be controlled by the upper side deflector. Heavier or coarser processed material was distributed further.

Distribution uniformity of straw (78%) was between 15-40 ft (5-2 m) at the recommended processing settings. The majority (43% of the total amount) of straw was distributed 20 ft (6 m) from the processor. The processor required 119 ft (36 m) for processing a 1414 lb (641 kg) straw bale at a moderately aggressive setting and a travel speed of 1.5 mph (2.4 km).

The majority of hay (93%) was spread between 0-30 ft (0-9 m) at a high aggressive processing setting. Distribution uniformity of hay was best between 10-30 ft (0-9 m) as shown in Figure 3. The processor required 218 ft (66 m) for processing a 1554 lb (705 kg) dry hay bale at a moderately aggressive setting and a travel speed of 1.5 mph (2.4 km).

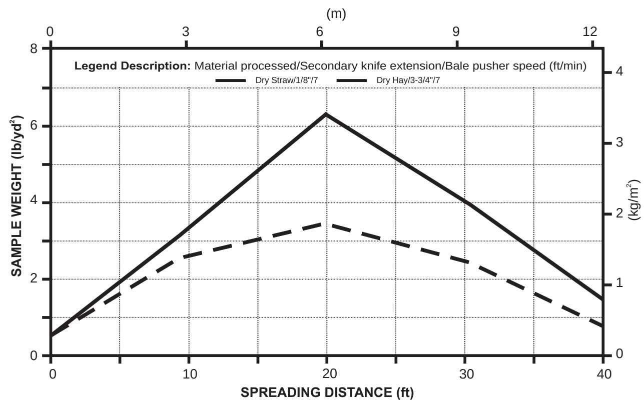


Figure 3. Average material spreading uniformity.

Bunk feeding was simple and was only limited by the operator's ability. A 1554 lb (705 kg) dry hay bale required 211 ft (64 m) to process at the mid-range processing speed and bunking rate of 1.5 mph (2.4 km/h).

Table 3. Processed material spreading results and times.

Adjustment Settings				Processed Material	Processing Time minutes*	Average Material Length Cut		Maximum Spreading		Average Spreading Distance	
Secondary Knife Exposure		Bale Pusher Speed									
in	cm	ft/min	m/min			in	cm	feet	meter	feet	meter
1/8	0.3	7.1	2.2	Dry Straw Dry Hay	1.50 0.71	N/A	N/A	N/A	N/A	N/A	N/A
1/8	0.3	13.3	4.0	Dry Straw	0.76	6-9	15-23	3-56	0.9-17	15-44	5-13
1/8	0.3	20.1	6.2	Dry Straw	N/A	6-8	15-20	3-67	0.9-20	16-53	5-16
3-3/4	9.0	9.3	2.9	Dry Straw	0.77	5-8	13-20	N/A	N/A	N/A	N/A
3-3/4	9.0	7.1	2.2	Dry Hay	1.34	4-5	10-13	0-43	0-13	0-34	0-10
1/8	0.3	26.0	8.0	Wet Straw Wet Hay	0.43 0.35	5-8 12-15	13-20 31-38	0.46 0.47	0-14 0-14	8-31 10-32	2-9 3-10

* The processing time is the time to process a complete bale.

HESSTON BP25 BALE PROCESSOR

Manufacturer:
AGCO Corporation
4205 River Green Parkway
Duluth, GA (Georgia) USA 30096
Ph: (770) 813-9200 Fax: (770) 813-6040

Participating Dealer:
Flaman Sales
4009 Mayor Magrath Drive South
Lethbridge, AB Canada T1K 6Y7
Ph: (403) 317-7200 or 1-800-883-8081

Figure 1. (1) Bale forks, (2) Tub/Chamber, (3) Bale driver arms, (4) Distribution chamber, (5) Upper side deflector.

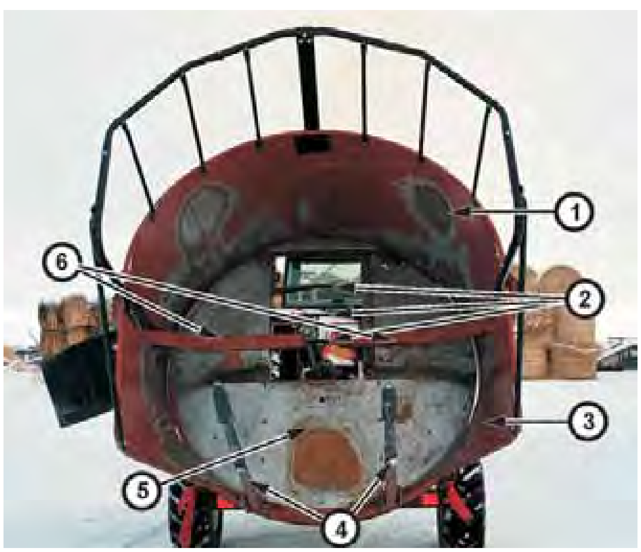


Figure 2a. (1) Tub/Chamber, (2) 3 Grid bar rotor guards, (3) Chamber hydraulically tilted 90°, (4) Bale lifting forks, (5) Tub floor, (6) Bale driver arms.

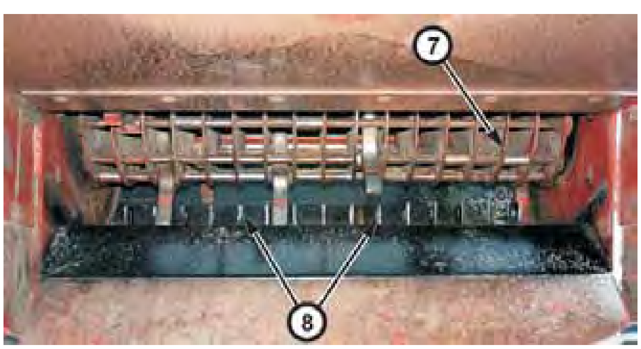


Figure 2b. (7) Open caged rotor with fixed rotor blades, (8) Secondary knife cutting assembly.

DESCRIPTION

The Hesston BP25 Bale Processor is a round or big square bale processor with a partially enclosed chamber. The chamber is hydraulically tilted 90o to load a bale. Two bale forks lift the bale as the chamber tilts back to a horizontal position. The hydraulically driven chamber turns clockwise or counter clockwise to assist the bale feeding into the processing rotor. In the chamber there are two bale driver arms on opposite sides to turn the bale as the tub rotates. The rotation direction and speeds are controlled by the tractor's hydraulic flow control. The rotor is an open cage with fixed rotor blades and is driven directly off the PTO shaft. The rotor is covered by 3 grid bars to prevent excess material flowing into the rotor. The grid bars and rotor clearance is fixed. The rotor is centered in the front half of the chamber and directly below the chamber floor. An adjustable stationary knife assembly is located in the rotor chamber for extra material processing. The distribution chamber runs along the entire length of the rotor and directs processed material out the left side of the processor. A side deflector has 5 settings to control the various bunk feeding or bedding applications. The processor is equipped with a PTO slip clutch safety feature and optional extension kit for handling big square bales.

EASE OF OPERATION AND ADJUSTMENTS

The Hesston was simple to operate and the manual thoroughly explained the different adjustments.The self-loading chamber was hydraulically controlled from the tractor. There was a very high negative hitch weight on the tractor when lifting a bale into the chamber. Tractors with flow control levers allowed for easy adjustment of the chamber rotation. Feeding rate into the rotor, length of cut, and processing time were controlled by the chamber rotation speed and direction (Table 1). Fast rotation speeds, in the opposite direction from the rotor direction, resulted in the fastest processing times. A slow rotation in the same direction as the rotor direction resulted in slow processing times and finer material cutting. The bale driver arms were easily adjustable to accommodate various bale sizes. A manual adjustment lever set the height of the stationary knife assembly through the rotor chamber floor. The stationary knife setting and chamber rotation direction and speed determined the feed rate, power requirements and aggressiveness of processing. The side deflector was easily raised or lowered by hand and a stabilizer bar with 5 settings held the deflector at the desired position (Table 1). Any wet material caused the rotor to hammer at moderate to aggressive processing settings. The bale twine should be cut off the processing rotor regularly to reduce wear and increase processing abilities. The processor should be operated at a level position. The double tongue hitch had various adjustment settings to accommodate any height of tractor hitch.

Table 1. Processor adjustments and settings.

Settings	Upper Deflector*		Tub Rotation Speed		Secondary Knife Exposure
	in	cm	Hydraulic Flow Setting	rpm	
1	53.0	135	Minimum	3.5	0.53 - 3 in (1.3 - 7.6 cm) out of chamber
2	38.0	97	Medium	15.0	
3	30.0	76			
4	24.0	61	Maximum	18.7	
5	18.5	47			

* The upper deflector measurement is from the ground to the bottom edge of the deflector.

HORSEPOWER REQUIREMENTS

The power required to operate the Hesston was between 14-83 hp (10-62 kW). See Figure 3 for horsepower requirements with different materials at various machine settings. The power to operate the rotor under no load was an average of 5 hp (4 kW) and maximum of 7.5 hp (6 kW). The startup torque of the rotor was very high and resulted in a peak requirement of 86 hp (64 kW). The processing aggressiveness, material type and moisture content determined the power requirements. Dry straw required 56% more horsepower, and dry hay required 16% more power at the most aggressive settings versus the least aggressive. Wet straw, hay and silage showed the same trend. Wet straw required 8% more horsepower and wet hay required 36% more average horsepower than dry straw or hay at the most aggressive processing rates. The stationary knife setting also affected horsepower requirements. On average, 28% less horsepower was required for processing all material at the minimum stationary knife setting as compared to the maximum setting. The maximum power ranged between 28-192 hp (21-43 kW). Hard or dense materials resulted in high power requirements and excessive vibration because of the design of the rotor with solid attached knives.

The hydraulic power requirement to operate the chamber under no load at the slowest speed was 4 hp (3 kW) and 12 hp (9 kW) at the fast speed. Under load the power requirements ranged from 4-8 hp (3-6 kW) at the slowest speed (1400 psi and 10 gpm flow) and 10-17 hp (7-13 kW) at the fast speed (1600-2200 psi and 16 gpm flow). The load was erratic during testing causing a wide range of power requirements.

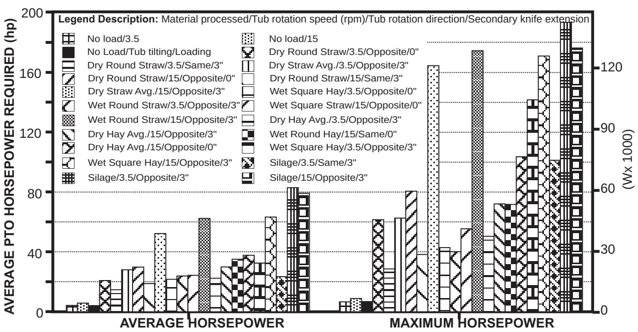


Figure 3. PTO horsepower requirements at various machine settings with different materials. The tub rotation direction is in relation to the rotor turning direction. A same setting means the tub was turning the same direction as the rotor (clockwise).

MATERIAL DISTRIBUTION

The processor handled all types of round and big square bales. While processing a high moisture silage bale the rotor jammed, causing the slip clutch to engage. While processing high moisture materials the feed rate and stationary knives should be adjusted to minimal settings to reduce power requirements, plugging and machine wear or breakdowns. The chamber rotation speed and direction and stationary knife setting determined the length of cut, processing time and distribution (Table 2). Bales did not always completely cover the tub floor causing gaps in the flow of material out of the processor. Round bales placed on end in the chamber had the least amount of gaps in material flow. Occasionally the bale driver arms would slip from the bale causing material distribution gaps.

The distance and uniformity of processed material spread varied with the different settings. The processor's material spreading was uniform as long as a steady supply of material was put through the rotor (Figure 4). The Hesston processor was designed mainly for bunk feeding or very fine chopping for bedding and feeding. The open caged rotor and knives did not create a high air flow for distribution. Slow travel speeds were required to distribute a heavy bedding layer. Material spreading distance could be controlled by the side deflector position. The aggressiveness of processing affected the material distribution. A fast chamber rotation in the opposite direction of the rotor resulted in the best spread and distribution of material.

The majority of straw (79%) was spread between 8-30 ft (2-9 m) for all settings. Distribution uniformity was best between 10-40 ft (3-12 m) at the more aggressive processing settings as shown in Figure 4. The processor required 151 ft (46 m) to process a 932 lb (423 kg) straw bale at 1.5 mph (2.4 km/h) at the most aggressive setting.

The majority of hay material (96%) was spread between 3-22 ft (0.9-7 m) at the moderate setting. Distribution uniformity was best between 10-20 ft (3-6 m) at the moderate processing setttings. The processor required 219 ft (67 m) to process a 1522 lb (690 kg) square hay bale at 1.5 mph (2.4 km/h) at the moderately aggressive setting. Most of the material beyond 25 ft (8 m) was finely chopped hay and dust.

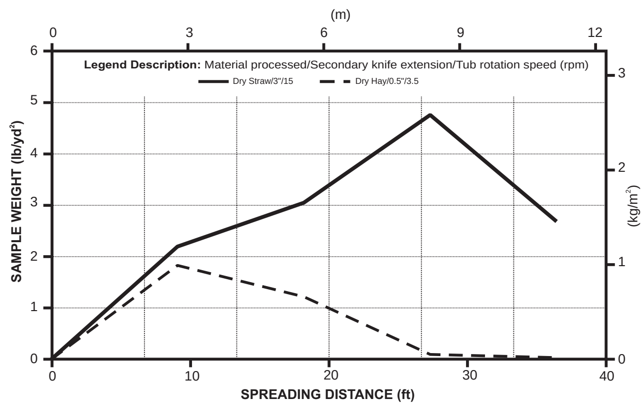


Figure 4. Average material spreading uniformity.

Bunk feeding was simple and was only limited by operator abilities. A 1522 lb (690 kg) dry hay bale required 697 ft (212 m) to process at the mid-range processing rate and bunking rate of 1.5 mph (2.4 km/h).

Table 2. Processed material spreading results and times.

Adjustment Settings				Processed Material	Average Processing Time Minutes**	Average Material Cut Length		33 24Maximum Spread-ing Distance		Average Spreading Distance	
Secondary Knife Exposure		Tub Rotation Speed	Tub Direction								
in	cm	rpm				in	cm	feet	meter	feet	meter
0	0	3.5	opposite	Round Dry Straw Square Wet Straw	3.6 2.8	4-9 4-9	10-23 10-23	2-26 2-24	0.6-8 0.6-7	7-20 7-20	2-6 2-6
0	0	15.0	opposite	Round Dry Straw Round Wet Hay Square Wet Straw	2.6 2.9 3.6	5-11 3-9 3-7	13-28 8-23 8-18	312 3-24 2-28	9.0 0.9-7 0.6-8	6-26 5-19 7-24	2-8 1.5-6 2-7
3	7.6	3.5	same	Round Dry Straw Round Silage	5.0 N/A	2-5 N/A	5-13 N/A	12.25 39	4 12	N/A 0-31	N/A 0-9
3	7.6	3.5	opposite	Round Dry Straw Square Dry Straw Round Dry Hay Square Dry Hay Round Wet Straw Square Wet Hay	3.2 2.5 2.9 6.2 4.3 4.0	4-7 6-9 2-3 2-3 3-7 2-4	10-18 15-23 5-8 5-8 8-18 5-10	33 31 24 27 33 24	10 9 7 8 10 7	10-25 N/A 0-20 5-19 8-27 9-19	3-8 N/A 0-6 1.5-6 2-8 3-6
3	7.6	15.0	same	Square Dry Hay	6.4	2-3	5-8	30	9	0-27	0-8
3	7.6	15.0	opposite	Round Dry Straw Square Dry Straw Round Wet Straw Square Wet Hay	3.2 2.9 2.7 2.5	6-11 6-10 2-5 3-8	15-28 15-25 5-13 8-20	34 39 19 40	10 12 6 12	N/A 7-30 8-16 10-33	N/A 2-9 2-5 3-10

* The tub rotation direction is in relation to the rotor turning direction. A same setting means the tub was turning the same direction as the rotor (clockwise).
** The processing time is the time to process a complete bale.

PATZ BALE CHOPPER

Manufacturer:
Patz Sales, Inc.
Pound, Wisconsin USA 54161-0007
Ph: (920) 897-2251 Fax: (920) 897-4312

Participating Dealer:
Lethbridge Dairy Mart Ltd.
3610 - 8th Avenue North
Lethbridge, AB, Canada T1H 5E8
Ph: (403) 329-6234

Figure 1. (1) Flow control system and lever, (2) Front high right discharge spout, (3) Tub/Chamber, (4) Low rear left discharge port, (5) Upright cutting knives, (6) Center hub, (7) Processing rotor, (8) Bale grippers, (9) Fan blades.

DESCRIPTION

The Patz Bale Chopper is a round bale or loose material processor. The chamber is fully enclosed but does not have a bale self-loading mechanism. A hydraulic motor and chain drive turns the chamber clockwise or counter clockwise. There are two large bale grippers on opposite sides of the chamber to turn the bale when the chamber rotates. The rotation speed is controlled by a flow control system supplied by Patz. The chamber rotation speed controls the material feeding rate, processing and cutting aggressiveness.

The processing rotor is a 36 in (91 cm) diameter disc mounted horizontally at the bottom front of the chamber. The rotor disc is driven by the tractor PTO through a 90o gear box. A 540 rpm or 1000 rpm tractor PTO speed can be used. At the perimeter of the disc are 2, 3 or 6 upright cutting knives as well as 6 radial fan blades. The fan blades create an air flow that carries the material out the discharge ports. A center hub of the rotor disc is hydraulically raised to lift the bale off the cutting knives upon startup. The cutting knives have 2 positions for cut aggressiveness. There are two 7 in (2.8 cm) wide distribution channels under the rotor disc that channel the material to one of two discharge ports. Gates at the beginning of each distribution channel control which discharge port is used. The two discharge ports, one on the right side near the front and one on the left side near the rear could be equipped with a variety of discharge spouts and deflectors. The unit tested came equipped with a spout on the right hand side with a discharge height of 80.5 in (31.7 cm). The processor is equipped with a PTO shear bolt safety feature.

EASE OF OPERATION AND ADJUSTMENTS

The Patz was simple to operate and the manual thoroughly explained the different adjustments. A Patz hydraulic flow control system controlled the speed and direction of the chamber. The manufacturer recommended processing all material with the chamber turning counter-clockwise. The tub bale grippers could be adjusted to accommodate various bale diameters. The chamber rotation speed, cutting knives height and number, and the rotor speed controlled the processing aggressiveness (Table 1). The cutting knives were manually adjusted to one of two heights by removing fastening bolts. The discharge ports were selected by closing/opening a door at the start of each channel. Various attachments could be attached to the discharge ports to accommodate different distribution applications. Occasionally wet material caused the distribution channel and spout to plug. A long narrow scoop was required to unplug the rear channel, while the spout could be easily removed for unplugging. The twines from the bales were very finely chopped during processing and caused no wrapping or plugging problems. The processor should be operated at a level position. The double tongue hitch had various adjustment settings to accommodate any height of tractor hitch.

Table 1. Processor adjustments and settings

Setting	Tub Rotation Speed		Discharge Ports*	Cutting Knives** Extension Height
	Hydraulic Flow	rpm		
1	#2	0.36	Rear Port 31.5 in (80 cm)	Bottom Hole 1-11/16 in (4.3 cm)
2	#4	4.00		
3	#6	7.60	Front Port 80.5 in (204 cm)	Top Hole 2-5/16 in (5.9 cm)
4	#8	10.70		
5	#10	15.00		

* The discharge port measurement is from the ground to the bottom edge of the opening.
** Cutting knives extension height is the amount of exposed knife exposed above table for material cutting.

HORSEPOWER REQUIREMENTS

The PTO power required to operate the Patz was between 22-81hp (16-60 kW) at 1000 rpm PTO and 7-19 hp (5-14 kW) at 540 rpm PTO with different materials and settings. See Figure 2 for horsepower requirements with all different materials at various settings. The power to operate the disc under no load at 540 rpm PTO was 2-3 hp (1.5-2 kW) and 11-16 hp (8-12 kW) at 1000 rpm PTO. The startup torque of the disc at tractor engine idle speed required 60 hp (45 kW). The chamber speed, material type and moisture content affected the horsepower requirements. The PTO speed determined power requirements. The chamber speed and material type had more of a effect on horsepower requirements than did the number of knives. Dry hay required 35% more horsepower at a low flow control setting compared to the highest flow control setting. Dry and wet hay required 34% more horsepower to process than dry and wet straw at the same settings. The maximum power was between 10-38 hp (7-28 kW) at 540 PTO rpm and 30-153 hp (22-114 kW) at 1000 PTO rpm with all materials. The silage bales required the most horsepower.

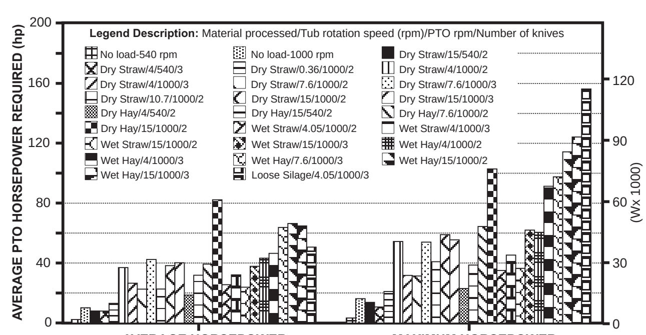


Figure 2. PTO horsepower requirements at various machine settings with different materials.

The hydraulic power to operate the chamber rotation under no load at rated engine rpm was 11 hp (8 kW). Different material types and moisture content had no effect on the horsepower required to operate the chamber rotation. Chamber speed had little effect on hydraulic power requirements. The range of hydraulic power requirements for all flow control settings (1900 psi and 12 gpm flow) was 10.5-13 hp (8-10 kW).

MATERIAL DISTRIBUTION

The Patz handled all the round bale types available for the evaluation at most adjustment settings. Both discharge channels plugged with moist and/or lumpy material because of a lack of air flow for heavy material. While processing high moisture materials the material feeding rate, number and height of cutting knives should be adjusted to minimal settings and the disc set at the maximum speed to reduce power requirements, plugging and machine wear or breakdowns. Material feeding rate into the processing disc, length of cut, and processing time, were controlled by the chamber rotation speed, disc rpm, and number and height of cutting knives (Table 2). With only 3 rotor knives, processing time was excessive. The rotor disc speed also affected the spreading distance. Bales placed on their side did not always completely cover the tub floor causing gaps in material flow. Round bales placed on end in the tub had no material flow gaps as long as the bale was rotating and the bale grippers did not slip. Bale grippers would assist in mixing of loose materials.

The distance and uniformity of processed material spread varied with different settings. Dry straw consistently spread less distance than all other materials processed at the same settings. Dry straw spread up to 35 ft (11 m) on average and all other material types spread up to 42-45 ft (13-14 m). Material spreading of the processor was uniform as long as a steady supply of material was put through the disc rotor (Figure 3). The Patz processor was designed mainly for bunk feeding or very fine material chopping for bedding or feeding. The air assisted distribution from the disc fan blades was very aggressive and created very high pressure to distribute finely cut material. The processing of the rotor with 3 knives was not aggressive and cut the material very fine. To achieve any kind of accumulation of material required stationary operation of the processor. Material spreading distance and direction could be controlled by deflectors connected to the discharge port openings. The aggressiveness of processing had no affect on the material distribution. The discharge spout did not distribute material as far or as uniform as the rear discharge port.

The majority of dry hay (73%) was spread between 16-30 ft (5-9 m) through the side discharge spout and 95% was spread between 19-37 ft (6-11 m) through the low rear discharge port. The majority of dry straw material (81%) was spread between 15-27 ft (5-8 m) through the rear discharge port. Distribution uniformity of straw was best between 15-25 ft (5-8 m) from the processor when discharged through the spout and between 25-35 ft (8-11 m) when discharged through the rear port as shown in Figure 3. The processor required 1294 ft (398 m) to process a 850 lb (386 kg) straw bale at 1.5 mph (2.4 km/h) with 2 cutting knives at the maximum chamber speed. The processor required 417 ft (127 m) to process a 840 lb (381 kg) hay bale at 1.5 mph (2.4 km/h) with 2 cutting knives at the maximum chamber speed. All distribution uniformity runs shown in the table were completed at 1000 rpm PTO. At the 540 rpm PTO speed, material spread was reduced substantially.

Bunk feeding runs were not completed as no discharge port extensions were supplied with the processor.

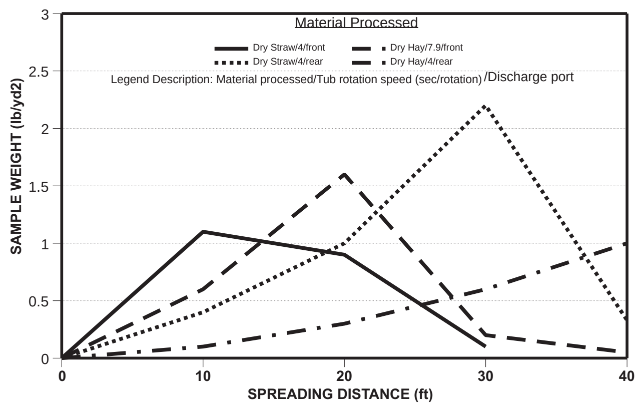


Figure 3. Average material spreading distance.

Table 2. Processed material spreading results and times.

Adjustment Settings			Processed Material	Average Processing Time minutes*	Average Material Cut Length		Maximum Spreading Distance		Average Spreading Distance	
Cutting Knives	Tub Rotation Speed rpm	PTO rev/min			in	cm	feet	meter	feet	meter
3	4.0	540	Dry Straw	10.96	N/A	N/A	N/A	N/A	N/A	N/A
2	7.6	540	Dry Hay	N/A	1.0-3.5	2.5-9	N/A	N/A	N/A	N/A
2	15.0	540	Dry Straw	N/A	2.0-6.0	5-15	23	7	N/A	N/A
2	4.0	1000	Dry Straw Wet Straw Wet Hay	8.56 11.52 3.92	1.0-3.0 1.0-3.0 0.5-1.5	2.5-8 2.5-8 1-4	36 6-39 10.44	11 2-12 3-13	N/A 14-31 17-36	N/A 4-9 5-11
3	4.0	1000	Dry Straw Wet Straw	16.40 14.20	1.0-2.5 1.0-3.5	2.5-6 2.5-9	6-27 6-46	2-8 2-14	11-22 16-35	3-7 5-11
2	7.6	1000	Dry Straw Dry Hay	13.35 3.61	1.0-3.5 0.5-1.5	2.5-9 1-4	36 4-44	11 1-13	N/A 19-37	N/A 6-11
3	10.7	1000	Dry Straw	10.24	1.0-3.0	2.5-8	12-40	4-12	19-32	6-10
2	10.7	1000	Dry Straw	11.70	1.0-5.0	2.5-13	36	11	N/A	N/A
2	15.0	1000	Dry Straw Dry Hay Wet Straw Wet Hay	12.86 4.21 14.90 5.56	1.5-4.0 0.5-1.5 0.5-3.0 1.0-2.0	4-10 1-4 1-8 2.5-5	8-36 7-41 6-43 10.44	2-11 2-12 2-13 3-13	17-29 18-35 14-34 20-37	5-9 5-11 4-10 6-11
3	15.0	1000	Dry Straw Wet Straw	9.60 14.80	1.0-3.0 1.0-2.5	2.5-8 2.5-6	5-28 4-43	1.5-8 1-13	10-22 13-35	3-7 4-11

* The processing time is the time to process a complete bale.
** All runs were completed with the cutting knives in the highest hole position.

MAKE AND MODEL: Bale King Vortex 2000 Bale Processor

MANUFACTURER: Bridgeview Mfg. Inc
P.O. Box 4, Hwy. 22 West
Gerald, SK Canada S1A 1B0
Ph: (306) 745-2711
Fax: (306) 745-3364

SPECIFICATIONS:
Processes all round bales or loose material
Rotor 1000 rpm PTO driven rotor
Remotes Requires 2 hydraulic remotes
Hitch weight 1530 lbs (694 kg)
Processing rotor 26.5 in (67 cm) diameter x 80 in (203 cm) long
Flail knives 30 knives: 3/4 x 1-1/2 x 8-5/8 in (2 x 4 x 22 cm)

SIZE:

Distribution chamber	10.5 x 75 in (27 x 109 cm)
Overall width	114 in (290 cm)
Overall height	108 in (274 cm)
Tub/Chamber	80 in (203 cm) x 110 in (279 cm)

OPTIONAL EQUIPMENT:
- Other models available with side mount feed tank and auger system to place supplement feed with the processed bale
- Hydraulic or electric driven ram to adjust upper side deflector from tractor cab
- Other models available with left or right side discharge

MECHANICAL HISTORY:
A PTO shear bolt broke upon startup of the rotor once. Starting the PTO with the tractor engine speed at idle will prevent shear bolt failure. Operating the processor at the recommended adjustment settings for different material types will also reduce wear and tear. Improper settings can result in the rotor flails hammering due to backslapping on the drum.

MAKE AND MODEL: Jiffy Model 920 Bale Shredder

MANUFACTURER: Westward Products Ltd.
6517 - 67th Street
Red Deer, AB Canada T4P 1A3
Ph: (403) 340-1160
Fax: (403) 335-4580

SPECIFICATIONS:

	Processes all round bales or loose material
Rotor	1000 rpm PTO driven rotor
Remotes	Requires 2 hydraulic remotes
Hitch weight	1465 lbs (665 kg)
Total machine weight	5105 lbs (2320 kg)
Processing rotor	9 in (23 cm) diameter x 92 in (234 cm) long
Flail knives	32 knives: 6 x 2 x 0.5 in (15 x 5 x 1 cm)

SIZE:

Distribution chamber	16 x 93 in (41 x 236 cm)
Overall width	115 in (292 cm)
Overall height	91.5 in (232 cm)
Tub/Chamber	106 x 83 in (269 x 211 cm)

OPTIONS:
- Side mount feed tank and auger system to place supplements with the processed bale
- Hydraulic or electric driven ram to adjust upper side deflector from tractor cab

MECHANICAL HISTORY:
Starting the PTO with the tractor engine speed at idle will prevent wear and tear on the processor. Operating the processor at the recommended adjustment settings for the different material types will also reduce wear and tear. Improper settings can result in the rotor hammer knives backslapping on the rotor drum.

MAKE AND MODEL: Highline Bale Pro 7000 Cattlemen Series

MANUFACTURER: Highline Mfg. Inc
P.O. Box 307
Vonda, SK Canada S0K 4N0
Ph: (306) 258-2233 Fax: (306) 258-2010
Toll Free: 1-800-665-2010
www.highlinemfg.com highline@getthe.net

SPECIFICATIONS:

	Processes all round bales or loose material
Rotor	1000 rpm PTO driven rotor
Remotes	Requires 3 hydraulic remotes with optional feed tank and auger system
Hitch weight	1710 lbs (776 kg)
Processing rotor	20-5/8 in (52 cm) dia. drum x 72 in (183 cm) long
Flail knives	26 knives: 6-7/16 x 7/16 x 2 in (16 x 1 x 5 cm)
Feed tank capacity	65 bu (52 cu. ft.)

SIZE:

Distribution chamber	10.75 x 72.25 in (27 x 183 cm)
Overall width	106 in (269 cm)
Overall height	105.5 in (268 cm)
Tub/Chamber	102 x 73 in (259 x 185 cm)

OPTIONS:
- Side mount feed tank and auger system to place supplement feed with processed bale

MECHANICAL HISTORY:
Starting the PTO with the tractor engine speed at idle will ensure minimal wear and tear on the processor. Operating the processor at the recommended adjustment settings for the different material types will also reduce wear and tear. Improper settings can result in the rotor flails backslapping on the rotor drum.

MAKE AND MODEL: Highline Top Gun

MANUFACTURER: Highline Mfg. Inc
P.O. Box 307
Vonda, SK Canada S0K 4N0
Ph: (306) 258-2233 Fax: (306) 258-2010
Toll Free: 1-800-665-2010
www.highlinemfg.com highline@getthe.net

SPECIFICATIONS:

	Processes all round bales
Rotor	1000 rpm PTO driven rotor
Remotes	Requires 2 hydraulic remotes
Hitch weight	N/A
Material distributor	Belt driven fan off PTO drive
Processing rotor	20-5/8 in (52 cm) diameter x 72 in (183 cm) long
Flail knives 32 knives:	6-7/16 x 7/16 X 2 in (16 x 1 x 5 cm)

SIZE:

Distribution chamber	10.5 x 72.25 in (27 x 183 cm) tapered to 12.75 x 40 in (32 x 102 cm)
Distribution spout	144 in (366 cm) long x 12 in (30.5 cm) square outlet
Overall width	142 in (361 cm)
Overall height	118 in (300 cm)
Tub/Chamber	102 x 73 in (259 x 185 cm)

OPTIONS:
N/A

MECHANICAL HISTORY:
Starting the PTO with the tractor engine speed at idle and operating the processor at the recommended adjustment settings will ensure minimal wear and tear on the processor. Improper settings can result in the flails backslapping on the rotor. The operator had to be careful when rotating the spout because there was no bypass on the hydraulic motor and the drive chain would break when the spout hit the stops.

MAKE AND MODEL:	Hesston BP25 Bale Processor
MANUFACTURER:	AGCO Corporation 4205 River Green Parkway Duluth, GA, USA 30096 Phone: (770) 813-9200
SPECIFICATIONS:	
	Processes all round and big square bales
Rotor	1000 rpm PTO driven rotor
Remotes	Requires 2 hydraulic remotes
Hitch weight	435 lbs (197 kg)
Processing rotor	24 in (61 cm) diameter drum x 38.8 in (98 cm) long
Flail knives	14 blades: 5-3/4 x 1-1/4 x 1 in (14.6 x 3.2 x 2.5 cm)
Blades	protrude 1 in (2.5 cm) above rear guard bar and 2.75 in (7 cm) above front 2 guard bars and are reversible
Tires	Standard wheels and tires 12.5 L x 15 flotation 6 ply tires
SIZE:	
Distribution chamber	9 x 42.25 in (23 x 107 cm)
Overall width	126 in (320 cm)
Overall height	132.5 in (337 cm) with big square bale extension bars
Tub/Chamber size	102 x 73 in (260 x 185 cm)

OPTIONS:
- Flotation wheels and tires
- Conveyor kit mounted in the discharge chute
- Adjustable conveyor extension kit mounted at end of deflector
- Secondary cutting knife assembly mounted in rotor chamber
- Small bale driver kit mounted in tub/chamber
- Hydraulic flow control kit
- Heavy bale kit for lifting larger bales

MECHANICAL HISTORY:
Starting the PTO with the tractor engine speed at idle and operating the processor at the recommended settings will ensure minimal wear and tear on the processor. The rotor would hammer away or jam if the feed rate and processing aggressiveness was set wrong. The PTO slip clutch would prevent damage to the processor when th rotor jammed.

MAKE AND MODEL:	Patz Model 9187 Bale Chopper
MANUFACTURER:	Patz Sales, Inc Pound, Wisconsin, USA 54161-0007 Ph: (920) 897-2251
SPECIFICATIONS:	
	Processes all round bales or loose material
Rotor	1000 or 540 rpm PTO driven rotor
Remotes	Requires 2 hydraulic remotes
Hitch weight	748 lbs (339 kg)
Processing rotor disc	36 in (91 cm) diameter
Flail knives	2, 3 or 6 cutting knives 4 in long tapered to 3/4 in points 4.75 in high x 3/16 in thick (10 x 2 x 12 x .5 cm)
SIZE:	
Distribution chutes size	7 in (18 cm) square
Distribution ports size	Front vertical discharge port - 7 in (18 cm) diameter x 80.5 in (204 cm) above ground Rear left side discharge port - 7 in (18 cm) diameter x 31.5 in (80 cm)
Overall width	93 in (236 cm)
Overall height	83 in (211 cm)
Tub/Chamber size	83 in (211 cm) diameter x 45 in (114 cm) deep

OPTIONS:
- Front vertical discharge port extension to raise outlet to 132 in (335 cm) above ground
- Front vertical discharge port adaptor to switch outlet to 31.5 in (80 cm) above ground
- Rear side discharge port adjustable deflector
- Rear side discharge port 7 in (18 cm) diameter flexible hose
- Short chop kit of a sickle section blades and shear blocks mounted on inside rim of disc housing

MECHANICAL HISTORY:
Starting the PTO with the tractor engine speed at idle and operating the processor at the recommended settings will ensure minimal wear and tear on the processor. Distribution chute plugging occurred occasionally while processing wet or lumpy material causing the PTO safety shear bolt to break.

MAKE AND MODEL:	Boss Two Square BaleProcessor
MANUFACTURER:	Falcan Industries Ltd. P.O. Box 1178 Fort Macleod, AB Canada T0L 0Z0 Ph: (403) 553-2114 Fax: (403) 553-2527 www.falcan.com falcan@telusplanet.net
SPECIFICATIONS:	
	Processes all big square bales
Rotor	1000 or 540 rpm PTO driven rotor
Remotes	Requires 2 hydraulic remotes
Hitch weight	627 lbs (284 kg)
Upper feed beater	56 in (142 cm) long with 4 metal bats 43 in (109 cm) above bed table
Processing rotor beater	8.5 in (22 cm) diameter x 56 in (142 cm) long
Flail knives	32 knives: 7 x 2 x 0.5 in (18 x 5 x 1 cm) and clear the table bed by 1.125 in (2.8 cm)
SIZE:	
Distribution side opening size	56.75 x 8.5 in (144 x 22 cm)
Overall width	144 in (366 cm)
Overall height	91 in (231 cm)
Bale table bed size	108 x 58 in (274 x 147 cm) long

OPTIONS:
- Side mount feed tank and auger system to place supplement feed with processed bale
- hydraulically driven ram to adjust upper side deflector from tractor cab

MECHANICAL HISTORY:
Starting the PTO with the tractor engine speed at idle and operating the processor at the recommended adjustment settings will ensure minimal wear and tear on the processor. Improper settings can result in the rotor flails backslapping on the rotor drum.

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