

Evaluation Report

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Hesston 560 Round Baler

A Co-operative Program Between



ALBERTA
FARM
MACHINERY
RESEARCH
CENTRE

PAMI

PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

HESSTON 560 ROUND BALER

MANUFACTURER:

Hay and Forage Industries
P.O. Box 4000
Hesston, KS
67062-2094
Phone: (316) 327-6217

DISTRIBUTOR:

Hesston Industries Ltd.
2-2315 30th Ave. N.E.
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Phone: (403) 250-7320

RETAIL PRICE: \$22,638 (March 1990 f.o.b. Portage la Prairie, MB) with floatation tires and gathering wheels.

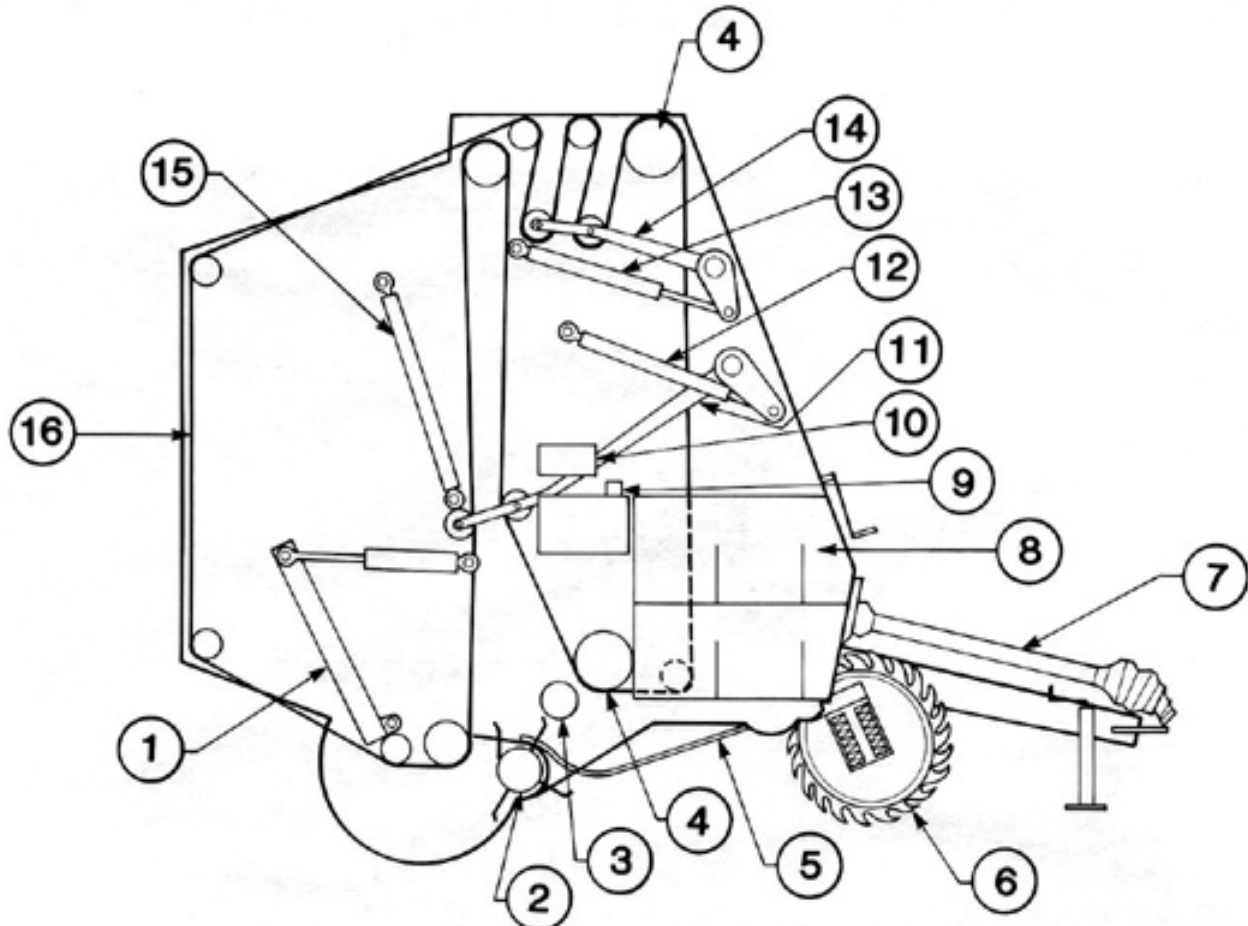


FIGURE 1. Hesston 560 Round Baler: (1) Bale Ejector Bar, (2) Pickup, (3) Starting Roller, (4) Crowned Driving Rollers, (5) Windguard, (6) Gathering Wheel, (7) Drive Shaft, (8) Twine Box, (9) Hydraulic Oil Reservoir, (10) Hydraulic Valve Control Block, (11) Bale Tension Arm, (12) Bale Tension Cylinder, (13) Belt Tension Cylinder, (14) Belt Tension Arm, (15) Gate Cylinder, (16) Forming Belts.

SUMMARY AND CONCLUSIONS

Rate of Work: Typical throughput of the Hesston 560 varied from 4.3 ton/h (3.9 t/h) in mixed grasses to 13.3 ton/h (12.1 t/h) in alfalfa. Throughput was limited by pickup and feeding performance rather than by the bale chamber capacity.

Quality of Work: Bale quality was excellent, with well formed and durable bales in all crops. Hay bales weighed from 1300 to 2000 lb (590 to 900 kg) and straw bales weighed from 900 to 1200 lb (408 to 550 kg).

Resistance to bale moisture penetration and spoilage was very good. Minimal spoilage had occurred during the 111 day weathering period. Leaf loss was rated very good. Total leaf loss ranged from 1.0 to 3.2% at 15% MC.

Ease of Operation: Ease of forming a bale was very good. The operator followed the direction lights on the monitor to produce a well formed bale. In hot, dry conditions it was sometimes necessary to reduce the PTO speed. Ease of feeding the bale chamber was excellent. The baler's feeding system was positive and aggressive in all crops. Ease of twine wrapping was very good and the ease of bale discharging was excellent. Twine wrapping and bale discharging were automatically sequenced and were completed in about 60 to

80 seconds.

Ease of transporting was good. The baler was easily manoeuvred but required care when backing up due to poor rear visibility. Ease of hitching the baler to a tractor was very good. Hitching components included a drawpin, PTO driveline and an electrical connection to the baler's monitor. Because the baler's hydraulic system was self contained, remote hydraulics were not required. Twine threading was excellent. Twine was easily threaded through the open twine arm without the use of mechanical aids.

Ease of Adjustment: Ease of relieving forming belt tension was excellent and was accomplished by turning a hydraulic valve. Ease of adjusting the pickup was good. The pickup height was controlled by a hand crank and required adjustment at each field. Ease of adjusting the bale size and density was excellent. Their controls were located on the baler and were simple to adjust. Ease of adjusting the twine wrap settings was very good. These adjustments included the number of twine wraps around the bale, the distance between the end wraps of twine and the end of the bale, and the twine tension. Ease of lubricating was good. Complete daily servicing took about 20 minutes.

Power Consumption: Peak power requirements were about 41

hp (31 kW) in hay on level fields. It was found by PAMI that a 65 hp (49 kW) tractor was needed to fully utilize baler capacity on soft land. The specific capacity of the Hesston 560 was 0.44 ton/hp-h (0.54 t/kW-h) in alfalfa at an instantaneous workrate of 13.0 ton/h (11.8 t/h) with the baler set at its highest density.

Operator Safety: Operator safety of the Hesston 560 was very good if normal safety precautions were observed.

Operator's Manual: The operator's manual was very good. It was well written and clearly illustrated.

Mechanical History: A twine guide rod broke at 105 hours, the electronic twine feeding sensor broke at 130 hours and a belt lacing pin broke at 132 hours. Numerous pickup teeth broke throughout the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to improve the baler's ability to crowd hay at the edges of the bale chamber.
2. Modifications to decrease twine wrapping time.
3. Modifications to the pickup assembly to improve floatation and ease of adjusting its operating position.
4. Modifications to prevent crop from being carried behind the forming belts above the twine knife shield and subsequently wrapping around the right side of the bottom drive roller.

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Project Engineer: R. W. Schott

THE MANUFACTURER STATES THAT

With regard to the recommendations: (1-4)

1. No changes are planned at this time.
2. A dual head twine arm is presently under test and is planned for a late 1990 introduction. A net wrap attachment is presently under test.
3. No changes are planned on floatation but pickup tines have been redesigned for improved reliability.
4. The starting roller has been repositioned to allow more tolerance for crop buildup to pass between drive roller and the belt before contacting the starting roller. The lower front idler roller has been repositioned to allow more distance between belt and twine knife cutoff shields.

GENERAL DESCRIPTION

The Hesston 560 is a pull-type, PTO driven baler with a variable cylindrical chamber and a drum pickup. The Hesston produces bales measuring 5.1 ft (1.6 m) wide and upto 6.2 ft (1.9 m) in diameter. Bale diameter is adjustable and the desired size is manually set on the baler. The amount of twine wrap and the density of the bale are variable and are manually set on the baler. The single tube twine wrapping system, tailgate operation and bale discharging system are automatically sequenced. The operator activates the sequence from the monitor on the tractor after an audible alarm sounds that indicates when the desired size has been reached. The baler requires a 12 volt power source to operate the monitor. Because the baler's hydraulic system is self-contained, tractor hydraulic remote circuits are not required.

Crop is fed directly into the vertical throat of the bale chamber by the drum pickup. Six, 7.0 in (178 mm) and two, 6.5 in (165 mm) wide forming belts form the bale. They also provide uniform pressure to the bale by using two tension arms and the self-contained hydraulic system. This hydraulic system permits infinitely adjustable bale pressure within a certain range. A 5.5 in (140 mm) diameter starting roller ensures crop feeds properly around the perimeter of the forming bale.

The electronic control and monitor system controls the automated sequencing of twine wrapping and bale discharging. The twine arm feeds twine across the front of the bale. The chamber gate then opens to allow the bale to be discharged and the ejection bar pushes the bale away from the baler. A clutch automatically disengages the forming belts when the bale is discharged. The operations are electro-hydraulically actuated and can also be manually controlled at the monitor. The

monitor system also contains an audible alarm for indicating a full bale condition, a light to indicate when the tailgate is closed, a light to indicate when the twine is or is not feeding, and direction lights to instruct the operator which direction to drive in order to fill the width of the bale chamber uniformly.

The test machine was equipped with optional floatation tires and optional gathering wheels. Other options available on the Hesston 560 but not tested, include a hydraulic pickup lift and a short crop kit.

Detailed specifications are given in APPENDIX I. FIGURE 1 shows the location of major components and FIGURE 2 shows the monitor.

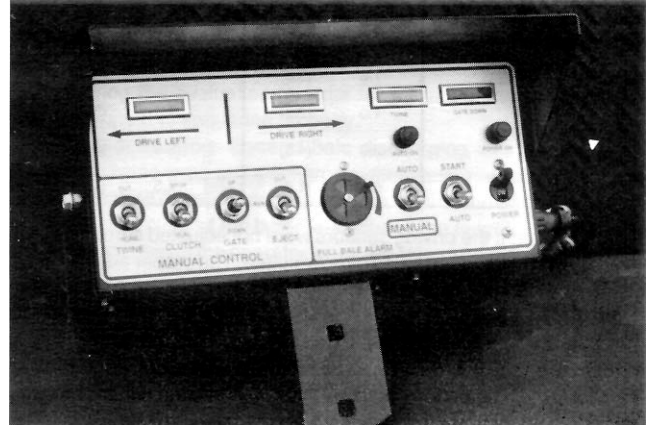


FIGURE 2. Hesston 560 Monitor.

SCOPE OF TEST

The Hesston 560 was operated in a variety of crops (TABLE 1) for 190 hours, while producing 2226 bales. It was evaluated for rate of work, quality of work, ease of operation, ease of adjustment, power requirements, operator safety, and suitability of the operator's manual. In addition, mechanical problems were monitored throughout the evaluation.

TABLE 1. Operating Conditions

| Crop | Operating Hours | Number of Bales | Equivalent Field Area (ha) | |
|--------------------|-----------------|-----------------|----------------------------|--------------|
| Alfalfa | 58 | 654 | 340 | (136) |
| Alfalfa/Bromegrass | 23 | 290 | 178 | (71) |
| Alfalfa/Timothy | 24 | 468 | 155 | (62) |
| Mixed Grasses | 50 | 334 | 320 | (128) |
| Barley Greenfeed | 3 | 48 | 18 | (7) |
| Oat Straw | 13 | 107 | 100 | (40) |
| Barley Straw | 8 | 136 | 70 | (28) |
| Wheat Straw | 11 | 182 | 52 | (20) |
| TOTAL: | 190 | 2226 | 1231 | (492) |

RESULTS AND DISCUSSION

RATE OF WORK

Throughput depended on windrow size, uniformity of crop conditions, field surface, available tractor speeds and operator skill. Typical throughputs for the Hesston 560 (TABLE 2) varied from 4.3 ton/h (3.9 t/h) in mixed grasses to 13.3 ton/h (12.1 t/h) in alfalfa. The values in TABLE 2 are based on typical workrates for daily field operation. Peak workrates during any one day were generally 10% to 20% higher.

In most crops, the feed rate was primarily limited by windrow size and pickup/feeding performance. In lighter crops, the ground speed was normally limited to about 8 mph (13 km/h) due to rough ground and pickup performance.

The automatic twine wrap and bale discharge system allowed a relatively short bale formation cycle. It would be possible to decrease the twine wrapping time by replacing the existing single twine tube with a multiple tube or surface wrap system. This would increase the workrate.

QUALITY OF WORK

Bale Quality: Bale quality was generally excellent. The Hesston 560 produced firm, durable bales with flat ends and uniform diameter in all hay and straw crops (FIGURE 3). With the driving sensors set correctly, the operator could follow the direction lights on the monitor to produce

TABLE 2. Typical Throughputs

| Crop | Crop Yield ton/ac (t/ha) | Typical Daily Throughput ton/h (t/h) |
|---------------------|--------------------------|--------------------------------------|
| Alfalfa: | | |
| Field A | 2.0 (4.5) | 13.3 (12.1) |
| Field B | 1.1 (2.5) | 8.6 (7.8) |
| Alfalfa-Bromegrass: | | |
| Field A | 1.6 (3.8) | 13.0 (11.8) |
| Field B | 1.0 (2.3) | 4.7 (4.3) |
| Alfalfa-Timothy: | | |
| Field A | 2.3 (5.3) | 13.0 (11.8) |
| Field B | 1.1 (2.5) | 6.6 (6.0) |
| Mixed Grasses | 1.4 (3.3) | 4.3 (3.9) |
| Barley Greenfeed | 1.6 (3.8) | 6.0 (5.4) |
| Barley Straw | 1.0 (2.3) | 9.0 (8.2) |
| Wheat Straw | 2.0 (4.5) | 9.0 (8.2) |
| Oat Straw | 0.6 (1.3) | 4.5 (4.1) |

a uniform bale. If the driving sensors were not adjusted correctly cone-shaped or barrel shaped bales often resulted. The proper adjustment of the sensors was easy to perform.

Baling windrows with a width greater than half the baler pickup, but less than the entire pickup, resulted in barrel-shaped bales. This is typical of round balers. Proper windrow preparation, consisting of windrows with widths less than half the baler pickup width or slightly wider than the baler pickup, ensures proper bale formation.

A typical hay or straw bale averaged 5.1 ft (1.6 m) in width, and could be made any diameter up to 6.2 ft (1.9 m). Bales tested settled to about 97% of their original height after 111 days. Typical 6 ft (1.8 m) diameter hay bales weighed from 1300 to 2000 lb (590 to 900 kg) with average densities ranging from 8.3 to 13.3 lb/ft³ (133 to 213 kg/m³). Typical 5.5 ft (1.7 m) diameter straw bales weighed from 900 to 1200 lb (408 to 550 kg) with densities ranging from 7.2 to 8.6 lb/ft³ (115 to 138 kg/m³). The bale density control allowed a wide range of densities. Variation in feed rate and uniformity of feed rate also affected bale density.



FIGURE 3. Typical Round Bale.

Bale Weathering: Resistance to bale weathering was very good. During a period of 111 days, over which 4 in (100 mm) of total rainfall was measured, moisture penetrated to a maximum of 1/4 in (6 mm) in the area where the bale touched the ground. Spoilage also occurred to a depth of 1/4 in (6 mm) on the top and on the sides of the bale.

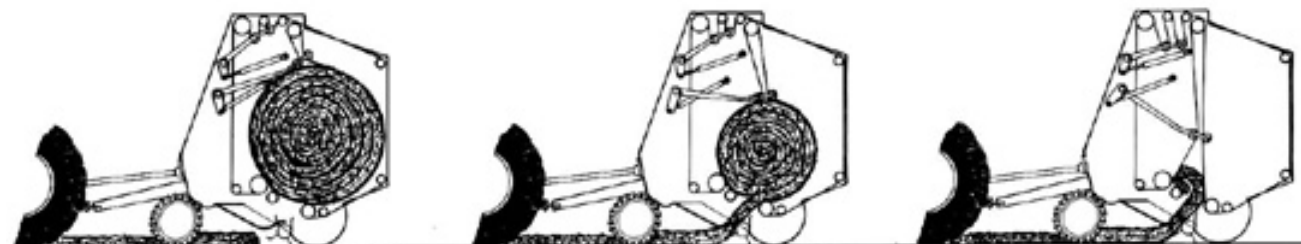


FIGURE 5. Stages of Bale Formation: (Left) Starting Bale, (Centre) Partially Completed Bale, (Right) Completed Bale.

Leaf Loss: Leaf and stem loss on the Hesston 560 ranged from 1.0 to 3.2% at a 15% moisture content which was considered very good. It was tested for leaf and stem loss in a light crop of alfalfa which had been cut with a 15 ft (4.6 m) windrower. Average crop yield was about 0.9 ton/acre (2.0 t/ha). Instantaneous workrates ranged from 13.2 to 16.2 ton/h (12.0 to 14.7 t/h).

The importance of baling at a high moisture content on losses can be noted in FIGURE 4. This figure represents an accumulation of previous data for several round balers showing the total measured leaf and stem loss over a range of moisture contents in fields of mixed alfalfa, crested wheatgrass and bromegrass. Although the Hesston 560 was tested in a different crop, its total measured leaf loss was less than that presented in the figure.

FIGURE 4 does not include the relative effects of baling unconditioned or light windrows. Heavy, conditioned windrows are important to minimize losses. Lowering the PTO speed is effective in reducing the number of times the bale turns in the chamber, and consequently reduces leaf loss.

Twine wrapping accounted for approximately 25% of the total leaf loss. This emphasizes the importance of minimizing the wrapping time. Devices such as multiple twine tubes are effective in limiting the number of turns the bale makes while being wrapped and thereby reduces the leaf loss.

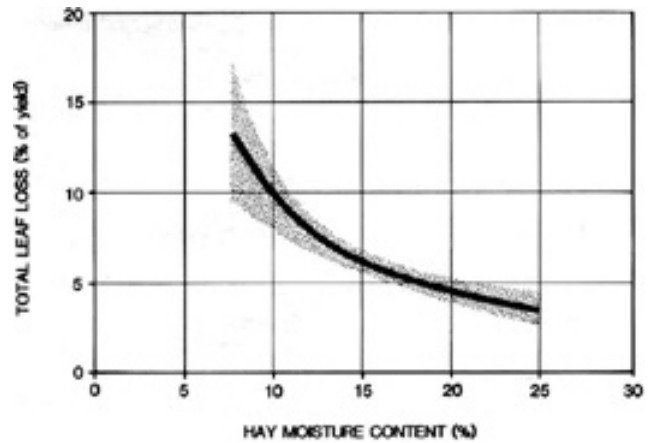


FIGURE 4. Typical Round Baler Leaf and Stem Loss in Mixed Alfalfa, Crested Wheatgrass and Bromegrass.

EASE OF OPERATION

Bale Forming: Ease of bale formation was very good. The forming belts aggressively conveyed the crop into the bale chamber from the pickup creating a positive feeding and forming action. The core was formed by initially feeding the centre of the baler followed by two quick left and right swings of the baler to feed the edges of the bale chamber. Then the direction lights could be followed to feed the width of the bale chamber uniformly which produced bales of uniform diameter. FIGURE 5 shows the stages of bale formation in the Hesston 560.

Because the direction sensors worked off the two outside belts it was important that the operator crowd the edges of the baler well. Otherwise, the outside belts would slacken off relative to the inner belts and cause the direction lights to come on too frequently. When this occurred, the operator would often weave too frequently which fed more material into the centre of the bale chamber than the outside edges. Barrel-shaped bales were often produced as a result.

The Hesston 560 was supplied with ground driven gathering wheels.

They were intended to help the operator pack the edges of the bale by crowding crop at the edges of the bale chamber. It was essential that the edges of the bales were well packed in order to obtain effective operation of the direction lights and to produce durable bales. However, they were not aggressive and often rode over the windrow. They worked well in fluffy windrows that were recently turned with a rake. The rubber teeth frequently worked part way out of the wheel assembly and caused interference with the gathering wheel arm. It is recommended that the manufacturer consider modifications to improve the baler's ability to crowd hay at the edges of the bale chamber.

Plugging occurred frequently when baling short dry crops in hot weather. Under these conditions, the forming belts crushed the hay as the core was formed. This often caused the core to fall onto the pickup. Because the visibility of the pickup from the tractor was poor, the operator had difficulty detecting the onset of plugging. It was found that decreasing the PTO speed and baling during late evening or morning when the crop was slightly damp improved the performance.

Feeding: Feeding performance was excellent. Feeding was positive and aggressive in all crops with only infrequent plugging. Any excessive blockages or plugging activated the main drive slip clutch. This clutch disengaged all feeding and bale forming mechanisms and thus prevented damage to the baler.

The baler plugged occasionally when baling short, dry crops in windy conditions. The wind blew dry crop between the driveline shield and the forming belts at the front of the baler, thereby allowing crop to collect on the twine knife shield. The forming belts then carried the collected crop up the front right side of the baler (FIGURE 6), where the crop found its way behind these belts and onto the bottom drive roller. Here the crop wrapped around the right side of the bottom drive roller and in time forced the belts to bear into the starting roller (FIGURE 1), which activated the main drive clutch. This problem occurred in both hay and straw. It is recommended that the manufacturer consider modifications to prevent crop from being carried behind the forming belts above the twine knife shield and subsequently wrapping around the right side of the bottom drive roller.



FIGURE 6. Crop Running up the Outside Forming Belt.

Twine Wrapping: Ease of twine wrapping was very good. An audible alarm alerted the operator when the bale had reached the predetermined size. The operator finished forming the bale to ensure a uniform diameter and then activated the automatic wrap and discharge system. As the twine tube quickly swung out to the left side of the baler, the operator stopped the forward motion of the tractor. The twine tube automatically returned across the width of the bale chamber at a predetermined speed chosen by the operator. The twine light on the monitor indicated when the twine was feeding into the bale chamber. The twine was cut on the right side of the baler with a twine knife assembly. The automatic twine wrapping system could be overridden by switching the monitor to manual mode. All twine wrapping operations could then be controlled manually.

Most operators preferred a twine wrapping sequence of 40 seconds consisting of 15 wraps. It is recommended that the manufacturer consider modifications to decrease twine wrapping time. This would increase workrates and decrease leaf losses.

Twine consumption was dependent upon the setting used by the operator. Most operators preferred a twine consumption of 400 ft/ton (135 m/t). This produced a durable bale in both hay and straw which could be handled several times. Typical twine consumption for small square balers is about 670 ft/ton (225 m/t).

The twine knife performed well. The slide of the knife assembly seized once during the evaluation. As a result, the sensors indicating the end of the twine wrapping sequence did not coincide and caused the autosequence to operate improperly. The problem was corrected and did not occur again.

Hay plugged the gears driving the twine arm once during the evaluation. This prevented the twine arm from returning to its home position. The problem was corrected and did not occur again. The sensors indicating when the twine arm was fully extended required adjustment twice during the evaluation in order for the automatic wrap and discharge system to sequence properly.

Bale Discharging: Ease of bale discharging was excellent. The automatic twine wrap and discharge system automatically disengaged the forming belt drive, opened the tailgate, moved the ejection bar out to push the bale clear of the baler, and closed the tailgate. A light on the monitor indicated to the operator when the tailgate was fully closed. The tailgate could also be operated manually from the monitor. The bale could be wrapped with twine and discharged in about 60 to 80 seconds.

Transporting: Ease of transporting the Hesston 560 was good. Ground clearance was adequate and there was adequate hitch clearance for turning sharp corners provided dual tractor tires were not used. Care was necessary when backing up or transporting on roadways due to obstructed visibility to the rear. The baler could easily be towed behind a tractor or a suitably sized truck. A safety chain was standard equipment. The load on the baler floatation tires with a full bale chamber did not exceed the Tire and Rim Association maximum load ratings at transport speeds of 25 mph (40 km/h). The operator had to dismount from the tractor to lift the pickup. An optional hydraulic pickup lift was available.

Hitching: Ease of hitching the Hesston 560 to a tractor was very good. The hitch jack was convenient for raising and lowering the A-frame hitch. However, the hitch jack could not be lowered enough to allow hitching to some pickup trucks. After hitching, the jack was raised off the ground, then removed and stored inside the left side safety shield. The baler monitor required a 12 volt electrical power source. Remote hydraulics were not required. The constant velocity joint on the PTO driveline was effective in minimizing driveline chatter.

Twine Threading: Twine threading was excellent. The twine was wrapped around a pulley before being threaded through the twine arm. A leaf spring mounted in the twine arm allowed the twine arm to have one open side. This made twine threading easy. The twine pulley rotated as the twine fed into the bale chamber. Sensors on the twine pulley assembly controlled a flashing light on the monitor. This signalled to the operator when twine was feeding.

Following the manufacturer's advice, of placing one complete wrap of plastic twine around the twine pulley, often led to the twine becoming jammed in the pulley and not feeding into the bale chamber. When plastic twine was wrapped half a turn around the pulley (as advised for sisal twine) jamming did not occur. In this case, the twine pulley occasionally did not stop immediately and caused the indicator light on the monitor to continue flashing for a few seconds after wrapping was completed.

EASE OF ADJUSTMENT

Forming Belts: Ease of relieving belt tension for servicing was excellent. Belt tension was relieved by turning the belt tension valve two complete turns counter clockwise. Typical of most balers, crop occasionally wrapped around the forming belt rollers of the Hesston 560. Relieving the forming belt tension aided in the removal of crop wrapped around the rollers. Belt tension was preset at the factory and could not be adjusted. The forming belts were easily replaced without disassembly of the baler. During the evaluation, a belt inverted and it was necessary to remove and rethread the belt. Removal of the lacing pin was difficult. Once removed, rethreading the belt was simple and took one person about 15 minutes.

Pickup: Ease of adjusting the pickup was good. A hand crank was provided to lower and raise the pickup to the desired position. The

operator was required to visually check the operating position of the pickup each time the pickup was lowered from its transport position. A more convenient design might include a locating device used to provide repeatability in setting the operating position of the pickup. This would permit the operator to adjust the pickup operating position only when necessary and allow the pickup to be quickly lowered for field operation without having to ensure it is at the proper height for operation at each field.

During the test a large portion of the pickup teeth broke and required replacing. Pickup floatation and the addition of a gauge wheel might help "ride" the pickup over uneven terrain and reduce the number of broken pickup teeth.

It is recommended that the manufacturer consider modifications to the pickup assembly to improve floatation and the ease of adjusting its operating position.

Bale Size and Density: Ease of adjusting bale size and density was excellent. Bale size was adjusted by setting the bale size selector knob to the desired size on the scale. The scale proved to be inaccurate for diameters over 5 ft (1.5 m). When the linkage from the bale tension arm crossed the actuator on the selector knob, an alarm on the monitor was triggered. This alerted the operator that the preselected size had been reached and the bale was ready to be wrapped with twine. The bale size indicator and selector knob were located on the front, right side of the baler and were visible from the operator's seat.

The Hesston 560 was equipped with an overflow protection mechanism linked to the pickup. If the bale became too large in the chamber, a declutching rod released the tension on the pickup drive belt.

Bale density was controlled by two bale tension rollers (FIGURE 1). As the bale grew, it pushed up on these rollers. The rollers were mounted to a tension arm. The self-contained hydraulic system provided resistance to tension arm rotation which in turn provided pressure to the forming bale. The bale density was controlled by adjusting the relief valve pressure setting. Turning the control knob clockwise increased the bale pressure.

Twine Wrap Settings: Ease of adjusting the bale twine wrap settings was very good. The number of twine wraps around the bale was governed by a twine orifice valve. This valve controlled the speed that the twine arm moved across the width of the bale. Rotating the valve clockwise decreased the twine arm speed which increased the number of twine wraps. Trial and error was necessary to set the valve properly for the desired number of wraps.

The distance between the end wraps of twine and the end of the bale could be adjusted by moving the twine guide rods in or out. Generally, a distance of 6 in (150 mm) was appropriate for most crops and operator preferences. This adjustment took one person about fifteen minutes. Twine tension was adjustable and did not create any problems with the twine wrapping system.

Lubricating: Ease of lubricating the Hesston 560 was good. It had 5 drive chains, 32 grease fittings, one gearbox, and one hydraulic oil reservoir. The operator's manual recommended lubricating the roller drive chains every 8 hours, servicing 14 grease fittings every 20 hours, 11 grease fittings every 50 hours, and two grease fittings once per season. Five grease fittings were omitted from the manual. These included one on each ejector arm pivot, one on each driving light sensor and one on the pickup lift crank. The gearbox plug was difficult to access for servicing. Complete daily servicing took one person about 20 minutes.

POWER CONSUMPTION

Power Requirements: FIGURE 7 shows typical PTO and drawbar power requirements for the Hesston 560 at a workrate of 12.2 ton/h (11.1 t/h) and 14.2 ton/h (12.9 t/h) for a high and low density bale respectively. The power input is plotted against the bale weight to show the power requirements while each bale is formed. The curves are an average of the highly fluctuating measured PTO data which varied from 12 to 16 hp (9 to 12 kW) at no load to a maximum of 37 hp (28 kW) in alfalfa for full sized bales. Drawbar requirements at 5.5 mph (9 km/h) were about 3.5 hp (2.6 kW) and 4.0 hp (3.0 kW) when the bale reached full size for low density and high density bales respectively. Although maximum horsepower requirements did not exceed 41 hp (31 kW), additional power was required to suit other field conditions such as soft and hilly fields. To fully utilize baler capacity, PAMI recommends a

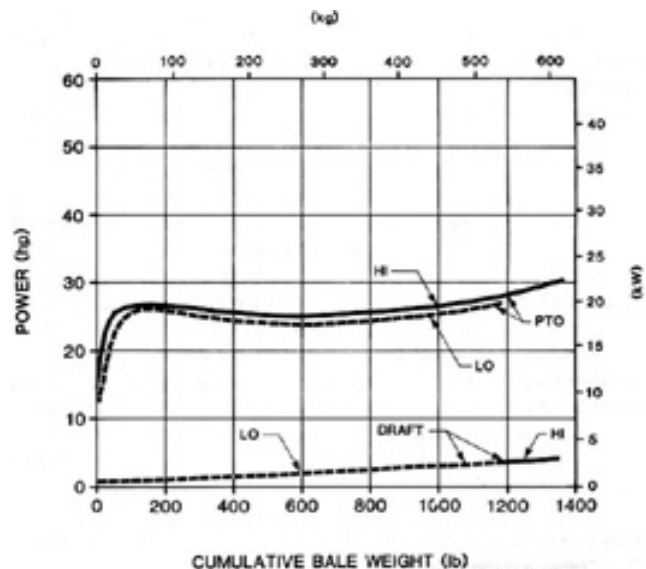


FIGURE 7. Typical Power Consumption During Bale Formation in Alfalfa (HI) High Density Bale, (LO) Low Density Bale.

tractor of at least 65 hp (49 kW) in order to have sufficient power reserve in all field conditions.

Specific Capacity: Specific capacity is a measure of how efficiently a machine performs a task. A large specific capacity indicates efficient energy use. The specific capacity of the Hesston 560 was 0.44 ton/hp-h (0.54 t/kW-h) in alfalfa at an instantaneous workrate of 13.0 ton/h (11.8 t/h) with the baler set at its highest density. A low density setting gave a specific capacity of 0.57 ton/hp-h (0.70 t/kW-h) in alfalfa at an instantaneous workrate of 14.6 ton/h (13.3 t/h). This specific capacity was greatly influenced by workrate. The typical range of specific capacities for small square balers in alfalfa is 0.6 to 1.2 ton/hp-h (0.7 to 1.4 t/kW-h).

OPERATOR SAFETY

Overall operator safety of the Hesston was very good if normal safety precautions were observed. The operator is cautioned that a round baler is potentially a very dangerous farm implement. The operator must disengage the PTO and stop the tractor engine before clearing blockages or making adjustments. Many serious and fatal accidents have occurred with round balers. Most of these are caused by operators dismounting from the tractor while leaving the baler running.

The Hesston 560 was safe to operate and service as long as common sense was used and the manufacturer's safety recommendations were followed. Rotating parts were well shielded. The pickup and feeding area were well guarded to discourage operators from attempting to clear blockages with the baler in operation. The safety shields were conveniently hinged so they did not have to be completely removed. Safety decals were prominently displayed at hazardous locations on the baler.

A tailgate safety switch provided safe servicing when working around the baler with the tailgate in a raised position. This switch deactivated the tailgate control switch on the monitor to prevent anyone inside the tractor from lowering the tailgate. A slow moving vehicle sign was provided with the baler. Optional safety equipment included a warning light kit for safe transporting on roads and highways and a fire extinguisher kit.

OPERATOR'S MANUAL

The operator's manual was very good. The manual was well written and clearly illustrated. It contained useful information on warranty, operation, servicing, adjustments, optional equipment and safety procedures.

MECHANICAL HISTORY

The Hesston 560 was operated for 190 hours while baling 2226 bales. The intent of the test was an evaluation of functional performance

and an extended durability evaluation was not conducted. TABLE 3 outlines those problems which occurred during functional testing.

DISCUSSION OF MECHANICAL PROBLEMS

Twine Guard Rod: The twine guard rod broke when a hard object entered the pickup. A new one was fabricated and mounted in place. No further problems occurred. Mounting the new twine guard took one person about 15 minutes.

Electronic Sensor: Twine slipped off the twine pulley, wrapped around the twine feeding sensor and broke it off. It was repaired with a new one supplied by the manufacturer. The repair took one person about 15 minutes.

Belt Lacing Pin: A belt lacing pin broke which caused a forming belt to separate. The failure was attributed to normal splice wear. The forming belt was rethreaded and spliced with a new lacing pin. One person repaired this in about 15 minutes.

Shear Pins: Occasionally a twine arm shear pin broke. Obstructions in the pickup jammed the twine arm as it moved across the front of the baler and broke the shear pin. The shear pin was easily replaced by one person in about 5 minutes.

Pickup Teeth: Approximately 75% of the pickup teeth broke and were replaced throughout the test. The manufacturer claims to have redesigned the pickup tine and tine mounting system on current production models. Improving pickup floatation to ride easier over rough terrain might also improve the problem.

Forming Belts: The forming belts were punctured periodically. This was attributed to the pickup throwing stones between the starting roller and forming belts. The starting roller jammed the stone against the forming belts.

TABLE 3. Mechanical History

| Item | Operating Hours | Equivalent Field Area ac (ac) | |
|--|-----------------|----------------------------------|-------|
| Twine guide rod broke and replaced at: | 105 | 635 | (254) |
| Electronic twine feeding sensor broke and replaced at: | 130 | 735 | (294) |
| Belt lacing pin broke and replaced at: | 132 | 755 | (302) |
| Several twine arm shear pins broke and were replaced: | | Throughout the evaluation | |
| Forming belts punctured: | | Throughout the evaluation | |
| Pickup teeth replaced: | | Throughout the evaluation | |

APPENDIX I

SPECIFICATIONS

| | | |
|------------------------------------|-----------------------------|-----------|
| MAKE: | Hesston | |
| MODEL: | 560 | |
| SERIAL NUMBER: | R560-00892 | |
| DIMENSIONS: | | |
| - width | 9.2 ft (2.8 m) | |
| - height | 9.4 ft (2.9 m) | |
| - length | 13.3 ft (4.0 m) | |
| - ground clearance | 6 in (150 mm) | |
| TIRES: | Two, 31 x 13.50 - 15NHS | |
| WEIGHT: | | |
| - left wheel | 2434 lb | (1104 kg) |
| - right wheel | 2456 lb | (1114 kg) |
| - hitch point | 944 lb | (428 kg) |
| TOTAL: | 5834 lb | (2646 kg) |
| BALE CHAMBER: | | |
| - width | 5.1 ft (1.6 m) | |
| - maximum diameter | 6.2 ft (1.9 m) | |
| - bale density control | Self contained hydraulics | |
| - bale peripheral speed at 540 rpm | 5.6 mph (9.0 km/h) | |
| FORMING BELTS: | | |
| - number of belts | Eight | |
| - belt width | 7.0 & 6.5 in (178 & 165 mm) | |
| - thickness | 3/16 in (5 mm) | |
| - spacing (centre to centre) | 7.5 in (191 mm) | |

| | |
|-------------------------------|------------------------|
| - belt speed (at 540 PTO rpm) | 490 ft/min (150 m/min) |
| - belt length | 47.5 ft (14.5 m) |

ROLLERS:

| | |
|-------------------------|------------------|
| Driving Rollers: | |
| - number | Two |
| - roller surface | Crowned Rubber |
| - length | 5.0 ft (1.5 m) |
| - minimum diameter | 7 in (178 mm) |
| - maximum diameter | 7.25 in (184 mm) |
| - speed | 260 rpm |

Starting Roller:

| | |
|------------------|------------------------------|
| - roller surface | Steel with four rubber flaps |
| - length | 5.0 ft (1.5 m) |
| - diameter | 5.5 in (140 mm) |
| - speed | 332 rpm |

PICKUP:

| | |
|--------------------------------|---|
| - type | cylindrical drum with spring teeth hand crank |
| - height adjustment | 5.1 ft (1.55 m) |
| - width | 10.5 in (267 mm) |
| - diameter | four, 12 double teeth per bar |
| - number of tooth bars | 125 rpm |
| - speed | 7.4 mph (11.9 km/h) |
| - tooth tip speed (at 540 rpm) | |

TWINE SYSTEM:

| | |
|---------------------|---|
| - capacity | 4 balls |
| - type | automatic hydraulic wrap with manual override |
| - recommended twine | sisal or plastic |
| - twine feed | automatic single twine arm |
| - twine cutter | pivoting knife against twine |

DRIVES:

| | |
|--------------------------------------|------|
| - number of belt drives | two |
| - number of chain drives | five |
| - number of gear drives | two |
| - number of universal joints | one |
| - number of constant velocity joints | one |

SAFETY DEVICES:

| | |
|---|--|
| - main drive slip clutch | |
| - overflow clutch, disengages pickup when chamber is overloaded | |
| - shear bolts on twine arm and bale ejector | |
| - tailgate down indicator | |
| - hinged safety shields | |
| - tailgate lockout switch | |

SERVICING:

| | | | |
|--------------|-------------------------------------|--------------|-----------------|
| | <u>20hr</u> | <u>50 hr</u> | <u>Annually</u> |
| - grease | 14 | 11 | 2 |
| - oil chains | every 8 hours | | |
| - gearbox | check oil level routinely | | |
| - hydraulic | check oil reservoir level routinely | | |

TRACTOR HOOKUP:

| | |
|----------------|---------------------------------------|
| - connections | PTO electrical connection for monitor |
| - hitch height | 13.5 to 29 in (343 to 737 mm) |

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

| | |
|-----------|----------------|
| Excellent | Fair |
| Very Good | Poor |
| Good | Unsatisfactory |

SUMMARY CHART

HESSTON 560 ROUND BALER

| | |
|----------------------------|--|
| RETAIL PRICE: | \$22,638.00 (f.o.b. Portage la Prairie, MB) with floatation tires anti gathering wneels |
| RATE OF WORK: | 4.3 ton/h (3.9 t/h) in mixed grasses to 13.3 ton/h (12.1 t/h) in alfalfa |
| QUALITY OF WORK: | |
| Bale Quality | Excellent; tight wrap |
| Weatherability | Very Good; about 1/4 in (6 mm) spoilage |
| Leaf Loss | Very Good; 1.0 to 3.2% in 15% moisture alfalfa |
| EASE OF OPERATION: | |
| Bale Forming | Very Good; follow monitor direction lights |
| Feeding | Excellent; positive and aggressive in all crops |
| Twine Wrapping | Very Good; automatic |
| Bale Discharging | Excellent; automatic |
| Transporting | Good; easy to manoeuvre, poor rear visibility |
| Hitching | Very Good; convenient |
| Twine Threading | Excellent; no mechanical aids required |
| EASE OF ADJUSTMENT: | |
| Forming Belts | Excellent; easily replaced |
| Pickup | Good; required adjustment at each field |
| Bale Size and Density | Excellent; fast simple adjustments |
| Twine Wrap Settings | Very Good; variable adjustments |
| Lubrication | Good; about 20 minutes for daily service |
| POWER CONSUMPTION: | |
| Power Requirements | A 65 hp (49 kW) tractor has sufficient reserve for most field conditions |
| Specific Capacity | 0.44 ton/hp-h (0.54 t/kW-h) at a work rate of 13.0 ton/h (11.8 t/h) |
| OPERATOR SAFETY: | Very Good; well shielded and visible decals. |
| OPERATOR'S MANUAL: | Very Good; well written |
| MECHANICAL HISTORY: | Twine guide rod broke, an electronic twine feeding sensor broke, belt lacing pin broke, several pickup teeth broke, and forming belts punctured throughout the test. |



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