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Evaluation Report 137

Kirchner Model 70 Automatic Bale Wagon

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

KIRCHNER MODEL 70 AUTOMATIC BALE WAGON

MANUFACTURER AND DISTRIBUTOR:

Kirchner Machine Ltd.
2419 - 2nd Ave. North
Lethbridge, Alberta
T1H 0C1

RETAIL PRICE:

$9,350.00 (June, 1979, f.o.b. Lethbridge, with optional 11L x 15, 6-ply tires, tier counter, automatic tooth roll-back and pick-up ram complete with hoses and valve).

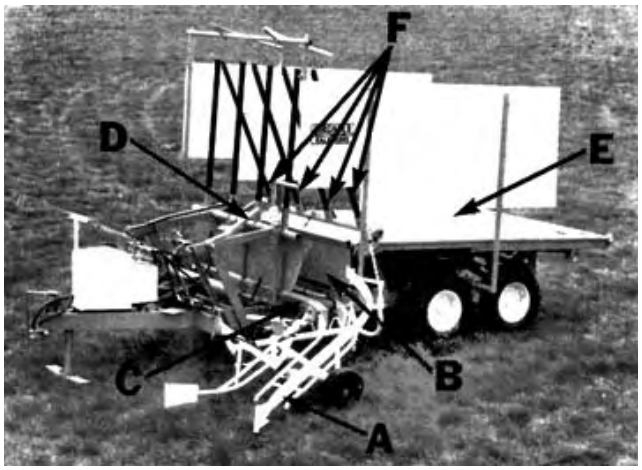

FIGURE 1. Kirchner 70: (A) Loader, (B) Bale Chamber, (C) Lift Table, (D) Push-Back, (E) Load Deck, (F) Load Deck Fingers.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Kirchner 70 was good. Ease of operation was fair while stack quality with dense, well-formed bales was good.

Considerable operator experience was needed to produce neat, durable stacks. A level stack site, with an adequate backstop, was required to prevent stack collapse. The most durable stacks were formed by placing two or more rows of bale loads beside each other. Bale uniformity was very important in obtaining a durable, weather resistant stack.

Suitable bale picking speeds varied from 5 to 10 km/h (3 to 6 mph). In average field conditions it took an experienced operator about 26 minutes to properly load 70 bales while unloading took about 6 minutes. Field efficiency depended mainly on operator dexterity and the speed at which the tractor could safely be handled. Hay loss during field operation was negligible.

The Kirchner 70 loaded firm, well-formed bales effectively. Sometimes, in rough fields, tiers were prematurely pushed onto the load deck. Manual correction was inconvenient and difficult. To obtain stack stability, the Kirchner 70 used a semi-automatic twine tie system. Tiers of bales were hand tied together with twine. Two sets of ties were needed on each bale load for stable stacks. Hand tying required about 7 minutes of operator time for each bale load. Unloading was easy once the load was aligned and positioned. During the push-off, the load deck fingers sometimes pulled the outer lower bales away from the stack.

Control rods were easily adjusted and could be positioned to suit most tractors. All lubrication and adjustments were easily accomplished with the load deck and table lowered. Hitching was inconvenient due to the large hitch weight. The support leg usually settled, requiring a jack.

To fully utilize the capacity of the wagon and to ensure safe road transport, at least a 45 kW (60 hp) tractor should be used.

The Kirchner 70 towed well, fully loaded, at speeds up to 30 km/h (19 mph). However, this was unsafe, as the tire loads exceeded the Tire and Rim Association maximum rating by 28%. Caution had to be used when transporting due to restricted rear visibility.

The Kirchner 70 was safe to operate if the manufacturer's safety recommendations were closely followed. Care had to be exercised when starting or completing ties.

Several mechanical problems occurred during the test. The table chain broke several times. The loader wheel bearing failed and front loader pivot bolt broke when operating in rough fields. The loader bale guides bent and the hitch clevis cracked.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying a hitch jack as standard equipment.
2. Supplying tires, which comply with the Tire and Rim Association rating for the specified wagon load.
3. Modification to the push-back valve trip to prevent premature tripping.
4. Modifications to increase the push off distance.
5. Providing a stable support for the wind back activator rod and valve assembly.
6. Providing a positive belt tightener on the wind back drive.
7. Supplying a mechanical lock on the load deck to improve operator safety when initiating and completing ties.
8. Supplying a slow moving vehicle sign.
9. Modifications to increase the hitch clevis strength.
10. Clarification in the operator's manual on set-up and adjusting instructions for the timer mechanism.

Chief Engineer: E. O. Nyborg
Senior Engineer: E. H. Wiens
Project Engineer: M. V. Eliason

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A hitch jack will be standard equipment on all future model 70 bale wagons.
2. This year we are using self-manufactured 3/8" A.R. plate centre rims to withstand heavier loads.
3. The push back valve, when properly adjusted and timed, will not trip prematurely unless dirt or small stones are thrown from the tractor wheel. A shield is now being installed on all bale wagons.
4. During the 1979 haying season, we are testing an experimental machine with a longer push off. If satisfactory, this will be incorporated into future production.
5. The wind back activator rod and valve assembly have been modified and strengthened.
6. A positive belt tightener would not allow the belt to act as a brake or clutch when loading. When properly adjusted, we have had very few problems. A better spring is being used.
7. A mechanical lock on the load deck to improve operator safety when initiating and completing ties is under consideration.
8. Supplying a slow moving vehicle sign has been considered. However, our problem is finding a location where the sign would be visible while transporting and not conflict or be knocked off during stacking.
9. A stronger hitch clevis is now being supplied.
10. The operator's manual has been redone and clarified. Also, important adjustment bolts have been color coded (4 colors) for quicker identification and ease of timing.

GENERAL DESCRIPTION

The Kirchner 70 is a pull-type automatic bale wagon. It has a maximum carrying capacity of 70, standard size, 355 x 460 mm bales or 70, commercial size, 405 x 460 mm bales. It will accommodate bale lengths from 910 to 1150 mm. The Kirchner 70 consists of a loader, bale chamber, lift table, push-back, and load deck, mounted on a main frame, supported by a single axle with dual tandem wheels. The self contained hydraulic system is powered by a 540 or 1000 rpm pump mounted on the tractor power take-off.

For field retrieval, bales must be lying with the twine side facing upward. Bales are retrieved with the loader, located on the left of the tractor and conveyed to the table. When two bales have been placed on the table, the table lift is automatically activated raising the two

bales into the bale chamber. This occurs a total of five times. When the table is filled after the last lift, the push-back is automatically activated, pushing a tier of 10 bales onto the load deck. Seven tiers complete the load.

The Kirchner 70 is equipped with a semi-automatic twine tie system which may be used, as required, to improve stack durability. Individual tiers, sets of tiers, or the complete load, may be wrapped with two twines. Once the tying cycle is initiated, by hand, twine is automatically wrapped around the load as it is formed. When a desired portion of the load has been wrapped, the twines have to be tied by hand.

To unload, the load deck is first raised slightly and the Kirchner 70 is lined up with the stack. The load deck is then completely raised and the load backed firmly into the stack. To maintain a tight stack, two stack poles are placed against the load. Two push-off feet are then activated to push the wagon partially away from the stack. Retracting the push-off feet and advancing the tractor in low gear separates the wagon from the stack. After the load deck is lowered, the load deck fingers automatically move forward.

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

SCOPE OF TEST

The Kirchner 70 was operated in the crops shown in TABLE 1, for 224 hours, while stacking about 14,255 bales. It was evaluated for quality of work, ease of operation, rate of work, power requirements, operator safety and suitability of the operator's manual.

TABLE 1. Operating Conditions

Crop	Hours	Number of Bales	Field Area (ha)
Alfalfa	76	4670	65
Alfalfa/Bromegrass	119	6390	121
Bromegrass/Crested Wheatgrass	20	1100	16
Bromegrass	10	620	8
Wheat straw	19	1475	26
TOTAL	244	14255	236

RESULTS AND DISCUSSION

QUALITY OF WORK

Bale Retrieval: Bale loader performance depended primarily on operator experience and dexterity. An experienced operator could pick dense, well-formed bales at speeds up to 13 km/h. Average picking speeds ranged from 5 to 10 km/h.

The distance needed to pick a bale off the ground varied with forward speed, power take-off speed, bale quality, crop type and field surface conditions. At high forward speeds, the bale slid along the ground as it entered the loader, sometimes causing broken twines or bale damage. FIGURE 2 shows the sliding distance when picking 25 kg, 1040 mm long wheat straw bales, over a range of ground speeds and power take-off speeds. No sliding occurred at speeds below 3 km/h. When picking at 10 km/h, bale sliding distance varied from 2 to 5 m at power take-off speeds of 500 and 300 rpm, respectively.

To reduce possible damage, bales should be picked with minimal sliding. However, slow picking speeds increase the loading time. Operator experience is needed to coordinate ground speed and power take-off speed with bale and field conditions.

Load Quality: The Kirchner 70 formed a durable load, which transported well with little shifting or settling. Load quality depended on bale quality. Large variation in bale length, or placement of loose poorly formed bales on the bottom rows, could cause some load shifting during transport.

Stack Quality: Stack quality and durability depended on operator care, operator experience, bale quality, bale uniformity and selection of a suitable stack site. With proper care in baler operation, site selection and unloading, solid, durable stacks (FIGURE 3) were formed. If bales were of poor or variable quality, or if care was not taken in selecting a good stack site and in properly positioning bale loads within the stack, the stack usually collapsed within several days (FIGURE 4).

Site selection was very important. A smooth, level area was best. If a stack had to be built on sloping ground, best results were obtained when the stack was started at the bottom of the slope and built uphill. Stacking on side slopes usually resulted in stack collapse.

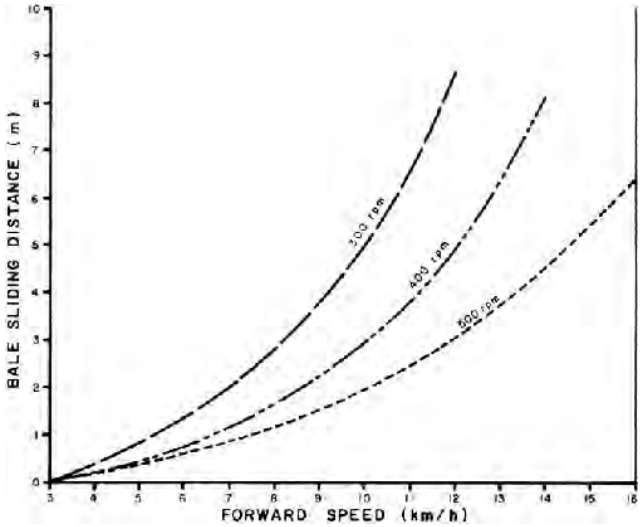

FIGURE 2. Bale Sliding Distance. Over a Range of Ground Speeds and Power Take-off Speeds. When Picking Wheat Straw Bales.

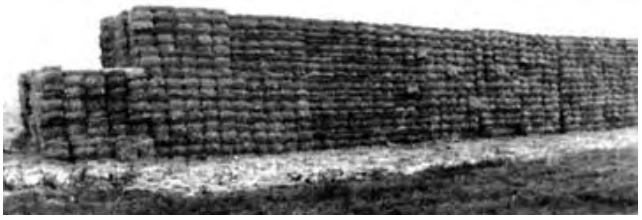

FIGURE 3. Solid. Durable Stacks were Formed when Proper Care was Taken in Baler Operation, Site Selection and Unloading.

FIGURE 4. Poor Site Selection. Poor Bale Quality, or Careless Unloading Usually Resulted in Stack Collapse.

An adequate backstop was needed to start a stack. A partial load, four or five tiers high, with one or two ties, formed a good backstop. Placing a full load against a fence, or placing props against the first load, was inadequate and lead to stack collapse. Partial loads, resulting from field cleanup, could sometimes be used to finish a stack and stabilize its end.

Good quality, durable stacks required dense, well-formed, uniform bales. Stack durability was greatly influenced by baler performance. Poorly formed bales on the bottom usually settled, resulting in stack collapse. Non-uniform bale lengths resulted in reduced stability and unsightly appearance on the right stack side, since all the bale length variations accumulated on this side (FIGURE 5).

Properly placing successive loads in the stack was very important for stack stability. Misaligned loads resulted in an unsightly, unstable stack. Loads that were not squarely and firmly placed into the stack resulted in gaps, which lead to weathering and subsequent collapse. Setting the stack poles immediately after load positioning was important for maintaining tight and stable stacks.

The most durable stacks were formed by stacking two or more loads wide. Multiple row stacking reduced weathering by decreasing the exposed surface area and also aided in stack stability. Uniform bale lengths were very important for multiple row stacking. Large bale length variations caused gaps between rows leading to internal weathering and spoilage. When gaps were a problem, the stack could be hand capped, by moving the top bales as shown in FIGURE 6.

FIGURE 5. Non-uniform Right Stack Side Resulting from Bale Length Variation.

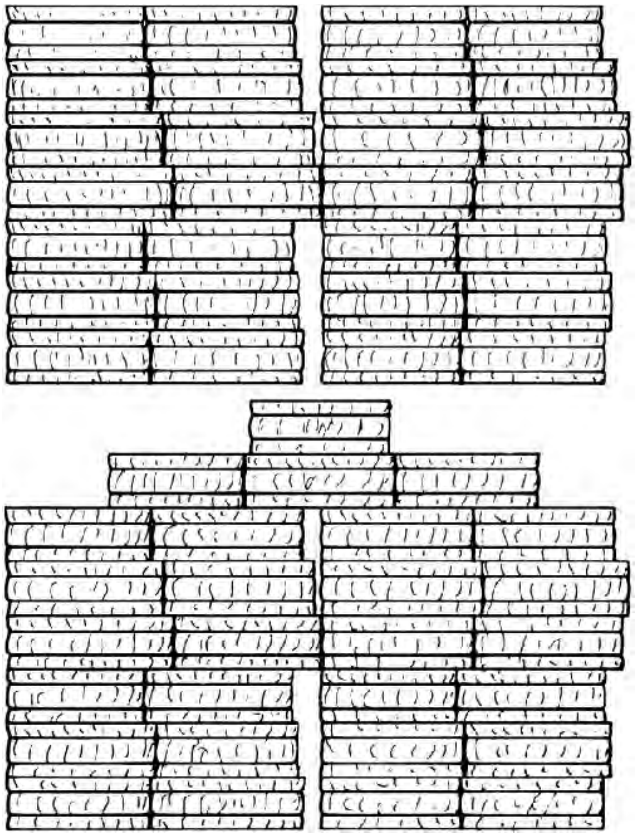

FIGURE 6. Hand Capping to Reduce Weathering Between Bale Rows.

EASE OF OPERATION

Hitching: The Kirchner 70 was equipped with an adjustable clevis hitch, which had sufficient adjustment to suit most tractor drawbar heights. When unhitched, the wagon was supported by an adjustable over-centre leg. Due to the heavy hitch weight (741 kg), the leg often settled, requiring a jack for hitching. Unhooking the wagon on a smooth surface was sometimes difficult as the leg occasionally slid and would not lock over-centre. It is recommended that the manufacturer supply a hitch jack as standard equipment.

Attaching the hydraulic pump to the tractor power take-off shaft was somewhat inconvenient since on most tractors the power take-off shield had to be removed. There was no provision for securing the pump to the tractor power take-off shaft other than hooking the torque arm chain ahead of the pump. On most tractors it was not possible to find a location, forward of the pump, to fasten the torque arm chain bolt. The pump was usually fastened using wire.

Controls: The control rods were easily adjusted and conveniently positioned for operation from the tractor seat when used on tractors without cabs. Control operation from within a tractor cab was awkward.

Loading: The ease with which the Kirchner 70 could be loaded depended mainly upon operator experience and bale quality. An experienced operator had little difficulty loading firm, dense, uniform bales.

It was important to pick bales in the same direction as they had been baled. Ragged, loose or damp bales tended to jam in the loader and bale guides when picked backwards. Dense, well-formed bales could be picked in either direction, however, loading was quicker and easier when picked in the direction of baler travel.

Properly aligning the loader with the oncoming bale was important for efficient picking. Bales could usually be picked at an angle to the direction of travel as they were rotated by the loader arms as they entered into the loader. In rough fields or long stubble, alignment was more important since misalignment sometimes caused the incoming bale to turn on edge, jamming between the loader.

Bales had to bend as they moved up the loader (FIGURE 7). Although this presented no problem with normal bales, it often caused the outer twine to break on very dense bales. The use of a good quality twine reduced breakage; however, if the bale did not bend to conform to loader curvature, the table chain often cut the outer twine. Twine from broken or deformed bales became entangled in the loader and table chain sprockets. Twine build-up caused the loader chains to jam and stop (FIGURE 8) on several occasions.

FIGURE 7. Bending of Bale in the Loader.

FIGURE 8. Twine Build-up on Loader Drive Sprocket.

Sufficient bale density was required for proper entry into the bale chamber. Loose or poorly formed bales jammed against the upper bale chamber sides (FIGURE 9). The bale could usually be cleared by quickly reversing the loader motors. If the loader motors were not reversed immediately, the bale broke or became badly deformed. If a broken or deformed bale was forced into the bale chamber it had to be cleared by hand. Hand removal was difficult, especially if this was the last bale of a lift or tier.

Leaf Loss: Pickup and table losses were insignificant. In alfalfa/bromegrass bales, total hay loss from the Kirchner 70 was less than 0.5%.

In rough fields, the first lift of bales in the bale chamber sometimes slipped edgeways (FIGURE 10). These bales usually straightened themselves on the next lift, however, an incoming bale

sometimes jammed against the fallen bales, as it entered the bale chamber.

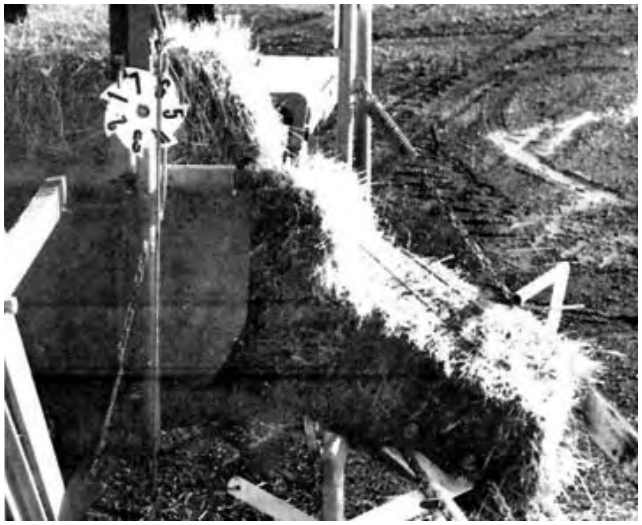

FIGURE 9. Loose Bale Wedged on Bale Chamber Side.

FIGURE 10. First Lift of Bales Slipped Sideways in Rough Fields.

Operation of the push-back timer mechanism was erratic in rough fields. When jarred, the push-back valve trip (FIGURE 11) was activated one or two lifts early resulting in partial tiers. Modifications to prevent premature push-back in rough fields, is recommended.

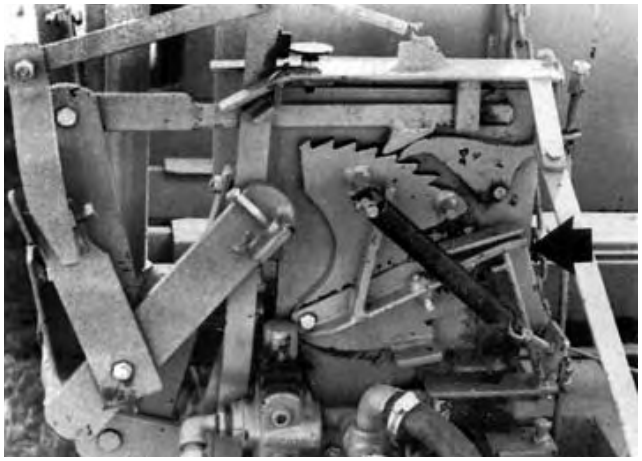

FIGURE 11. Push-back Valve Trip Activated One Lift Too Early.

Ties: For stable stacks, two sets of ties usually were used on each load. The first four tiers were tied together and the last three tiers were tied together. The operator had to stop and dismount three times to make two sets of ties. It took about seven minutes of operator time, in addition to loading time, to properly tie the load. Initiating and completing ties was inconvenient as the operator had to climb through the push-back and into the bale chamber. Twine threading was easy. Good quality twine was needed for stable stacks.

Transporting: The Kirchner 70 was easy to transport. All that was required after load completion was to hydraulically raise the loader and to disengage the power take-off. The Kirchner 70 towed well, fully loaded, at speeds up to 30 km/h. However, when loaded to the manufacturer's specified limit, individual tire loads exceeded the Tire and Rim Association maximum rating for 11L x 15, 6-ply tires, by 28%. It is recommended that the manufacturer equip the Kirchner 70 with tires, which comply with the Tire and Rim Association load rating.

Rear visibility was severely restricted by the load during transport.

Stacking: Unloading the Kirchner 70 was easy once the wagon had been aligned with the stack. A skilled operator had little difficulty in backing squarely into the stack. Visibility was limited (FIGURE 12) but raising the load deck slightly allowed the operator to see the wheels, to permit alignment with previous tracks or markers. For durable, stable stacks, the operator usually had to dismount twice while unloading. The first dismount was just before tipping the load past vertical to ensure that the load was properly aligned. The second dismount was just after the load was backed into the stack to set the stack poles.

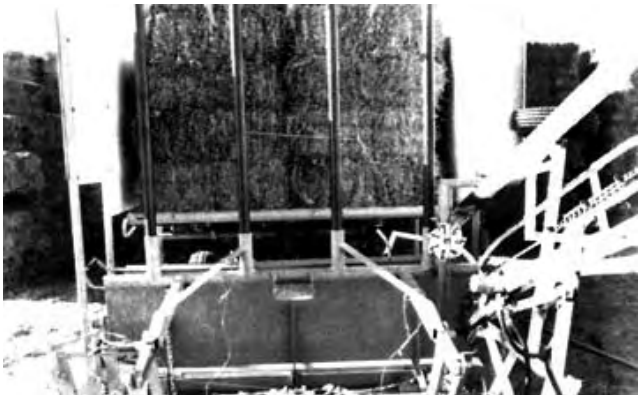

FIGURE 12. Limited Visibility when Backing into the Stack.

After extending and retracting the push-off feet, the operator had to move the tractor forward to pull the load deck fingers from beneath the stack. This sometimes pulled the outer lower bales away from the stack (FIGURE 13). It was difficult for the operator to notice this, as visibility through the load deck was limited. Backing the wagon into the stack and repeating the push-off straightened the lower bale row, but on several occasions, props had to be placed against the lower bales. Modifications to increase push-off length are recommended to correct this problem.

When the load deck is lowered, the load deck fingers are winched forward by a hydraulic motor. The motor was started when an activator rod contacts the main frame. The rod sometimes slipped off the main frame (FIGURE 14) as the mechanism was supported only by the hydraulic plumbing. Stable support for the activator mechanism is recommended.

FIGURE 13. Lower Bales Pulled Away From Stack by the Load Deck Fingers.

Adjustments: The side panels were easily adjusted to accommodate various bale lengths. Proper adjustment of the side panels was important in maintaining a tight load. In non-uniform bales, excessively long bales sometimes jammed between the table side panel and the next lift of bales.

Insufficient belt tension adjustment was provided on the load deck finger wind back mechanism drive. This caused the load deck fingers to sometimes slip backward during loading. Modifications are

recommended to eliminate this problem.

All necessary adjustments could be easily accomplished with the load deck and lift table lowered. Extreme care must be used when working under a raised deck or table.

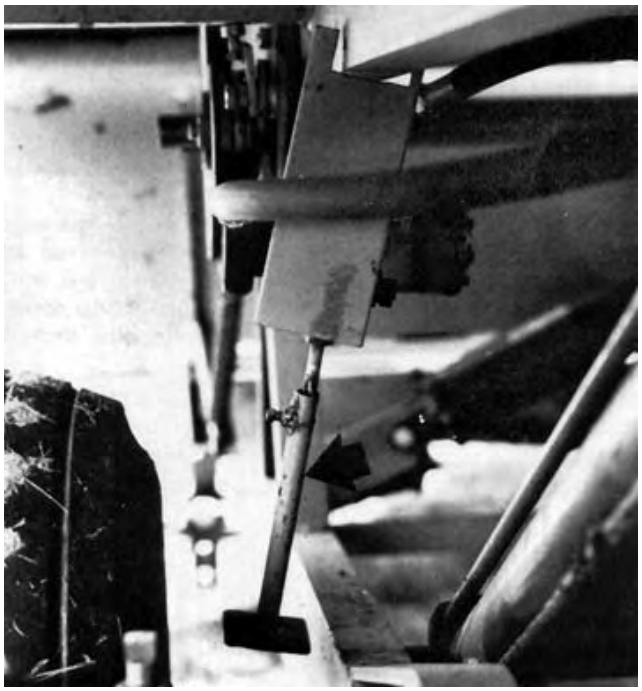

FIGURE 14. Load Deck Finger Activator Rod Misaligned with Main Frame.

Lubrication: The Kirchner 70 had seven grease fittings requiring twice-weekly lubrication. All fittings were accessible.

RATE OF WORK

Work rate depended upon operator experience and dexterity, bale quality, field conditions, transport distance, and accessibility at the stack site.

The minimum measured loading time, for 70 bales, was five minutes. This time did not include ties and required the operator to stop the loader after every two bales. The minimum measured loading time, when two sets of ties were placed on the load, as is normally required, was 16 minutes. Both of these times represent ideal conditions, which cannot be achieved in usual field conditions.

TABLE 2 gives an indication of average work rates, which can be expected with an experienced operator. The table gives an average time based on five trips in average field conditions. Each trip consisted of loading, transporting and unloading 70 straw bales from a smooth field. Each one-way trip involved about 0.8 km of field travel and 0.4 km of road travel. Average round trip time for each 70 bale load was 37 minutes.

TABLE 2. Average Rate of Work

Travel to field (1.2 km)	3 min
Load 70 bales	25.5 min
Travel to stack	3 min
Unload	5.5 min
TOTAL	37 min

POWER REQUIREMENTS

The manufacturer recommended a minimum 30 kW tractor be used with the Kirchner 70. Maximum power take-off requirements were less than 8 kW, while drawbar requirements on level ground were usually less than 30 kW. To fully utilize bale wagon capacity on soft or hilly fields, a 45 kW tractor was needed.

OPERATOR SAFETY

The Kirchner 70 was safe to operate as long as the manufacturer's safety precautions were observed and common sense was used.

Caution had to be used when initiating and completing ties. Since the operator had to climb into the machine, the power take-off had to be disengaged and the tractor brakes set. Reaching under the partially raised load deck (FIGURE 15) to initiate or complete a tie was dangerous. Modification to include a mechanical load deck lock, to prevent possible injury, is recommended.

FIGURE 15. Reaching Under Partially Raised Load Deck to Initiate a Tie.

The towing tractor had to be of sufficient weight and equipped with good brakes to ensure safe road transport. Caution was also needed as the load restricted rear visibility. The tractor drawbar had to be of adequate strength to carry the heavy hitch loads. Maximum hitch weight, with a full load was about 1320 kg.

With a full load, the Tire and Rim Association maximum rating for 11L x 15, 6-ply tires was exceeded by 28%. This tire overload was considered unsafe and hazardous, especially at high transport speeds.

The Kirchner 70 was not equipped with a slow moving vehicle sign or mounting bracket. It is recommended that a sign be supplied to comply with provincial safety regulations.

OPERATOR'S MANUAL

The operator's manual clearly outlined general operating and maintenance instructions. Setup and adjusting instructions for the timer mechanism were difficult to understand. Clearer presentation and illustration of these instructions is recommended.

MECHANICAL PROBLEMS

TABLE 3 outlines the mechanical history of the Kirchner 70 during 244 hours of field operation while stacking about 14,255 bales. The intent of the test was evaluation of functional performance. The following failures represent those, which occurred during functional testing. An extended durability evaluation was not conducted.

TABLE 3. Mechanical History

Item	Hours	Number of Bales
Loader		
-The pickup width adjustment bolt loosened and was tightened at	57, 162	4050, 9510
-The lower loader bale guide bent and was straightened at	111	7920
-The loader drive control arm broke and was replaced at	119	8470
-The front loader bolt broke and was replaced at	190	11260
-The inner loader wheel bearing wore requiring replacement at	190	11260
-The upper loader bale guide bent and was straightened at	129	8750
Load Deck		
-The wind back pulley hub loosened and was tightened at	Beginning of Test	
-The cable clamp holding the load deck fingers loosened and was tightened at	Beginning of Test	
-The hydraulic plumbing at the wind back valve loosened end was tightened at	34	3140
-The wheel bolts required tightening at	149, 203	9300, 11540
-Several bolts attaching the side panels to the load deck and lift table were noticed missing at	End of Test	
-The hydraulic plumbing at the left load deck cylinder began leaking and was tightened at	End of Test	
Bale Chamber		
-The table chain broke and was replaced at	64	4470
-The table chain connecting link broke and was replaced at	119, 137	8470, 9000
Clevis		
-The hitch clevis was bent and cracked at	End of Test	

DISCUSSION OF MECHANICAL PROBLEMS

Loader: The loader bale guides bent (FIGURE 16) when deformed bales were cleared from the loader. The guides were easily straightened by hand. The loader pivot bolt and loader wheel bearing failed when operating on very rough fields. Bale **Chamber:** The table chain and connecting link broke when deformed bales jammed in the bale chamber.

Clevis: The hitch clevis bent and cracked (FIGURE 17) as a result of the heavy hitch loads during loading. Safe operation depended upon adequate hitch strength, Modifications to increase clevis strength are recommended.

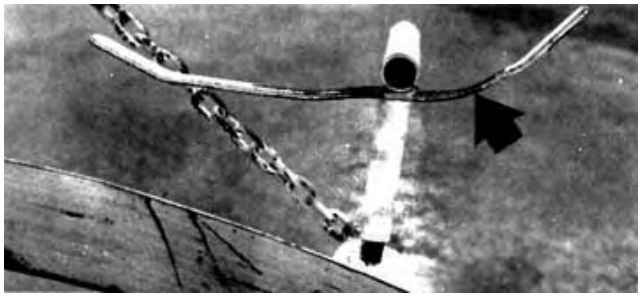

FIGURE 16. Bent Loader Bale Guides.

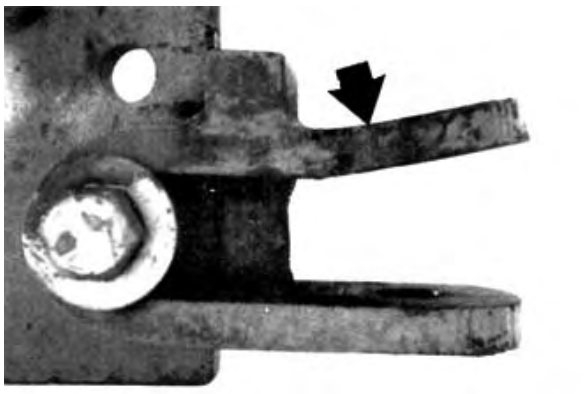

FIGURE 17. Bent Hitch Clevis.

APPENDIX I
SPECIFICATIONS

MAKE:	Kirchner Automatic Bale Wagon	
MODEL:	70 Bale King	
SERIAL NUMBER:	3408	
OVERALL DIMENSIONS:	FIELD POSITION	TRANSPORT POSITION
-- length	6160 mm	6160 mm
-- width	4305 mm	2720 mm
-- height	3355 mm	3355 mm
-- ground clearance	305 mm	305 mm
-- wheel base	4470 mm	4470 mm
-- wheel tread	1785 mm	1785 mm
TIRES:	4. 11L x 15, 6-ply	
WEIGHTS:	FIELD POSITION	TRANSPORT POSITION
-- right wheels	809 kg	733 kg
-- left wheels	841 kg	895 kg
-- loader wheel	68 kg	
-- hitch	691 kg	741 kg
TOTAL	2409 kg	2409 kg
LOAD CAPACITY:	70 bales, 3180 kg	
PICK UP SIDE:	left	
HYDRAULICS:		
-- type	self contained	
-- reservoir capacity	86 L	
STACK SIZE:		
-- height	3200 mm (7 bale widths)	
-- width	2 bale lengths	
LUBRICATION:		
-- pressure grease fittings	7, twice weekly	
-- wheel bearings	4, annual service	

OPTIONAL EQUIPMENT:
- -- 11L x 15, 6-ply tires*
- -- tier counter*
- -- automatic tooth roll-back*
- -- 4 spool solenoid valve
- -- goose neck hitch
- -- engine kit c/w hydraulic pump

* supplied on test machine

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 conversions may be used:

1 hectare (ha)	= 2.47 acres (ac)
1 kilometre/hour (km/h)	= 0.62 miles/hour (mph)
1000 millimetres (mm) = 1 metre (m)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.20 pounds mass (lb)

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