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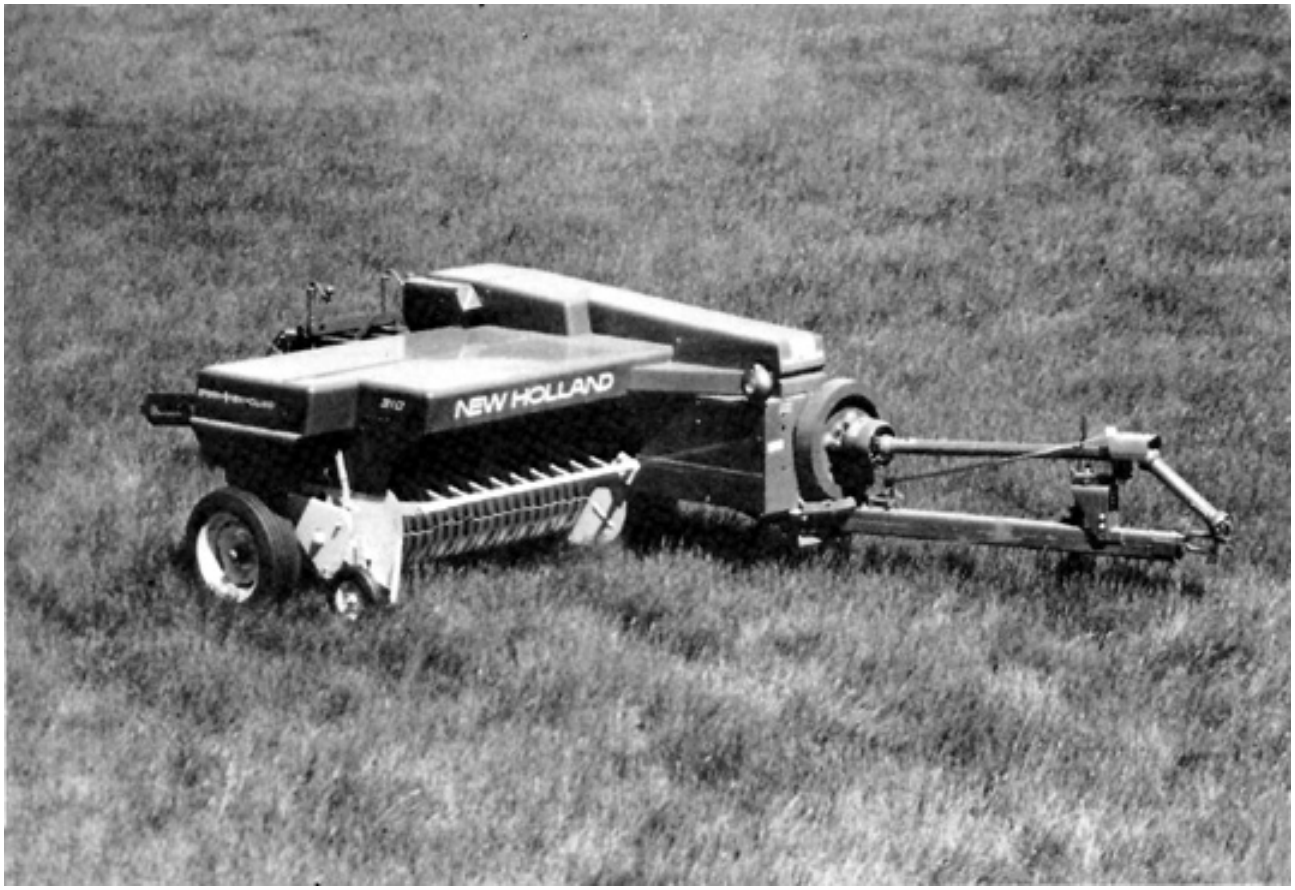
Evaluation Report 236



New Holland Model 310 Baler

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

NEW HOLLAND MODEL 310 BALER

MANUFACTURER:

Sperry New Holland
Division of Sperry Rand Corporation
New Holland, Pennsylvania 17557
U.S.A.

DISTRIBUTOR:

Sperry New Holland
Box 777, .Winnipeg, Manitoba R3C 2L4
Box 1907, Regina, Saskatchewan S4N 2S3
Box 1616, Calgary, Alberta T2P 2M7

RETAIL PRICE:

$7700.00 (July, 1981, f.o.b. Lethbridge, complete with quarter-turn bale chute and synthetic twine billhooks).

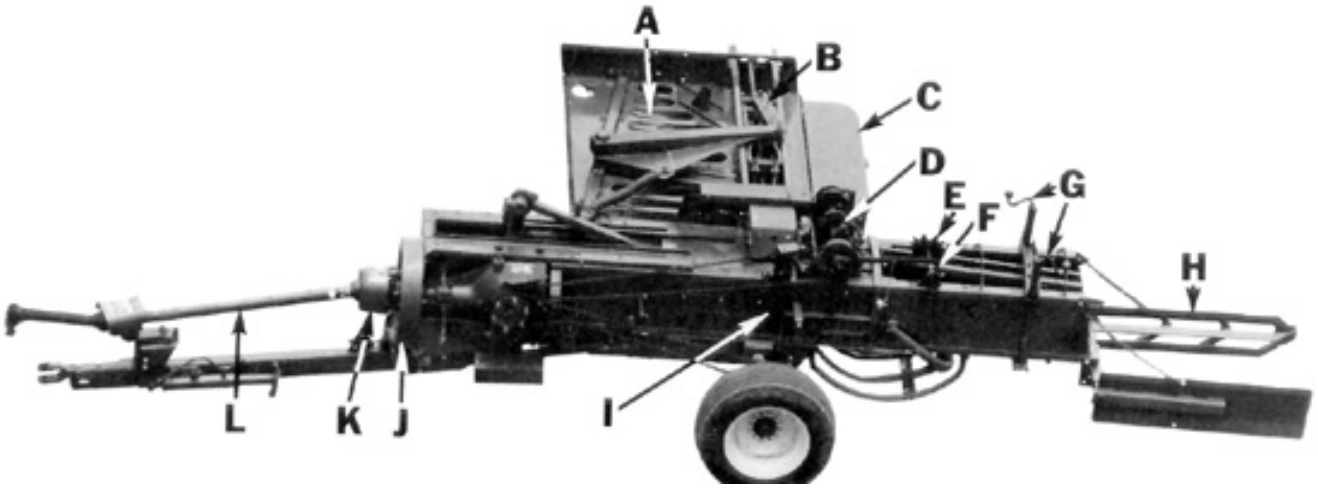


FIGURE 1. New Holland Model 310 Baler: (A) Pick Up, (B) Feeder Carriage, (C) Twine Box, (D) Knotters, (E) Metering Wheel, (F) Metering Arm, (G) Bale Density Adjustmen,t, (H) Quarter Turn Bale Chute, (I) Bale Chamber, (J) Flywheel, (K) Slip Clutch, (L) Power Shaft.

SUMMARY AND CONCLUSIONS

Overall functional performance of the New Holland 310 baler was *very good.*

Average feedrates varied from 2 to 8 t/h (2.2 to 8.8 ton/h). Field speeds were usually limited to 10 km/h (6.2 mph) due to bouncing on rough ground and reduced pickup performance at higher speeds. Maximum instantaneous feedrates in excess of 15 t/h (16.5 ton/h) were measured in heavy uniform alfalfa windrows. Feeding was aggressive in all crops.

The New Holland 310 was capable of producing firm, well formed bales. Length of the 356 x 457 mm (14 x 18 in) bales could be adjusted from 305 to 1320 mm (12 to 52 in). Bales length variation at the 1000 mm (39 in) length setting was about 100 mm (3.9 in). For a certain length setting, longer bales were usually produced at higher feedrates. Average hay bales weighed from 27 to 35 kg (59 to 77 lb), while average straw bales weighed from 18 to 22 kg (40 to 48 lb). Average bale density varied from 174 to 205 kg/m^3 (10.4 to 12.3 lb/ft^3) in hay and from 123 to 115 kg/m^3 (6.9 to 7.4 lb/ft^3) in straw.

The New Holland 310 was easy to operate and adjust. Knotter performance was very good with most twines when properly adjusted. The synthetic twine billhooks required only minor adjustments for use with sisal twine.

Average power requirements were usually less than 19 kW (25 hp) but a 40 kW (54 hp) tractor was needed to overcome power take-off fluctuations and provide sufficient power on hilly or soft fields.

Total leaf and stem loss was usually less than 3%, similar to that of other conventional square balers.

The New Holland 310 was safe to operate if the manufacturer's safety recommendations were closely followed and normal safety precautions were observed.

Several mechanical problems occurred during the test. The drive shaft slip clutch was adjusted slightly beyond the manufacturer's specifications to prevent excessive slippage. A plunger face extension bent, a twine needle broke, a bale chute chain support bracket failed and the bale chute frame cracked.

RECOMMENDATIONS:

It is recommended that the manufacturer consider:

1. Including adjustment instructions for the bale chute anti-bounce brake in the operator's manual.

Chief Engineer: E. O. Nyborg

Senior Engineer: E. H. Wiens

Project Engineer: R. K. Allam
Project Technologist: P. A. Bergen

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. We will be producing adjustment instructions for the bale chute anti-bounce brake in our operator's manual as new editions are printed.

NOTE: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX III.

GENERAL DESCRIPTION

The New Holland Model 310 is a pull-type, 540 rpm, power take-off driven, automatic twine tie baler. A floating drum pickup delivers hay to the feed chamber, where it is fed into the 356 x 457 mm (14 x 18 in) bale chamber by a reciprocating feeder carriage. Hay is compacted and bales formed by a slicing plunger operating at 75 strokes per minute.

FIGURE 1 shows the location of major components while detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The New Holland 310 was operated in a variety of crops (TABLE 1) for 104 hours while producing 15,625 bales. 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	HOURS	NO. OF BALES
Alfalfa	21	3 820
Alfalfa, Bromegrass	50	5 405
Bromegrass	2	100
Greenfeed	10	1 600
Wheat Straw	19	4 505
Barley Straw	2	195
TOTAL	104	15 625

RESULTS AND DISCUSSION

Rate of Work: Average feedrates varied from 2 t/h (2.2 ton/h) in light bromegrass to 8 t/h (8.8 ton/h) in heavy alfalfa and bromegrass. Average feedrate depended on windrow size and uniformity, crop condition, field surface, available tractor speeds and operator skill. Speeds were normally limitedto about 10 km/h (6.2 mph) due to bouncing on rough ground and poorer pickup performance at higher speeds.

In heavy, uniform alfalfa windrows, instantaneous feedrates in excess of 15 t/h (16.5 ton/h) were measured. These were peak values representing maximum baler capacity, which could not be maintained continuously.

Feeding was aggressive in all crops. Feedrate was usually limited by slippage of the power take-off slip clutch or shearing of the flywheel shear bolt. In very dry conditions, feedrate was limited by pickup and feeder carriage performance.

QUALITY OF WORK

Bale Quality: At normal feedrates the New Holland 310 was capable of producing firm, durable bales with square ends in all crops (FIGURE 2). Average hay bales weighed 27 to 35 kg (59 to 77 lb), while average straw bales weighed 18 to 22 kg (40 to 48 lb). Average bale densities varied from 174 to 205 kg/m^3 (10.4 to 12.3 lb/ft^3) in hay and 115 to 123 kg/m^3 (6.9 to 7.4 lb/ft^3) in straw. Bale quality deteriorated at higher feedrates.

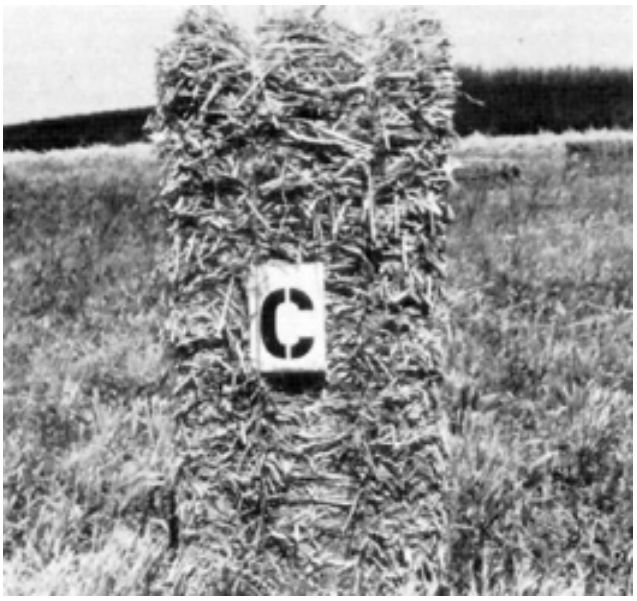
Bale Length Variation: As with most conventional square balers it was difficult to obtain consistent bale length, especially in non-uniform windrows. When set for 1000 mm (39.4 in) length, bale lengths typically varied from 950 to 1050 mm (37.4 to 41.3 in).

Bale length is adjusted by positioning the metering arm stop (FIGURE 3). The metering wheel advances the metering arm with each plunger stroke. Bale length uniformity depends on a consistent number of plunger strokes to form each bale. If the metering arm trips at the beginning of the last plunger stroke, rather than at the end of the stroke, bale length is increased by the length of compressed hay delivered during the last plunger stroke. Uniform feedrates are therefore important in reducing bale length variation.

For the same length setting, higher feedrates usually produced longer bales. For exmple, in a uniform alfalfa crop average bale length was 1000 mm (39.4 in) when baling at 5 t/h (5.5 ton/h), but increased to 1090 mm (42.9 in) at 12 t/h (13.2 ton/h). The same trend was evident in wheat straw with average bale length increasing from 1030 mm (40.6 in) at 3 t/h (3.3 ton/h) feedrate to 1090 mm (42.9 in) at 10 t/h (11.0 ton/h).

A

B



C

D

FIGURE 2. Typical Bales: (A) Alfalfa, (B) Sromegrass, (C) Greenfeed, (D) Straw.

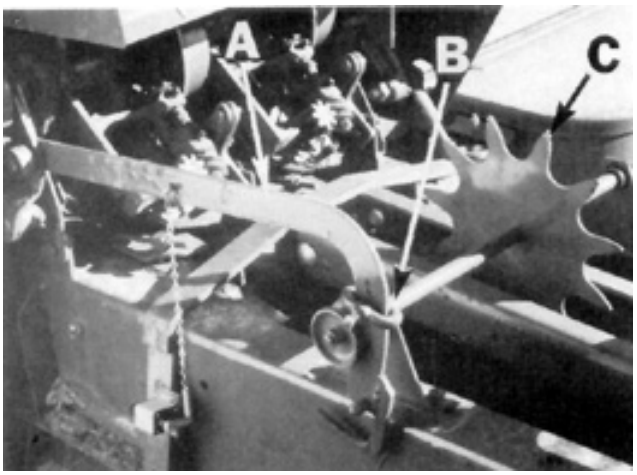


FIGURE 3. Bale Length Adjustment: (A) Metering Arm, (B) Metering Wheel, (C) Adjustable Stop.

Leaf and Stem Loss: As with most conventional square balers, leaf and stem loss in dry hay was lower than with round balers. In most field conditions, total loss from the pickup and bale chamber was less than 3%. Pickup losses were insignificant unless ground speed was very high or windrows were light and poorly formed.

Knotter Reliability and Performance: The knotters, when properly adjusted, performed well with both sisal and synthetic twines. The New Holland 310 was supplied with the synthetic twine billhooks which could also readily be used with sisal twines providing twine holder and twine box tension were slightly increased.

POWER CONSUMPTION

Power Take-off Requirements: FIGURE 4 shows typical instantaneous power take.off requirements for the New Holland 310. Power requirements fluctuated from 0 to 28 kW (0 to 38 hp) on each plunger stroke. Due to these wide power fluctuations, average power requirements were less than instantaneous requirements, varying from 5 to 19 kW (7 to 25 hp) over a full range of feedrates. FIGURE 5 shows the average power take-off requirements at various feedrates in alfalfa and wheat straw.

Tractor size: The manufacturer recommended that 2 to 3 plow (about 25 kW) (35 hp) tractor be used. Average power take-off requirements were usually less than 19 kW (25 hp) and power required to pull the baler on level ground was usually less. than 4 kW (5 hp). A 40 kW (54 hp) tractor was, however, needed to fully utilize baler capacity in soft or hilly fields and to overcome the power fluctuations illustrated in FIGURE 4.

Specific Capacity: Specific capacity is a measure of how efficiently a machine performs a task. A high specific capacity indicates efficient energy use while low specific capacity indicates inefficient operation. The specific capacity of the New Holland 310 varied from 0.9 to 1.2 t/kW·h (0.7 to 1.0 ton/hp·h) in alfalfa and from 0.6 to 0.8 t/kW·h (0.5 to 0.7 ton/hp·h) in wheat straw. This compares to an average specific capacity of 0.5 t/kW·h (0.4 ton/hp·h) for large round balers in alfalfa. These values represent average conditions and not peak outputs.

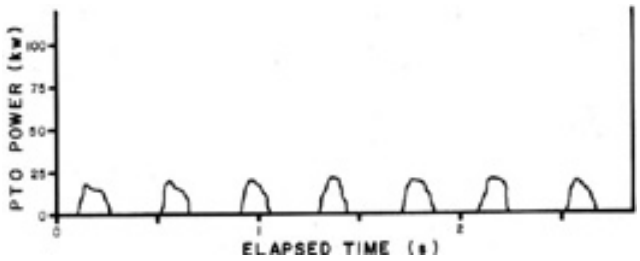


FIGURE 4. Instantaneous Power Take-off Requirements when Baling Alfalfa at an 8 t/h Feedrate.

EASE OF OPERATION

Hitching: The New Holland 310 was easily hitched to tractors equipped with 540 rpm power take-off. The hitch jack was convenient for raising or lowering the hitch tongue. The hitch clevis and power shaft pedestal were adjustable to suit various drawbar heights.

Transporting: The hitch tongue could be placed into transport or field position without getting off the tractor. Dismounting the tractor was necessary to fold the bale chute and raise the pickup. The New Holland 310 could normally be placed in transport or field position in about two minutes.

The baler towed well behind a tractor or suitably sized truck.

Feeding: Feeding was agressive and positive in all crops. The pickup was wide enough to accommodate most well

formed windrows with minimum trampling by the rear tractor tire. Pickup visibility was excellent from most tractors.

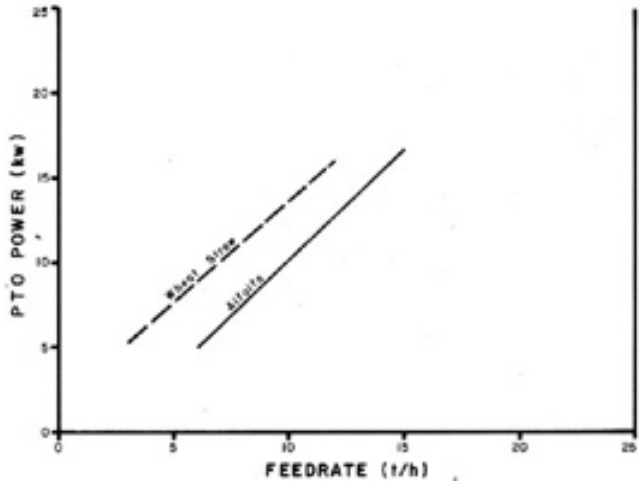


FIGURE 5. Average Power Take-off Requirements when Baling Alfalfa and Straw.

Maneuverability:*The* New Holland 310 was sufficiently maneuverable for efficient baling.

Twine Threading: Twine threading was convenient· The operator's manual gave a clear description of twine threading procedures and a twine threading diagram was provided on the twine box lid.

EASE OF ADJUSTMENT

Bale Length: Bale length was conveniently adjusted with a wrench. Bale length settings from 305 to 1320 mm (12 to 52 in) were possible· Obtaining a consistent bale length was difficult, since bale lengths varied, depending on windrow uniformity and feedrate.

Bale Density: Bale density was adjusted by hand cranks located at the rear of the bale chamber. The cranks were difficult to adjust when under tension. Setting the cranks for a specific crop was a trial and error procedure and required the operator to dismount the tractor.

The hand cranks provided sufficient adjustment range to produce bales of adequate density in most crops. Normally, flywheel shearbolt failure and twine knot strength were the only factors limiting bale density. In very dry conditions or light windrows, additional bale wedges had to be installed in the bale chamber.

Feeding System: Feeder carriage penetration was easily adjusted by lengthening or shortening the feeder sled link (FIGURE 6). The feeder sled link had five settings which required the use of wrenches. This adjustment was usually sufficient to produce square, well formed bales in most crops. Additional adjustment of the feeder back could also be used to improve bale shape. The feeder back was easily adjusted with wrenches.

FIGURE 6. Feeder Sled Link Adjustment.

Pickup: The pickup height was set by positioning the pickup gauge wheel. The pickup windguard was easily adjusted to suit various windrow sizes. Once shielding was removed, the pickup slip clutch was easily adjusted. Pickup adjustments required the use of wrenches.

Overload Devices: The drive shaft slip clutch slipped excessively at high feedrates when adjusted to manufacturer's specifications. Twice during the test the drive shaft slip clutch was increased beyond the manufacturer's specification to improve capacity. Adjusting the drive shaft slip clutch was easy. Flywheel and knotter shear bolts were convenient to change. The pickup slip clutch functioned well and required no adjustment during the test.

Bale Chute: The quarter turn bale chute was easily adjusted to place the bales on edge. The bale chute was reversible so bales could be dropped on either the left or right side. The anti-bounce brake required periodic cleaning and adjustment. Wrenches were required.

Servicing: The New Holland 310 had three chain drives, 41 grease fittings, four oil ports and one gearbox. The operator's manual recommended daily chain oiling, lubrication of 37 grease fittings and four oil ports every 1000 bales, three grease fittings twice weekly, and one grease fitting every 10, 000 bales, inspection of the gearbox every 5000 bales and packing the wheel bearings annually. About 15 minutes were needed for daily servicing of the New Holland 310.

Tool Box: A tool box located on the left side near the front of the baler was convenient for carrying tools, spare shear bolts and parts.

OPERATOR SAFETY

The New Holland 310 was safe to operate and service if normal safety precautions were observed. All moving parts, except for the flywheel, were well shielded. As with most power take-off equipment the power take-off must be disengaged and the tractor engine stopped before adjusting or servicing.

OPERATOR'S MANUAL

The operator's manual was clear, well written and contained much useful information on operation, servicing, adjustments and safety procedures. It did not include information on adjustment of the bale chute anti-bounce brake. It is recommended that the manufacturer consider including adjustment instructions for the anti-bounce brake in the operator's manual.

DURABILITY RESULTS

TABLE 2 outlines the mechanical history of the New Holland 310 during 104 hours of field operation while baling 15,625 bales. 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	OPERATING HOURS	EQUIVALENT BALES
DRIVE TRAIN		
· The slip clutch began to slip excessively and was readjusted to specifications at	58, 88	7580, 11,900
FEEDER ASSEMBLY		
- The feeder carriage roller to track clearance was checked and adjusted to specifl· cations at	60	8840
- a feeder carriage roller cap was lost and replaced at	91	12,660
- Side play on the feeder carriage became excessive. Shims were added to the side wear blocks at	91	12,660
PLUNGER		
· A plunger face extension was bent **and** was straightened at	9	690

- The plunger face extension broke off and was replaced at	32	5160
- The plunger and knife to knife clearances were checked and adjusted to specifications at	32	5160
TWINE NEEDLES		
- The left twine needle broke and was replaced at	9	690
BALE CHUTE		
- The bale chute chain support bracket broke and was repaired at	101	15,460
- The bale chute frame cracked at the base of the deflector arm and was repaired at	101	15,460

DISCUSSION OF MECHANICAL PROBLEMS

DRIVE TRAIN

Slip Clutch: The drive shaft slip clutch slipped excessively at higher feedrates when adjusted to the manufacturer's specification. Improved feedrates were obtained if the slip clutch was adjusted beyond specifications.

PLUNGER AND TWINE NEEDLES

The left twine needle broke and a plunger face extension bent as a result of an obstruction in the bale chamber.

BALE CHUTE

The right bale chute chain support bracket broke (FIGURE 7) and the frame at the base of the bale chute deflector arm cracked due to excessive bale chute bouncing. The anti-bounce brake (FIGURE 8) was improperly adjusted. The brake was disassembled, cleaned and adjusted to minimize bouncing. It is recommended that the manufacturer consider including instructions for the bale chute anti-bounce brake adjustment in the operator's manual.

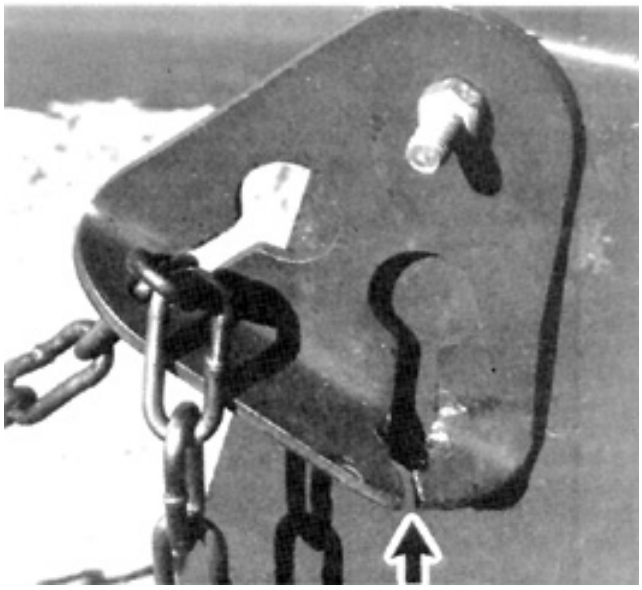


FIGURE 7. Broken Chain Support Bracket.

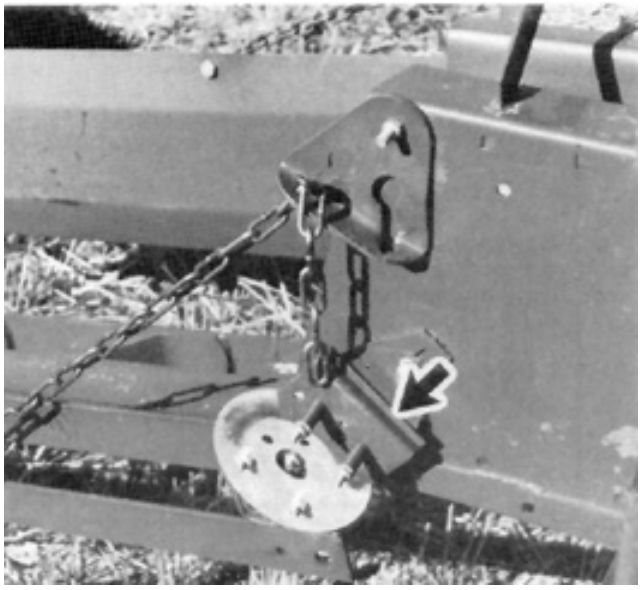


FIGURE 8. Bale Chute Anti-bounce Brake.

APPENDIX I

SPECIFICATIONS

Make:	New Holland Baler
Model:	310
Serial Number:	539484
Overall Dimensions:	
- width	2740 mm
- length	6210 mm
- height	1370 mm
- ground clearance	255 mm
Weights:	
- left wheel	630 kg
- right wheel	450 kg
- hitch	200 kg
Total	1280 kg
Tires:	
- left	9.5-15, 6-ply terra-rib
- right	7.50-15, 6-ply terra-rib
- pickup gauge	12 x 3.00 semi-pneumatic
Pickup:	
- type	cam actuated drum pickup
- height adjustment	pickup gauge wheel
- width	1570 mm
- number of tooth bars	4
- number of teeth	80
- tooth spacing	68 mm
- speed	81 rpm
Feeding Mechanism:	
- type	reciprocating feeder carriage
- speed	75 cycles per minute
Plunger:	
- strokes per minute	75
- length of stroke	760 mm
Bale Chamber:	
- width	457 mm
- height	356 mm
- range of bale lengths	305 mm to 1320 mm
- bale density control	compession bars (primary) side wedges (secondary)
Twine Capacity:	4 balls
Drives:	
- number of chain drives	3
- number of gear drives	1
- number of universal joints	3
Safety Features:	
- power take-off slip clutch	
- flywheel shear bolt	
- knotter drive shear bolt	
- plunger safety stop	
- pickup slip clutch	
Servicing:	
- grease fittings	37, every 1000 bales 3, twice weekly 1, every 10,000 bales
- oil ports	4, every 1000 bales
- chains	3, oil daily
- gearbox	1, check every 5000 bales
- wheel bearings	*2*
Optional Equipment:	
wagon hitch and loading chute	
needle slot baffles	
hydraulic bale density control	
*quarter turn bale chute**	
light kit	
bale thrower	
*synthetic twine billhook**	
slow moving vehicle emblem	

* supplied on test machine

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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

APPENDIX III

CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometrelhour (km/h)	= 0.62 miles/hour (mph)
1 tonne (t)	= 2200 pounds mass (lb)
1 tonnelhour (t/h)	= 1.10 ton/hour (ton/h)
1 tonnelhectre (t/ha)	= 0.45 ton/acre (ton/ac)
1 millimetre (mm)	= 0.04 inches (in)
1 meter (m)	= 39.4 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 kilogram/cubic meter (kg/m^3)	= 0.06 pounds mass/cubic foot (lb/ft^3)
1 tonne/kilowatt hour (t/kW·h)	= 0.8 ton/horsepower hour (ton/hp.h)

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