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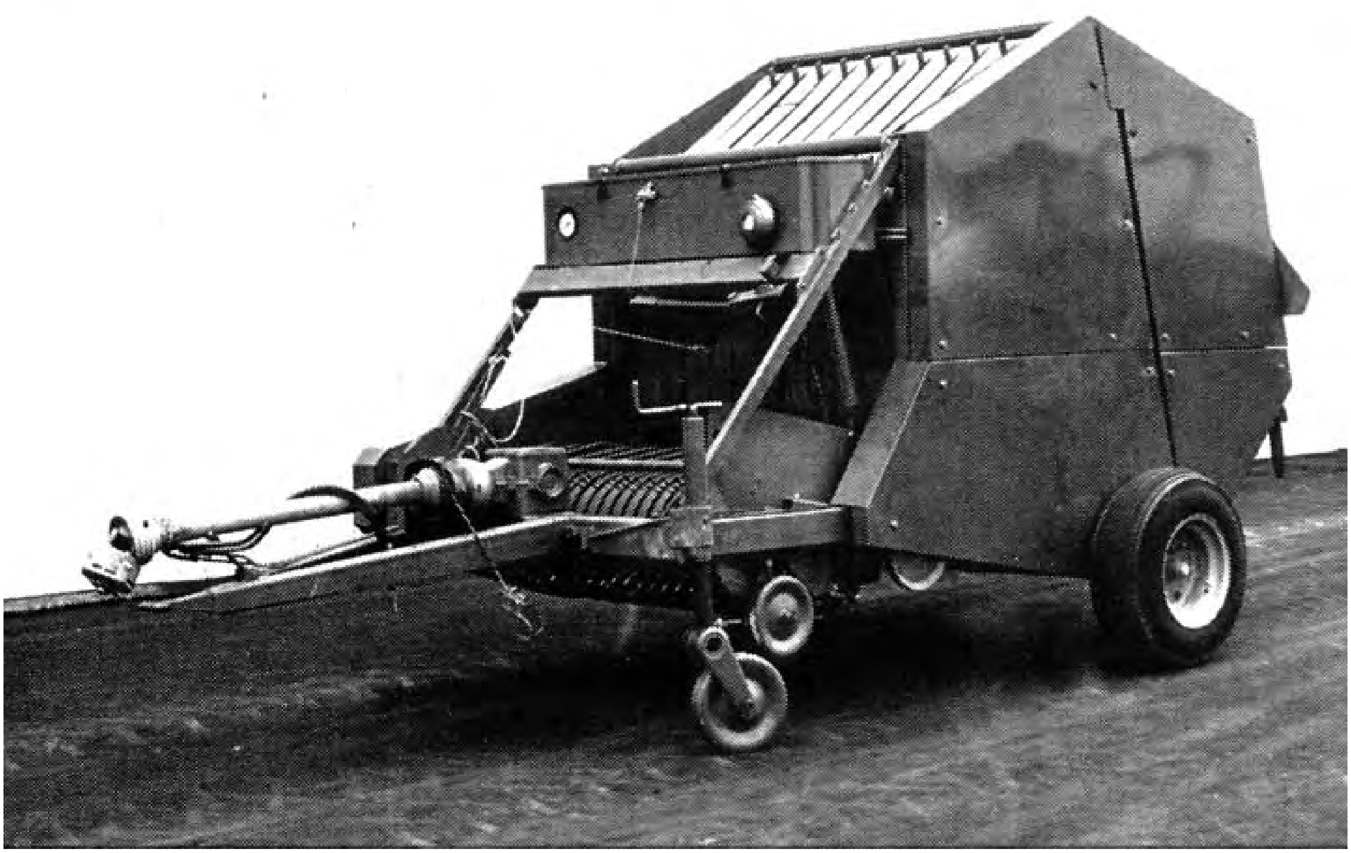
Evaluation Report 19



McKee Model 1500 Round Baler

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

McKee Model 1500 Round Baler

Manufacturer:
McKee Bros. Limited
P.O. Box 70
Elmira, Ontario
N3B 2Z9

Distributors:
Saskatchewan
-Farmland Sales Ltd., Regina
Alberta
-Wheat-Belt Industries Ltd., Calgary
-Br. McKee Harvester (Alberta) Ltd., Red Deer
Manitoba
Yetman's Ltd., Winnipeg

Retail Price:
$7500.00 (May, 1977, f.o.b. Humboldt)

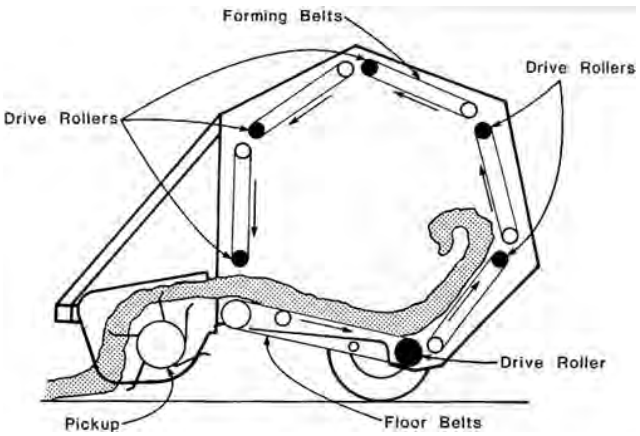


Figure 1. Schematic View of McKee 1500 Round Baler.

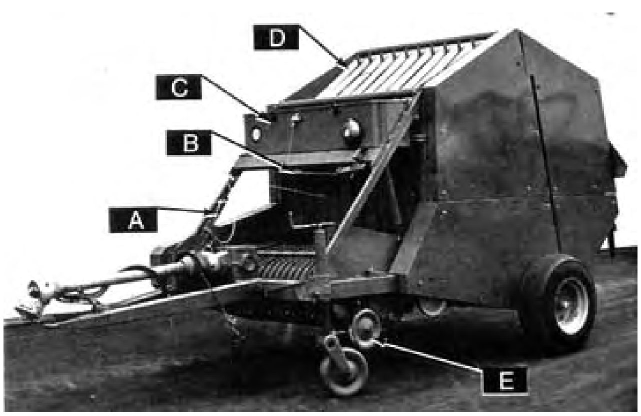


Figure 2. Front View of McKee 1500 Round Baler. Identification of components: (A) Pickup Transport Lever, (B) Twine Mechanism, (C) Twine Box, (D) Forming Belts, (E) Gauge Wheel.

Figure 3. Rear View of McKee 1500 Round Baler. Identification of components: (F) Forming Belts, (G) Pickup Transport Lever.

Summary and Conclusions

Overall functional performance of the McKee 1500 round baler was very good in most crops. Ease of operation and adjustment both were very good. Operation of the twine wrapping mechanism was good.

Average field speeds varied from 8 to 11 km/h (5.0 to 6.9 mph) while average throughputs varied from 6.9 to 12.3 t/h (7.6 to 13.5 ton/h). Ground speed was usually limited by pickup loss and not by baler capacity. Feeding was aggressive in all crops except in very heavy windrows where capacity was limited by occasional plugging at the pickup compression bars.

Bales were well formed and neat in appearance. The McKee 1500 produced bales with an average length of 1.5 m (59 in) and an average diameter of 2 m (78 in). Hay bales weighed from 760 to 840 kg (1680 to 1850 lb) with an average density of 173 kg/m^3 (10.8 lb/ft^3). Peak power take-off requirements were about 45 kW (60 hp) in hay and 40 kW (53 hp) in straw.

Leaf loss was comparable to that of other large round balers. In heavy windrows, at optimum moisture content, bale chamber loss was less than 5% while in light, dry alfalfa, average bale chamber loss was 10% and pickup loss was 7%. Heavy windrows, proper conditioning and baling at the maximum permissible moisture content all were important in reducing bale chamber loss.

The McKee 1500 was safe to operate if normal safety procedures were closely followed. The absence of gate cylinder locks created a safety hazard while servicing.

Recommendations

It is recommended that the manufacturer consider:

1. Modifications to prevent failure of the pickup wheel mounting assembly, to eliminate interference of the frame and pickup wheel mount bracket and to prevent the pickup wheel assembly from pivoting forward when backing the baler.
2. Modifications to prevent the twine tie rope from jamming between the pulley and the rope retaining bracket.
3. Strengthening the compression bar limiting arm and restricting its upward travel to improve feeding in heavy windrows.
4. Extending the pickup compression bars to improve feeding in heavy windrows.
5. Supplying a Slow Moving Vehicle sign as standard equipment.
6. Installing gate cylinder locks to improve operator safety.
7. Providing lubrication holes in the chain shields to aid in servicing.
8. Supplying a suitable operator's manual.

Chief Engineer -- E. O. Nyborg
Senior Engineer -- L. G. Smith
Project Technologist -- D. H. Kelly

The Manufacturer States That

With regard to recommendation number:

1. The pickup wheel assembly has been completely redesigned and is now attached with two bolts.
2. The pulley bracket has been redesigned to eliminate this problem.
3. This is under active consideration.
4. This is under active consideration.
5. An SMV sign bracket is now supplied as standard equipment.
6. Gate cylinder locks are now provided on all Model 1500 balers.
7. Shields have been modified to include lubrication access holes.
8. A new operator's manual is supplied with all balers.

General Description

The McKee 1500 is a pull-type, power take-off driven baler with a cylindrical baling chamber and a floating drum pickup. The twine wrapping mechanism is manually actuated.

Hay is fed directly into the baling chamber by the pickup. The baling chamber consists of five 280 mm (11 in) wide floor belts on the bottom and five sets of forming belts on the top. Each set contains eleven 120 mm (4.7 in) wide belts. The baling chamber has a fixed volume, with all belts rotating in a fixed location. As a result, the McKee 1500 produces bales with a low density core.

Detailed specifications are given in Appendix I while Figures 1 to 3 show the location of major components.

Scope of Test

The McKee 1500 was operated at 540 rpm with a David Brown 1412 tractor in the conditions shown in Table 1 for 43 hours while baling about 183 ha (453 ac). It was evaluated for rate of work, quality of work, power consumption, ease of operation, ease of adjustment, operator safety and suitability of the operator's manual.

Table 1. Operating Conditions

Crop	Crop Yield Range		Hours	Average Speed		Area Baled		Average Throughput	
	t/ha	ton/ac		km/h	mph	ha	ac	t/h	ton/h
Alfalfa, Bromegrass & Crested Wheat-grass	1.0 - 4.0	0.5 - 1.8	16.7	9.0	5.6	56	139	9.8	10.8
Alfalfa	0.5 - 5.0	0.2 - 2.0	0.3	8.0	5.0	1	2	9.5	10.5
Wheat Straw	1.0 - 2.0	0.4 - 9.0	5.0	9.5	6.0	22	55	7.7	8.5
Wheat & Oat Straw mixture	2.0	0.9	6.0	11.0	6.8	30	74	10.1	11.1
Wheat & Barley Straw mixture	1.5	0.7	10.0	9.5	6.0	45	111	6.9	7.6
Oat & Sweet Clover Straw mixture	2.0	0.9	4.0	11.0	6.8	20	49	10.1	11.1
Flax Straw	1.3	0.6	1.0	10.0	6.2	9	23	12.3	13.5
Total			43.0			183	453		

Results and Discussion

RATE OF WORK

Average throughputs for the McKee 1500 (Table 1) varied from 6.9 t/h (7.6 ton/h) in a wheat and barley straw mixture to 12.3 t/h (13.5 ton/h) in flax straw that had been cut with a 9100 mm (30 ft) windrower. In heavy, uniform alfalfa, continuous workrates of about 13 t/h (14 ton/h) were possible and a bale could be formed in about three minutes. In addition it took about one minute to wrap the bale with twine and eject it.

In nearly all crops, the maximum workrate was limited by pickup performance except in very heavy windrows where capacity was limited by the bale chamber. Pickup loss usually limited ground speed to a range of 8 to 11 km/h (5.0 to 6.8 mph). A heavy windrow was desirable to fully utilize baler capacity.

Feeding was aggressive in all crops except in very heavy windrows where capacity was reduced by occasional plugging at the pickup compression bars.

QUALITY OF WORK

Bale Quality: The McKee 1500 produced fairly firm, durable bales (Figure 4) with flat ends and uniform diameter. Bales averaged 1.5 m (59 in) in length and 2 m (78 in) in diameter. Average hay bales weighed from 760 to 840 kg (1680 to 1850 lb) with an average density of 173 kg/m³ (10.8 lb/ft³). Density at the outer diameter was about double that at the centre of the bale.

Due to the low density bale core, bales settled somewhat and flattened during storage. As a result, these bales were slightly more difficult to pick, with some bale handlers, than higher density bales.

Figure 4. Typical Bales Formed by the McKee 1500.

Leaf Loss: Total leaf loss for the McKee 1500 varied from less than 5% in ideal windrows to 17% in light dry windrows.

In a field of 4.5 t/ha (2 ton/ac) alfalfa which had been cut with a 5500 mm (18 ft) windrower but which had not been conditioned, bale chamber losses were less than 5%. In this case, the windrow was heavy enough to fully utilize the capacity of the baler.

In another field of 1.2 t/ha (0.5 ton/ac) second cut alfalfa, which had also been cut with a 5500 mm (18 ft) windrower, average pickup loss was 7% while average bale chamber loss was 10.0%. The hay had not been conditioned and due to drying conditions in late August, the stalks were at a moisture content, which would just permit storage while the leaves were quite dry and brittle.

Bale chamber loss in a round baler depends on how long the bale is in the bale chamber. In the 1.2 t/ha (0.5 ton/ac) alfalfa crop it took about 15 minutes to form a bale while in the 4.5 t/ha (2 ton/ac) crop, a bale could be formed in about three minutes.

Research has shown that to minimize bale chamber losses with a round baler, windrows should be as heavy as possible, the hay should be conditioned to aid in stalk curing and moisture content should be at the maximum level which permits safe storage. Feedrate should also be as high as possible to minimize time in the baling chamber. It is often more economical to allow some pickup loss, by driving too fast, as the total loss level will be reduced due to a decreased bale chamber loss. Under ideal conditions, bale chamber loss may be as low as 0.5%. Bale chamber losses in light crops can also be reduced by running the tractor at a lower power take-off speed and in a higher gear to maintain proper ground speed. This results in fewer turns to form a bale. Power take-off speed must, however, be fast enough for satisfactory pickup performance.

Loss characteristics of small square balers are quite different. For square balers, bale chamber loss varies from about 2 to 5% regardless of windrow size or moisture content. With a large round baler losses depend on how long a bale stays in the baling chamber since the hay is in constant agitation while the bale is being formed.

POWER CONSUMPTION

Power Take-Off Requirements: Figure 5 shows the power take-off input for the McKee 1500 in alfalfa and in wheat straw. The power input is plotted against bale weight to show the power requirements as a bale is being formed. The power input varied from 2 kW (3 hp) at no load to a maximum of 45 kW (60 hp) in alfalfa and 40 kW (53 hp) in wheat straw. Maximum power requirements for the McKee 1500 were about twice as large as those for round balers with spring loaded forming belts or apron chains, which adjust their position during bale formation.

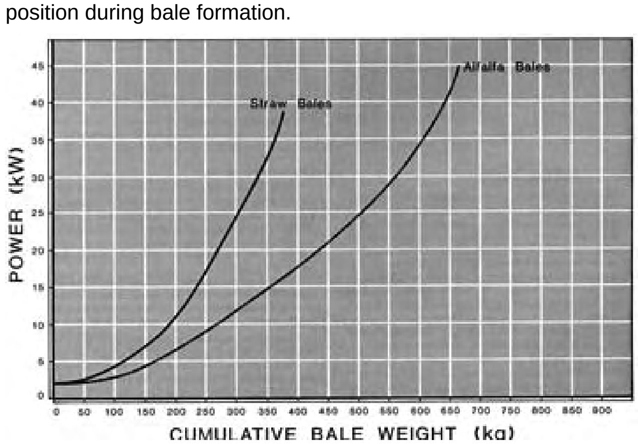


Figure 5. Power Consumption of the McKee 1500 During Bale Formation.

Specific Capacity: The specific capacity is a measure of how efficiently a machine performs a task. A high specific capacity indicates efficient energy use while a low specific capacity indicates inefficient operation. The specific capacity of the McKee 1500 was about 0.41 t/kW•h (0.34 ton/hp•h) in alfalfa and 0.36 t/kW•h (0.30 ton/hp•h) in wheat straw. This compares to an average specific capacity of 0.98 to 1.45 t/kW•h (0.8 to 1.2 ton/hp•h) for small square balers in alfalfa. These values represent average operating speeds in average field conditions and not peak outputs.

EASE OF OPERATION

Forming a Bale: It was very easy to form a neat bale with the

McKee 1500. Since the bale chamber on the McKee 1500 is a fixed diameter, feeding hay across the entire width of the bale chamber, during bale core formation, was not as critical as with conventional round balers. During core formation, hay tumbled within the bale chamber distributing itself quite evenly across the chamber. Weaving the baler slightly, back and forth across the windrow, was needed in the later stages of bale formation, since the hay was less likely to distribute itself when the bale chamber was full.

Occasionally, in very heavy windrows, if a large wad of hay entered the baling chamber, just when beginning to form a bale the hay would not begin to tumble and distribute itself uniformly. This problem could be prevented by reducing ground speed when starting a bale.

Figure 6 illustrates bale formation in the McKee 1500.

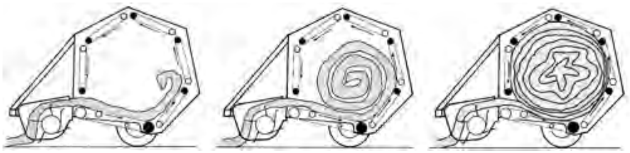


Figure 6. Power Consumption of the McKee 1500 During Bale Formation. Figure 6. Stages of Bale Formation. (Left) Bale Core, (Centre) Half Completed Bale, (Right) Completed Bale.

Wrapping the Twine: A hydraulic pressure gauge at the front of the baler shows when the bale is full size and ready for twine wrapping. The twine tube is controlled from the tractor with a rope.

To start wrapping, the twine tube is pulled to the right of the bale chamber. Once the twine has been caught by the hay entering the bale chamber, the operator stops tractor forward travel but allows the power take-off to run. When the twine has made at least one full wrap around the right end of the bale, the operator slowly releases the rope allowing a return spring to pull the twine tube across the front of the bale chamber. The rate at which the rope is released determines the number of wraps around the bale. When the twine tube reaches the left side of the bale, the operator momentarily holds the rope so there is at least one complete twine wrap around the left bale end. The operator then pulls sharply on the rope and releases it. This permits the return spring to snap the twine tube into cut position and the twine is cut by a set of knives.

The twine tie rope occasionally jammed between the rope pulley and rope retaining bracket. A modified retaining bracket is needed to prevent this problem.

Twine consumption for the McKee 1500 was about 62 m/t (185 ft/ton). This compares to a twine consumption of about 225 m/t (670 ft/ton) for small square balers.

Discharging a Bale: Once the twine is cut, the power take-off is shut off and the tractor and baler are backed up about 6 m (20 ft). The rear gate is hydraulically opened and the power take off is engaged, with the tractor at idle, to eject the bale. The tractor and baler are then moved ahead about 4.5 m (15 ft) and the rear gate closed. A slight pressure is required on the gate hydraulic cylinders to ensure that the gate is fully closed. About one minute was needed to wrap and discharge the bale.

Transporting: The McKee 1500 was easy to manoeuvre and transport. Ground clearance was adequate and there was ample hitch clearance for turning sharp corners. The baler could easily be towed behind a tractor or a small truck.

Hitching: The McKee 1500 was easy to hitch to a tractor. If the tractor was equipped with a cab it was sometimes difficult to find a suitable place for the twine tie rope to enter the cab and have the rope completely operative.

Feeding: Feeding was positive and aggressive in nearly all crops with only infrequent plugging. In very heavy windrows, wads of hay occasionally caused the floating pickup compression bars to raise higher than the top of the bale chamber opening. If this happened, hay fed up the front of the forming belts rather than into the bale chamber (Figure 7). Two minor modifications greatly reduced this problem: The allowable upward movement of the pickup compression bars was reduced and the compression bar limiting arm was strengthened. Extending the pickup compression bars to minimize the distance between the compression bars and the bale chamber opening is also recommended to improve feeding.

Twine Threading: Twine threading was quite easy. Twine could be threaded without the use of a wire or additional aids.

Figure 7. Plugging in Heavy Windrows Due to Excessive Lift of Compression Bars.

The twine cutter performed well. No adjustment was needed during the test.

EASE OF ADJUSTMENT

Forming Belts: The forming belts on the McKee 1500 rotate in a fixed location and do not reposition themselves during bale formation. The forming belts are not adjustable. The forming belts are chain driven through five separate drive rollers. The drive chains all used spring loaded chain tighteners, which needed no adjustment.

Platform Belts: The platform belts on the McKee 1500 also rotated in a fixed position and were not adjustable. The rear platform belt roller was chain driven and used a spring loaded tightener, which needed no adjustment.

Pickup: Pickup flotation was provided by a pickup gauge wheel, which was assisted by an adjustable flotation spring. The gauge wheel was adjusted to give about 25 mm (1 in) clearance between the ground and the pickup teeth. The flotation spring was adjusted to carry as much weight as possible without excessive pickup bounce. The pickup also used a hydraulic shock absorber to reduce bounce and to decrease shock loads on rough ground. The pickup drive chain had a manually adjusted tightener, which needed no adjustment during the test.

The pickup gauge wheel mounting bracket was modified by the manufacturer to eliminate interference between the bracket and the baler frame when the pickup was in transport position. Because of this alteration, it was not possible to raise the pickup to its maximum ground clearance position. The pickup gauge wheel was also secured by only one bolt. When the baler was backed up, the wheel pivoted about the attaching bolt making it necessary to reposition the wheel manually before baling could be resumed. Repeated failures of the pickup gauge wheel mounting assembly occurred during the test. Modification to the pickup gauge wheel assembly to eliminate these problems is required.

The pickup compression bar pivot point was adjustable with the option of two positions. With minor alterations during the test, the compression bar flotation limit was also made adjustable. Limiting the maximum lift of the compression bars improved feeding in heavy windrows.

The pickup tooth pattern was circular at the front but employed cam action for tooth retraction at the rear. No adjustment of tooth pattern was possible.

Servicing: The McKee 1500 had seven chain drives, four grease fittings and one gearbox. The manufacturer recommended daily chain oiling, weekly lubrication of all grease fittings and checking gearbox level and repacking wheel bearings every season.

About 30 minutes were needed to service the McKee 1500. All the chains were enclosed with shields, which had to be removed for servicing. Installation of oiling holes in the shields, to increase ease of servicing, is recommended.

OPERATOR SAFETY

The McKee 1500 was safe to operate, and service as long as common sense was used and the manufacturer's safety recommendations were followed. Rotating parts were very well shielded.

The McKee 1500 was not equipped with a Slow Moving Vehicle sign or mounting bracket. Since these are required by law in many parts of Canada a Slow Moving Vehicle sign should be supplied.

The McKee 1500 did not have rear gate cylinder locks. Working on the inside of the bale chamber with the rear gate open and no locks in place is a definite hazard and should not be attempted. It is recommended that the manufacturer install cylinder locks to improve operator safety.

GENERAL SAFETY COMMENTS

The operator is cautioned that a round baler is potentially very dangerous. The operator must disengage the power take-off and stop the tractor engine to clear blockages or to make 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 manufacturer can only go to certain limits in providing shielding and safety devices and must rely on the operator's common sense in following established safety procedures.

OPERATOR'S MANUAL

The McKee 1500 used during the test was new to the North American market and the operator's manual was in preparation. No assessment of the operator's manual could be made.

Durability Results

Table 2 outlines the mechanical history of the McKee 1500 during 43 hours of field operation while baling about 183 ha (453 ac). The intent of the test was functional evaluation. The following failures represent only those, which occurred during functional testing. An extended durability evaluation was not conducted.

Table 2. Mechanical History

Item	Hours
Pickup Assembly	
-The pickup pivot mount bolt loosened and was replaced at	11
-The pickup gauge wheel mounting bracket bent and was straightened at	21 and 43
-Several pickup guards were bent by rocks and were straightened at	27
-The pickup gauge wheel mounting plate bolts sheered and were replaced at	27 and 33
Compression Bars	
-The compression bar movement limiting arm bent in a heavy windrow and was straightened at	21, 33 and 37

Discussion of Mechanical Problems

Pickup Gauge Wheel Assembly: The wheel mounting bracket bent several times, and the bracket mounting plate bolts sheered twice. Since the pickup wheel was steel, the mounting assembly received large impact loads in rough fields. It is believed that the impact loads caused the bracket and bolt failures.

Compression Bars: The pickup compression bar movement limiting arm bent three times during the test. This occurred when feeding wads in very heavy windrows.

APPENDIX I
SPECIFICATIONS

Make:	McKee Model 1500 Round Baler
Serial Number:	1701.01.127
Overall Dimensions:	
-- Ground Clearance	254 mm (10 in)
-- Width	2409 mm (95 in)
-- Height	2430 mm (96 in)
-- Length	4650 mm (183 in)
Tires:	2, 11L x 15, 8-ply
Weight (with drawbar in field position and two bales of twine):	
-- Left wheel	694 kg (1530 lb)
-- Right wheel	712 kg (1570 lb)
-- Hitch point	334 kg (737 lb)
Total Weight	1740 kg (3837 lb)
Bale Chamber:	
-- Width	1495 mm (59 in)
-- Maximum diameter	1800 mm (71 in)
-- Floor Belts:	
-number of belts	5
-belt length	2626 mm (103 in)
-thickness	4 mm (0.16 in)
-belt speed	1.83 m/s (360 ft/min)
-- Forming Belts	
-number of belts	55
-belt width	120 mm (4.7 in)
-belt length	1880 mm (74 in)
-thickness	3 mm (0.12 in)
-spacing (centre to centre)	140 mm (5.5 in)
-belt speed	1.75 m/s (345 ft/min)
-- Bale Chamber Tension Method	Hydraulic
-- Bale Size Indicator	Pressure gauge
Pickup:	
-- Type	Floating drum with spring teeth
-- Height adjust	Gauge wheel
-- Width	1415 mm (56 in)
-- Number of tooth bars	5
-- Tooth spacing	72 mm (2.8 in)
-- Speed	65 rpm
-- Tooth pattern	Circular with cam actuated retraction
Twine System:	
-- Capacity	4 balls
-- Recommended twine thickness	151 m/kg (225 ft/lb)
-- Twine feed and cutter	Manual rope control
Safety Devices:	Adjustable power take-off slip clutch, hydraulic relief valve on rear gate.
Servicing:	
-- Grease fittings	4, weekly greasing
-- Gear boxes	1, seasonal
-- Chains	7, daily oiling
-- Wheel bearings	2, yearly

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

(a) excellent	(d) fair
(b) very good	(e) poor
(c) good	(f) unsatisfactory

APPENDIX III
METRIC UNITS

In keeping with the Canadian metric conversion program, this report has been prepared in SI units. For comparative purposes, the following conversion may be used:

1 hectare (ha)	= 2.47 acres (ac)
1 kilometre/hour (km/h)	= 0.62 miles/hour (mph)
1 tonne (t) = 2204.6 pounds (lb)	= 1.10 ton (ton)
1 tonne/hour (t/h)	= 1.10 ton/hour (ton/h)
1 tonne/hectare (t/ha)	= 0.45 ton/acre (ton/ac)
1000 millimetres (mm) = 1 metre (m)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.20 pounds (lb)
1 tonne/kilowatt hour (t/kW•h)	= 0.82 tons/horsepower hour (ton/hp•h)

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