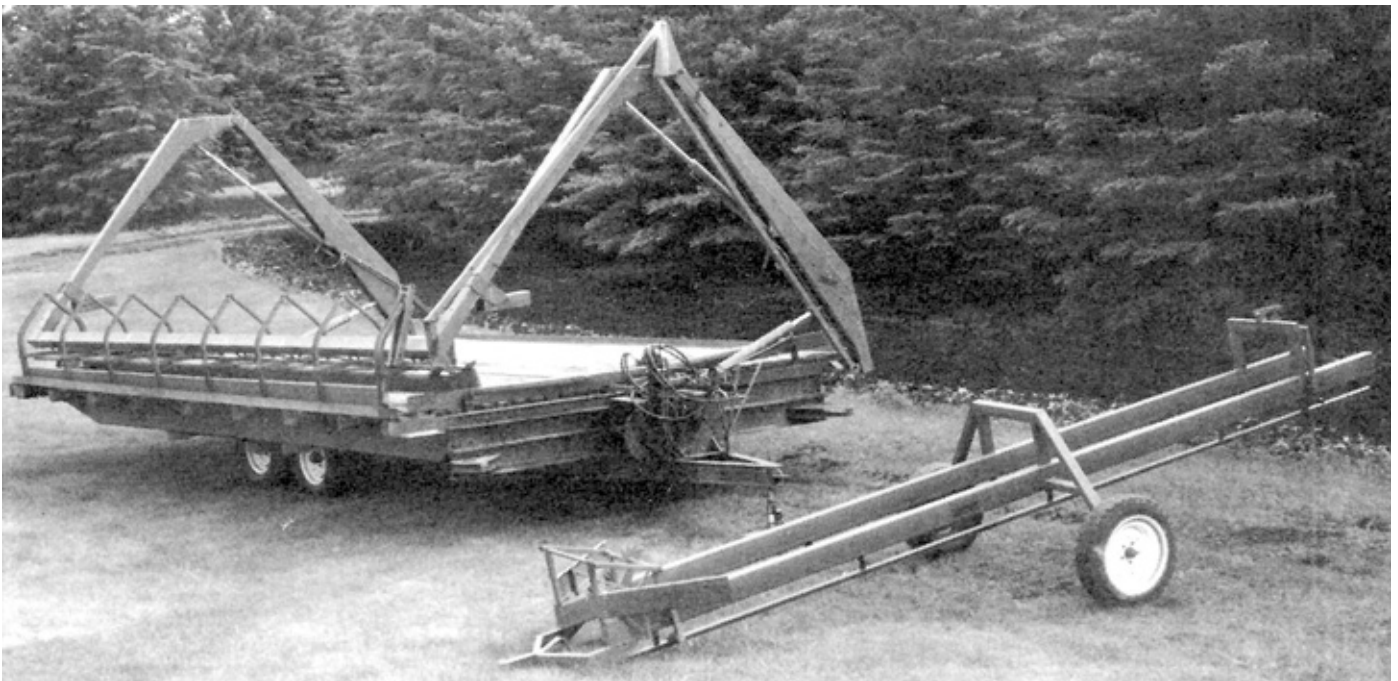


# Evaluation Report

# 548



## Knudson Square Bale Stacker and Mover

A Co-operative Program Between



ALBERTA  
FARM  
MACHINERY  
RESEARCH  
CENTRE



PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

## KNUDSON SQUARE BALE STACKER AND MOVER

### MANUFACTURER AND DISTRIBUTOR:

Knudson Manufacturing and Equipment Ltd  
P.O. Box 3,  
Consort, Alberta  
T0C 1B0  
(403) 577-2105

**RETAIL PRICE:** \$12,025, including Accumulator (March, 1988,  
f.o.b. Consort, Alberta)

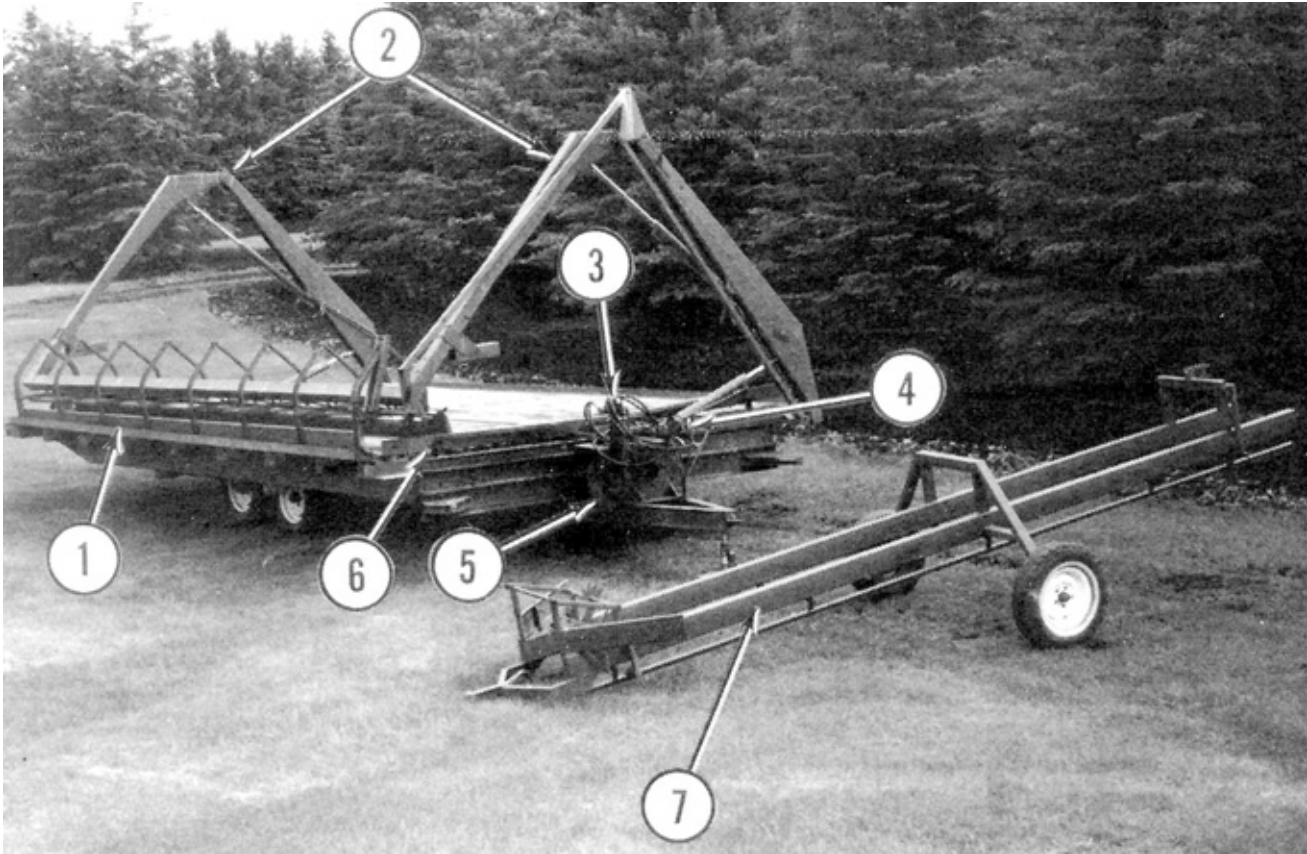


FIGURE 1. Major Components: (1) Bale Pickup, (2) Control Arms, (3) Flow Divider, (4) Hand Winch for Bale Drag, (5) PTO Winch, (6) Bale Drag, (7) Accumulator.

### SUMMARY

**Rate of Work:** The rate of work was hampered by the performance of the accumulator, and the inability of the staker pickup to release the bales at the desired time. A full load of 310 bales could be picked up and placed on the staker's deck in about 1.25 hours. Unloading took about five minutes.

The Knudson staker allowed room for 310 bales; 34 in (864 mm) in length or 285 bales, 40 in (1016 mm) in length. At an average bale weight of 70 lb (32 kg), the wagon would carry 10.8 tons (9.8 t) in a single load. The tires supplied with the Knudson were poorly selected and did not provide adequate carrying capacity for normal working loads.

**Quality of Work:** The Knudson staker was gentle to the crop, and did not impart aggressive action to the bales. The exposed surface area/ton of crop was high in comparison to other means of square bale stacking. The quality of work was rated as good.

**Ease of Operation and Adjustment:** The accumulator would accumulate six bales, and drop them in a row, but would often carry the seventh bale some 10 to 15 ft (3 or 4.5 m) further before dropping it to the ground, making loading difficult. Operators required considerable practice picking up bales and loading them onto the deck. Unloading was easy and took about five minutes. PAMI rated accumulating, hitching, loading and lubricating as fair. Adjustments were rated as good.

Transporting and unloading were rated as very good.

**Power Requirements:** The Knudson staker required a tractor with two remote hydraulic outlets capable of 1500 psi (10.3 MPa) and 540 rpm PTO shaft. PAMI effectively operated a fully loaded staker with a 110 hp (82 kW) Deutz-Allis 7110 tractor.

**Operator Safety:** The Knudson square bale staker was safe to operate if normal safety precautions were followed. The Knudson was not equipped with an implement jack and required the hitch to be lifted with a hydraulic jack or other similar device when hitching. Care had to be exercised when hitching. The Knudson did not display a slow moving vehicle sign, nor were there decals in place that would warn operators or bystanders of potential danger zones. Operator safety was rated as fair.

**Operator's Manual:** The operators manual was poor and did not contain much useful information.

**Mechanical History:** The Knudson staker evaluated by PAMI had been previously stored for an indefinite period outdoors. All of the hinge points on the pickup frame were rusted and were troublesome when loading. A pin that connects the two portions of one unloading arm failed and had to be replaced. The flared opening of the pickup bent and had to be repaired. In addition, the tires supplied with the machine were old and worn out, as well as being of different types. Two flat tires occurred during the short test.

## RECOMMENDATIONS:

It is recommended that the manufacturer consider:

1. A modification to prevent the last bale from hanging up in the accumulator.
2. Supplying a hitch jack.
3. Providing weather protection for the hinge points of the pickup.
4. Providing instructions for attaching the accumulator to the baler.
5. Providing adequate shielding around the moving parts of the unloading winch, and the cables that the winch operates.
6. Providing a hitch safety chain.
7. Supplying better quality tires and ensure that all tires are the same type.
8. Providing a safer walking surface on the stacker deck.
9. Supplying a slow moving vehicle sign, and decals that warn persons of potential danger zones.
10. Providing a more comprehensive operator's manual.

Station Manager- G.M. Omichinski

Project Technologist- R.K. Harris

## THE MANUFACTURER STATES THAT

With regard to recommendation: (1-10)

1. A modification to prevent the last bale from hanging up in the accumulator is provided in the operators instructions (manual).
2. We do make stackmovers that are equipped with adequate tires and hitch jack.
3. Weather protection is not needed if machine is adequately greased at beginning of season and hinge bolts left loose.
4. Instructions for attaching the accumulator to the baler are provided in the accumulator instructions (manual).
5. Adequate shielding will be provided on future models.
6. Hitch safety chain will be provided on future models.
7. Tires of better quality and same type will be provided on our future models.
8. Safer walking surface on the stacker deck will be provided on our future models.
9. Slow moving vehicle signs and decals that warn persons of potential danger zones will be provided.
10. Operator's manual will be provided (with more detailed instructions).

## GENERAL DESCRIPTION

The Knudson square bale stacker is a self-loading eight wheeled trailer, designed to load, transport and unload square bales. It consists of a main frame that holds the walking beam design suspension. Attached to the main frame is a wood covered tilttable deck upon which the bales are stacked.

Working in conjunction with the Knudson stacker is a bale accumulator. The accumulator connects directly to the baler, collecting bales as they are ejected. It automatically drops six or seven bales in a row on the field.

The stacker picks bales from the field six or seven at a time, by a mechanical pickup that hangs over the right hand side. The bales are stacked in a pyramid shape, with each ascending stack layer containing one less row. The pickup is 20ft (6.1 m) in length and is controlled by two hydraulically operated arms on either end of the machine.

Unloading is accomplished by tilting the deck and activating the PTO-powered winch. The winch winds up a cable attached to a push bar through a series of pulleys. The push bar spans the width of deck and pulls the bales off the deck. FIGURE 1 shows the location of major components and APPENDIX I gives complete specifications.

## SCOPE OF TEST

The Knudson square bale stacker was operated in typical prairie

fields for 30 hours while moving 2500 standard square bales of alfalfa. It was evaluated for: ease of operation and adjustment, quality of work, rate of work, power requirements, operator safety, and suitability of the operator's manual. The purpose of the test was functional performance, and an extended durability test was not conducted. However, mechanical problems were noted throughout the test.

## RESULTS AND DISCUSSION

### RATE OF WORK

Rate of work was hampered by the performance of the accumulator, and the inability of the stacker pickup to release a train of bales when desired. A full load of 285 or 310 bales could be picked from the field and stacked on the deck in about 1.25 hours. Operator experience and ability also affected rate of work. Most operators had difficulty aligning the pickup with the train of accumulated bales on the ground. If the pickup did not slide over the bales due to misalignment, the bales would be knocked askew, and the operator had to manually rearrange them.

The Knudson bale stacker arranged the bales in layers on the deck of the wagon forming a prism (FIGURE 2). The deck was capable of holding 310 bales, 34 in (864 mm) or 285 bales, 40 in (1016 mm) in length. With an average weight of 70 lb (32 kg) per bale, the stacker deck was capable of supporting 10.8 tons (9.8 t) of crop. For eight 7.50 - 16 tires inflated to a maximum pressure of 36 psi (248 kPa), the maximum load is 9 ton (8.1 t) according to standards of the Tire And Rim Association. A fully loaded Knudson stacker would exceed this load limit by 1.8 tons (1.6 t).

### QUALITY OF WORK

Quality of work was good, as the Knudson stacker did not impart any aggressive action on the crop. The bales were stacked in a prism shape, with their longitudinal axes all running the same direction. The stack was constructed in layers, with each ascending layer containing six or seven less bales (one row) than the preceding layer. The exposed surface area per ton of hay was high in comparison with round bales or other automatic square bale stackers. No long term study was conducted to determine the weatherability of stacking hay in this fashion. The resulting stack was stable and required no poles or other means of support.



FIGURE 2. Bale Arrangement On Deck.

### EASE OF OPERATION AND ADJUSTMENT

**Accumulating:** The performance of the accumulator made loading the Knudson stacker difficult.

The purpose of the bale accumulator was to collect bales as they were ejected from the baler. The bales were accumulated butt end to end. When the accumulator was full of bales, they were automatically dropped in the field in the direction they were baled. The accumulator allowed space for six bales, 40 in (1016 mm) long and seven bales 34 in (864 mm) long, for a cumulative length of 20 ft (6.1 m). Often the sixth or seventh bale would hang up in the accumulator and a large space of 15 to 20 ft (45 to 61 m) would be left in the train of bales dropped in the field. No adjustments were available to rectify the problem. When crops with less than 16% moisture were baled, the problem did not occur as often. It is recommended that the manufacturer make modifications to pre-

vent the last bale from hanging up in the accumulator. Accumulator performance was rated as fair.

**Adjustments:** Adjustments for the height and angle of the stacker pickup were easy and took one person about five minutes to accomplish. The adjustment consisted of loosening four bolts and sliding the arm stop to the desired position (FIGURE 3). Bale length had to be adjusted to effectively operate the accumulator. No other adjustments were available on the accumulator. Adjustments were rated as good.

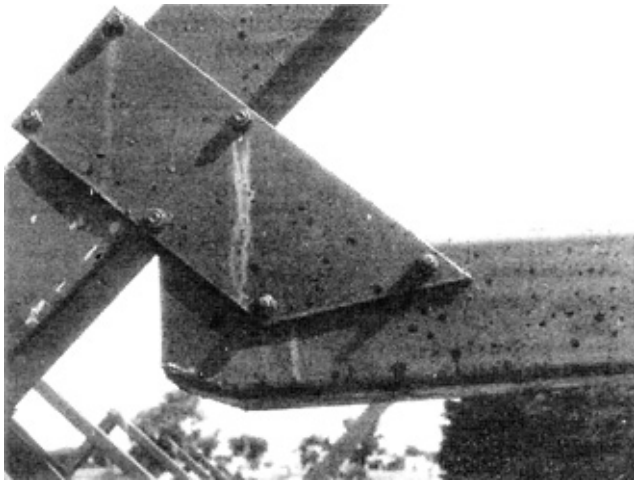


FIGURE 3. Adjustable Arm Stops.

**Stacker Hitching:** The Knudson stacker was not equipped with an integral hitch jack. A hydraulic jack or other similar device had to be used to raise the hitch to the proper height for hitching. Sometimes, if the wagon was not sitting level, it would fall off to one side when the hitch was raised for hook-up, creating a dangerous situation. It is recommended that the manufacturer provide a suitable jack for hitching or unhitching. Once the hitch was raised to the proper height and the hole in the hitch aligned with the drawbar hole, a pin of the proper size with a suitable locking device made the hookup safe and reliable. Hook-up was completed when the power shaft was connected to the 540 rpm PTO shaft of the tractor, and four hydraulic hoses were connected to the remote hydraulic outlets of the tractor. Hitching was rated as fair.

**Accumulator Hitching:** The accumulator was equipped with a hitch to connect it directly to the baler. The operator's manual did not contain instructions that outlined the proper procedure for connecting the accumulator to the baler. It is recommended that the manufacturer provide adequate instructions for hitching to the baler. Modifications to a John Deere 347 square baler were necessary to attach the accumulator. The bale chute had to be removed and holes drilled in the sides of the bale chamber to allow attachment of the accumulator hitch. Modifications to the baler took two persons about two hours. These modifications were difficult and time consuming, but once accomplished accumulator hook-up was quick and easy. Accumulator hitching was rated as good.

**Loading:** The Knudson stacker was placed in field position by hydraulically lifting the pickup from its transport position and placing the arm stops in the field position on the front and rear of the frame (FIGURE 4). The train of bales were approached and the pickup guided to slide over the bales. When the first bale into the pickup reached the rear, it tripped a trigger that closed the pickup on the train of bales (FIGURE 5).

Considerable practice was required before operators became proficient at aligning the pickup with the train of bales on the ground. The narrow opening of the pickup mouth made retrieval of bales difficult. Normally, the pickup mouth is in the open position for the bale retrieval. However, when the accumulator dropped the last bale some distance from the main row, the pickup was closed by the time it reached this displaced bale. This made loading difficult. In addition, the operator was forced to turn in the seat to look back at the loading sequence at all times. This contributed to operator fatigue.

The bales were raised clear of the ground and placed in the desired position on the stacker deck. The bales were released from the pickup by applying a downward force of the pickup arms,



FIGURE 4. Pickup in Field Position.

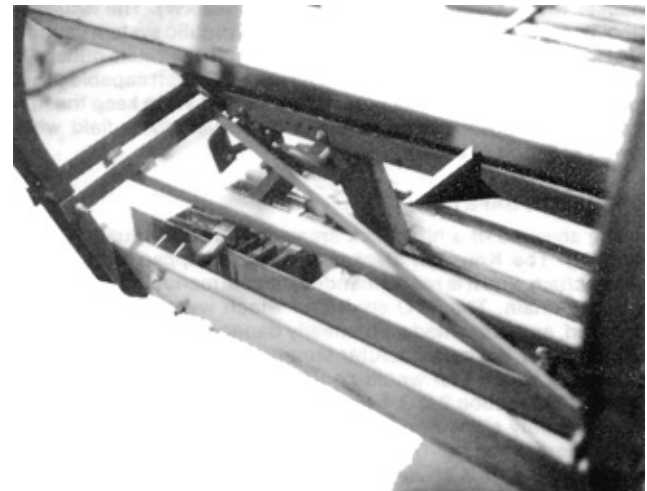


FIGURE 5. Trigger for Closing Pickup.

re-engaging the pickup in the open position. The arms lifted the pickup free of the bales, and moved the pickup cage to the field position. In most cases the pickup would not reset itself to the open position, and the operator had to dismount the tractor, walk to the rear of the bale stacker and free the mechanism with a screw driver. It is recommended that the manufacturer supply a method or device that would prevent the hinge points from rusting during outdoor storage. Loading was rated as fair.

**Transporting:** The Knudson Square Bale Stacker was equipped with a gooseneck fifth wheel type hitch for transporting the bale mover long distances. It was transported empty for approximately 700 mi (1120 km). The goose neck hitch was removed for field work. The Knudson stacker towed straight and was maneuverable when backing to an unloading site. The fully loaded wagon could be brought to a complete stop in 23 ft (7 m), when travelling at 15 mph (24 km/h) with a 110 hp (83 kW) tractor. Transporting was rated as very good.

**Unloading:** The Knudson stacker was unloaded by selecting the proper position of the flow divider valve that controlled the flow of hydraulic oil to the various cylinders. When oil was directed to the deck tilt cylinder, the deck tilted to the rear in preparation for unloading. The arms that controlled the bale pickup were moved to a position where they would not interfere with the bales as they were moved off the machine. The operator then left the tractor seat and placed the winch levers in the proper position for PTO operation. Once again in the tractor seat, the operator engaged the PTO winch and the bales started to move off the deck. It was necessary to move the tractor ahead very slowly until all of the bales were on the ground. Once the bales were unloaded, the deck was returned to the field position, the PTO winch was placed in neutral, and the push bar returned to the front by manually cranking a hand winch connected to a cable. The flow divider was returned to the field position and the pickup was returned to the field position. Unload-



ing was easy and took one person about five minutes. Unloading was rated as very good.

**Lubrication:** Grease pressure nipples were provided at four positions on the bale accumulator and were easy to service. The Knudson stacker required lubrication at the hinge points of the loading arms and the pivot points of the tie bar that connects the front and rear loading arms. The pressure nipples at the loader arm hinge points were difficult to get at and two refused grease. In addition, pressure nipples were provided to lubricate the walking axles. Lubrication was rated as fair.

## POWER REQUIREMENTS

The Knudson stacker was supplied with a gooseneck fifth wheel type hitch, for transporting long distances with a truck. PAMI suggests a truck of at least 1 ton capacity with a low rear axle ratio.

The manufacturer does not make a recommendation of tractor size or power. ASAE standards state that the weight of the towing vehicle should not be exceeded by the implement or trailer being towed. For a fully loaded Knudson stacker, this would require a tractor of at least 150 hp (112 kW) to safely operate and keep the fully loaded stacker under control during a sudden stop situation. However, PAMI effectively operated a fully loaded Knudson stacker with a Deutz-Allis 7110 of 110 hp (82 kW). The Knudson stacker required a towing vehicle with a hydraulic system capable of at least 1500 psi (10.3 MPa) and two remote hydraulic outlets. In addition, the towing vehicle had to have a PTO shaft capable of 540 rpm. The Knudson stacker required 33 hp (25 kW) to keep the fully loaded bale mover rolling across a firm level alfalfa field when towed at 5 mph (8 km/h).

## OPERATOR SAFETY

The absence of a hitch jack created an unsafe situation when hitching. The Knudson stacker was not equipped with a hitch safety chain, and it is recommended that the manufacturer provide a safety chain. The PTO shaft and winch were not adequately guarded, and presented a potentially dangerous area. It is recommended that the manufacturer supply guards for the PTO shaft and cable winch that would conform to the ASAE standard for safety §390 section 2.2, 2.4 and 2.6. The Knudson stacker did not display safety signs or decals necessary to alert the operator or bystanders of the risk of personal injury during normal operation and servicing. It is recommended that the manufacturer supply such decals. The deck of the Knudson stacker was constructed of 2 x 4 lumber, with space between boards. When walking on the deck, care had to be taken not to injure an ankle or leg. It is recommended that the manufacturer provide a safer walking surface on the deck. The Knudson stacker was not equipped with a slow moving vehicle sign. It is recommended that a slow moving vehicle emblem be provided as suggested by ASAE standards. The operator safety was rated as fair.

## OPERATOR'S MANUAL

No operator's manual was supplied. Instead, a folder that contained some photographs, and a few rudimentary instructions was supplied.

The manual did not contain much useful information. It is recommended that the manufacturer supply an operator's manual that would include such items as: operation and adjustments, service and maintenance, safety, specifications, and hydraulic schematics. The operator's manual was rated as poor.

## MECHANICAL HISTORY

TABLE 1.

ITEM	HOURS
Pivot pin failed at	6
Pickup bent at	17
Flat tires at	21 & 24
Boards on deck broke at	at end of test

The Knudson stacker received by PAMI, had been previously stored outdoors for a considerable time. The hinge points on the pickup cage were rusted, and did not operate freely. The pickup cage was troublesome throughout the test period, and frequently required a prybar to reset to the open position. In addition the pickup cage would not release the bales when desired. A pivot pin

that connected the two halves of the hydraulically operated pickup arm failed and had to be replaced. The cost of the replacement pin was negligible, but it took two persons about two hours to affect repairs. The flared opening of the pickup bent, as a result of aligning the pickup with the train of bales. The pickup had to be straightened, and took one person about four hours. The tires supplied with the machine were old and worn, and were not all of the same type or size. It is recommended that the manufacturer supply tires that are capable of the intended requirement. Two flat tires occurred during the test period. The wooden deck of the stacker was weathered and worn, and some boards were broken during the test. TABLE 1 shows the mechanical history of the Knudson stacker and the times the failures occurred.

APPENDIX I		
<b>SPECIFICATIONS:</b>		
<b>MAKE:</b>	Knudson	
<b>MODEL:</b>	Square Bale Stacker	
<b>SERIAL NUMBER:</b>	0089	
<b>OVERALL DIMENSIONS:</b>		
- length	28.2 ft	(8.6 m)
- overall width (transport)	15.0 ft	(4.6 m)
- length with gooseneck	35.9 ft	(10.9 m)
- pickup length	22.7 ft	(6.9 m)
- height	12.0 ft.	(3.6 m)
- width in field position	18.0 ft	(4337 kg)
<b>WEIGHT:</b>		
- weight, total	9541.8 lb	(4337 kg)
- right wheel	4329.6 lb	(1968 kg)
- left wheel	4171.2 lb	(1896 kg)
- hitch	1041.0 lb	( 473 kg)
<b>SUSPENSION:</b>		
- axles	4	
- arrangement	Walking beam	
- tires	eight, 7.50-16	
<b>HYDRAULICS:</b>		
- cylinders	5	
- deck lift cylinders		
- bore	2.5 in	( 64 mm)
- stroke	24.0 in	(610 mm)
- control arm cylinders		
- lower (2 cylinders)		
- bore	3.0 in	(76 mm)
- stroke	36.0 in	(915 mm)
- upper (2 cylinders)		
- bore	2.5 in	(64 mm)
- stroke	28.0 in	(710 mm)
- oil flow control	1 flow divider valve (manually operated)	
<b>LOAD CAPACITY:</b>	9 ton	(8.1 t)
<b>DECK:</b>		
- material	2 x 4 spruce lumber	
- tilt	35°	
<b>LOADING:</b>	Hydraulic arm pick-up	
<b>UNLOADING:</b>	Deck tilts hydraulically. Bales are pushed off mechanically. PTO driven power winch. Hand operated winch for bale drag return.	
<b>ACCUMULATOR:</b>		
- length	21.7 ft	(6.6 m)
- width overall	7.0 ft	(2.1 m)
- height	3.9 ft	(1.1 m)

APPENDIX II	
<b>MACHINE RATINGS</b>	
The following rating scale is used in PAMI Evaluation Reports	
Excel lent	Fair
Very Good	Poor
Good	Unsatisfactory

## SUMMARY CHART

### KNUDSON SQUARE BALE STACKER AND ACCUMLATOR

<b>RETAIL PRICE:</b>	\$12,025 including Accumulator (March 1988, f.o.b. Consort, Alberta.)
<b>RATE OF WORK:</b>	A full load of 285 or 310 bales could be stacked in 1.25 hr. Rate of work was hampered by accumulator performance.
<b>QUALITY OF WORK:</b>	<b>Good;</b> no aggressive action to crop. Resulting stack was stable.
<b>EASE OF OPERATION AND ADJUSTMENTS:</b>	
- stacker hitching	<b>Fair;</b> no hitch jack was provided.
- accumulator hitching	<b>Good;</b> some baler modifications were required.
- loading	<b>Fair;</b> pickup would not release bales when desired.
- transporting	<b>Very Good;</b> towed straight and true. Required a 1 ton truck for long distance travel.
- unloading	<b>Very Good;</b> was easy to unload.
- lubrication	<b>Fair;</b> some nipples were hard to get at, others would not accept grease.
- accumulating	<b>Fair;</b> would drop the last bale some distance from the others. No adjustments other than bale length were possible.
- stacker adjustments	<b>Good;</b> adjustments for the height and angle of pickup were available.
<b>POWER REQUIREMENTS:</b>	ASAE standards suggest a tractor 150 hp (112 kW) for the weight of the loaded stacker. PAMI effectively operated the stacker with 110 hp (83 kW) tractor.
<b>OPERATOR SAFETY:</b>	<b>Fair;</b> lack of hitch jack created an unsafe situation when hitching. No safety decals were displayed.
<b>OPERATOR'S MANUAL:</b>	<b>Poor;</b> lacked instructions and necessary information.
<b>MECHANICAL HISTORY:</b>	The pickup cage was troublesome. A pivot pin failed. The flaired bale pickup bent, and boards on the stacker deck were broken.



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