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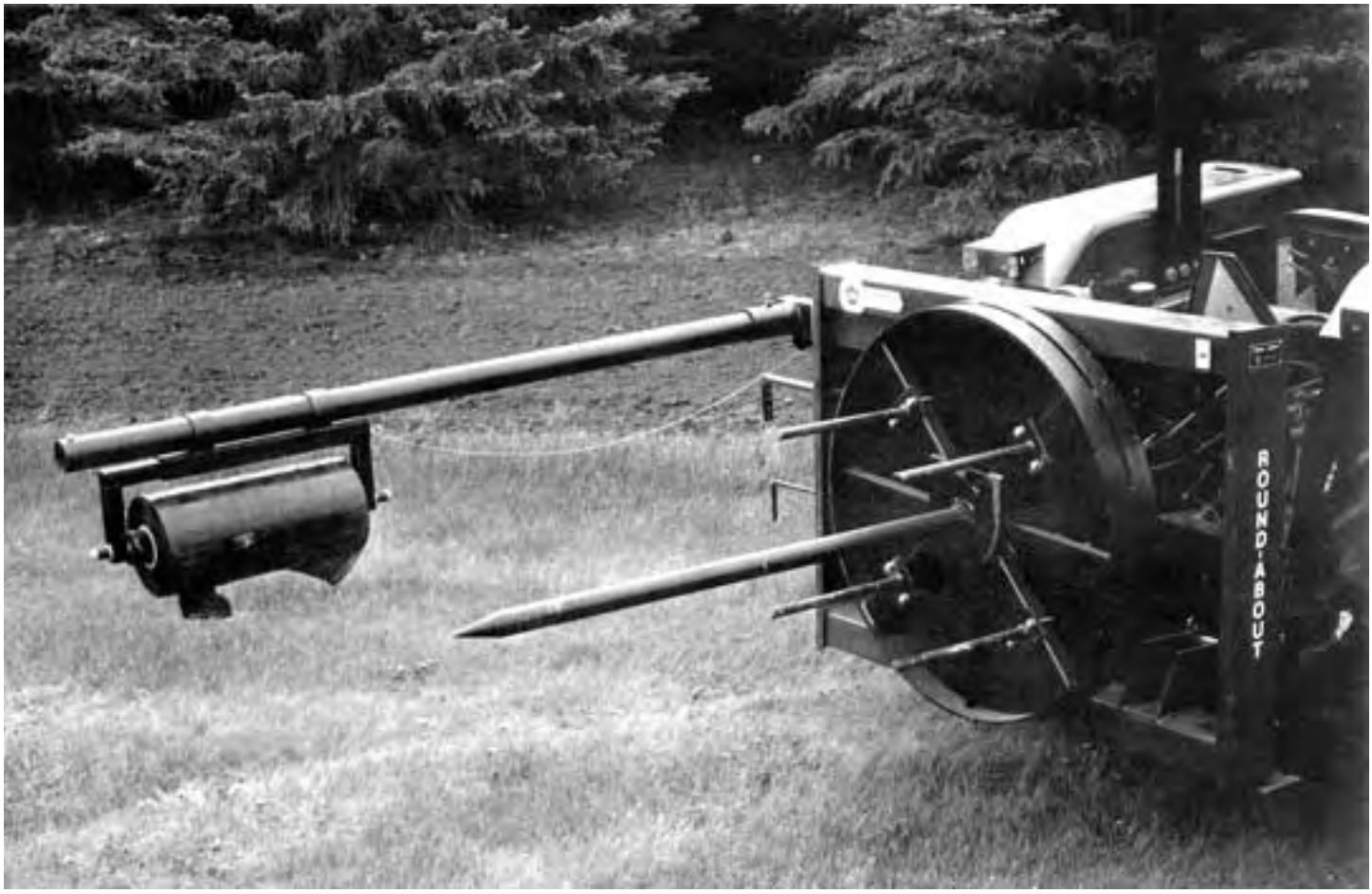
Evaluation Report 627



Unverferth RA220 Bale Wrapper

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

UNVERFERTH RA220 BALE WRAPPER

MANUFACTURER:

Unverferth Manufacturing Co. Inc.
P.O. Box 357
Kalida, Ohio
45853
Phone (419)532-3121

DISTRIBUTOR:

Ag Line International Ltd.
3020 Idylwyld Drive N.
Saskatoon, SK
S7L 5Y6
Phone: (306) 242-7856

RETAIL PRICE:

$2,295.00 (March 31,1990, f.o.b. Portage la Prairie, MB) Plastic wrap 1.7 x 6000 ft (0.51 x 1829 m) roll $83.00 (March 31,1990, f.o.b. Portage la Prairie, MB).

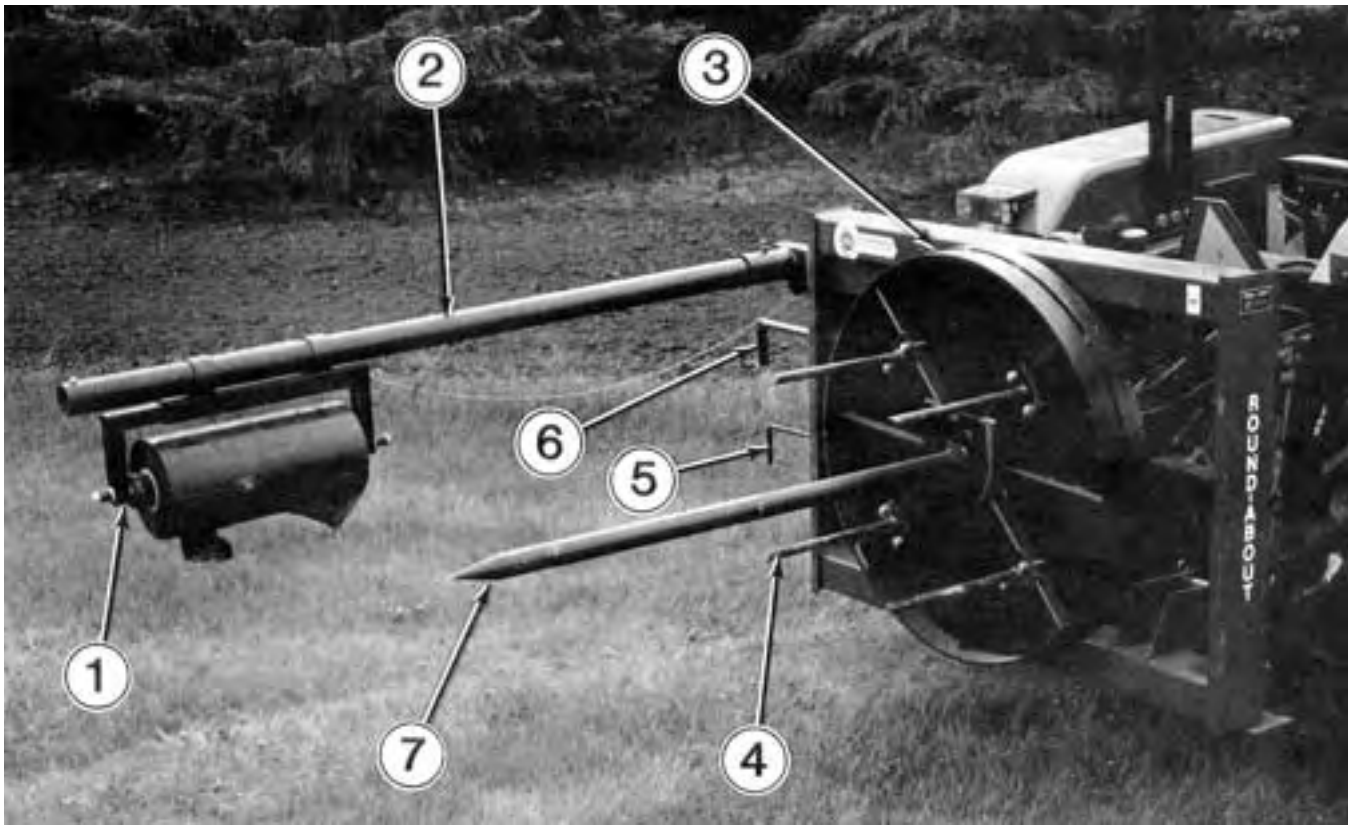


FIGURE 1. Unverferth Bale Wrapper: (1) Plastic Wrap Carrier, (2) Carrier Pole, (3) Drive Wheel, (4) Drive Prongs, (5) Winch Control Handle, (6) Speed Control Handle, (7) Centre Spike.

SUMMARY AND CONCLUSIONS

Rate of Work: Peak workrates of 10 to 12 bales/hour were realized. Rate of work was highly dependent upon the proximity of the hay bales to the storage site.

Quality of Work: Quality of work of the wrapping system was very good. The Unverferth was well suited to bale shape variations. The clinging agent of the plastic provided a good bond between the plastic layers. Storability of wrapped bales was very good. A space of 4 to 6 in (100 to 150 mm) between bales placed end to end provided good ventilation.

Ease of Operation: Ease of hitching, plastic wrap installation and removal of plastic was very good. Ease of wrapping, loading and unloading, and maneuverability was good. Plastic wrap rolls were easy to install. Well formed bales loaded onto the Unverferth concentrically ensured easy wrapping. Operator had to disengage carrier winch in advance of wrap completion to prevent damage to the winch. Plastic was easily removed.

Ease of Adjustment: Ease of adjusting plastic overlap was very good. Ease of adjusting the plastic wrap tension was fair. Ease of lubricating the Unverferth was good. Adjustments were fast and simple and accomplished with common farm tools.

Power Requirements: Most 65 hp (50 kW) tractors were of adequate weight to maintain stability while supporting up to a 2000 lb (900 kg) bale on the three-point hitch.

Operator Safety: Operation of the Unverferth required special safety precautions.

Operator's Manual: The operator's manual was poor. Among other items, the operator's manual failed to include specific safety instructions or warnings, descriptions of major components and repair instructions. The instructions presented in the operator's manual provided limited information.

Mechanical History: The drive gear of the hydraulic motor failed. The carrier winch plate distorted during the evaluation. The drive wheel periodically rubbed against the frame.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to provide a more durable plastic roll retaining system on the plastic wrap carrier.
2. Modifications to the carrier winch control that would improve operator safety and functional performance.
3. Incorporating a device to cut the plastic at the end of the wrap cycle.
4. Modifications to the plastic wrap tension system to improve ease of adjustment and to prevent changes in tension as the bale is being wrapped.
5. Including warning signs on the machine at hazardous locations.
6. Modifications to the operator's manual to meet the items

suggested by the ASAE Engineering Practice EP 363.1 "Technical Publications for Agricultural Equipment."

Station Manager: B.H. Allen

Project Engineer: R. W. Schott

THE MANUFACTURER STATES THAT

With regard to the recommendation:

1. We have changed the thickness on the inner tube so it will withstand the force of a setscrew.
2. An additional pulley has been placed for the cable to pass through. When the plastic holder has bottomed out, belt tension is released. This prevents bending of the winch assembly and is also a safety feature.
3. A device to cut the plastic at the end of the wrap cycle will be considered.
4. When we tested the RA220, this problem was not experienced. We will check the quality of the lock nut on the inner spool for friction consistency. The appropriate changes will be made.
5. A stop will be located on the back side of the pole to eliminate the pinch point. The new device to automatically release belt tension does away with the potential of cable breakage. Appropriate warning decals will be placed on the machine and in the Operator's Manual.
6. A new Operator's Manual is being drafted.

MANUFACTURER'S ADDITIONAL COMMENTS

1. The failure of the sprocket on the drive motor was due to its powdered metal construction. Our supplier mistakenly shipped these instead of the steel sprocket.
2. More clearance will be provided to keep the wheel from contacting the frame.
3. The free fall of the bale can be eliminated by adjusting the return flow valve.
4. A holder has been added to store the centre spike stand when not in use.

GENERAL DESCRIPTION

The Unverferth Bale Wrapper (FIGURE 1) is a hydraulically driven round bale wrapping system which mounts onto a Category II or III three-point tractor hitch and can wrap a wide range of bale shapes and sizes. A single hydraulic remote outlet is required for operation of the wrapper. Bales are wrapped with a 20 in (508 mm) wide roll of plastic. The roll is mounted into the plastic wrap carrier and is free to turn as the rotating bale pulls the plastic off of the roll. The carrier moves along the edge of the bale as the bale turns. The Unverferth bale wrapper is not designed to totally encase the bale in plastic. Only the circumference of the bale is wrapped. The ends of the bale are left exposed.

To load a bale, the wrapper is backed into the bale. The 57 in (1450 mm) centre spike and the four 16 in (406 mm) drive prongs pierce the bale. To begin the wrapping sequence, the plastic wrap and carrier are moved to the end of the carrier pole. The free end of the plastic is tied around 2 or 3 twines at the end of the bale. To begin wrapping, the speed control handle is turned up to open the hydraulic flow control valve. This valve governs the speed at which the bale rotates. Once the end of the bale is wrapped, the carrier winch assembly is engaged by pulling the winch control handle fully out and locking it in place. The winch assembly pulls the plastic wrap carrier along the carrier pole. The speed at which it travels is timed with the rotational speed of the bale. Once the plastic reaches the inner end of the bale, the winch assembly is disengaged. The flow control valve is then turned off when this end of the bale is completely wrapped.

The amount of plastic overlap and the plastic tension are adjustable. The carrier pole can be moved in or out to suit the diameter of the bale. The 20 in (508 mm) wide roll of 0.9 mil plastic contains a clinging agent and an ultraviolet inhibitor. One 6000 ft (1830 m) roll will wrap about thirty-five, 5 x 5 ft (1.5 x 1.5 m) bales with a double layer of plastic wrap.

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

SCOPE OF TEST

The Unverferth Bale Wrapper was operated for approximately 16 hours while wrapping 142 hard core, round bales of alfalfa. It was evaluated for rate of work, quality of work, ease of operation, ease of adjustment, tractor requirements, operator safety and suitability of the operator's manual. Although extended durability testing was not conducted, the mechanical failures, which occurred during the evaluation were recorded.

RESULTS AND DISCUSSION

RATE OF WORK

Rate of work was highly dependent upon the proximity of the hay bales to the storage site. The Unverferth was most suitable for wrapping bales once they had been transported to the storage site. Peak workrates of 10 to 12 bales/hour were realized with one operator. A second person did not increase the workrate significantly.

QUALITY OF WORK

Plastic Wrap: The quality of work of the wrapping system was very good. Bales of varying widths and diameters were wrapped with two layers of plastic to provide a durable cover. The clinging agent of the plastic provided a good bond between the layers of plastic. The Unverferth was well suited to bale shape variations such as barrel shaped and cone shaped bales. The narrow width of the plastic ensured a good fit of the plastic around the bale. The plastic can be easily punctured and therefore the bales must be handled with care after wrapping.

Storability: Storability of the bales wrapped by the Unverferth was very good. However, proper moisture content was important to prevent spoilage. Hay baled at 15% MC or less could be wrapped the same day that it was baled. Hay baled between 15% and 18% MC was left in the field for a few days, weather permitting, before wrapping to allow the bales to dissipate any excess moisture. Bales that had a moisture content greater than 18% were not wrapped because the plastic would limit their "breathing" ability and promote heating and subsequent spoilage of the bales.

It was determined that the best way to store bales was when they were placed end to end in rows with a 4 to 6 in (100 to 150 mm) space between bales (FIGURE 2). This space allowed the bales to ventilate. Any moisture that penetrated the bale through punctures in the plastic or "hot spots" within the bale could then dissipate. Storing bales by placing their ends tight against adjacent bales allowed little ventilation and could potentially lead to heating and spoilage.

FIGURE 2. Storage of Round Bales Wrapped with Plastic.

EASE OF OPERATION

Hitching: Ease of mounting the Unverferth Bale Wrapper to a tractor was very good. The Unverferth could be mounted to a tractor using a Category II or III three-point hitch. However, bushings required for Category II were not provided. Stands were provided which allowed the operator to set the Unverferth on the ground and detach it from the tractor. During operation, these stands were removed from the wrapper. One set of hydraulic couplings was connected to a hydraulic remote circuit on the tractor.

Plastic Wrap Installation: Ease of installing the plastic wrap was very good. The plastic wrap carrier allowed a maximum roll diameter of 12 in (305 mm) and a roll length ranging from 17 to 31 in (430 to 790 mm).

The plastic wrap carrier (FIGURE 3) was made of two hollow steel tubes. One tube fit inside the other. A cone shaped spool was fastened to the end of the framework of each tube. The spools protruded into the ends of the cardboard core of the plastic roll and were knurled to provide greater gripping force to the core of the plastic

roll. The inner tube moved inside the outer tube to tightly squeeze the spools into the plastic roll. A bolt threaded through the outer tube and bearing against the inner tube was intended to secure this assembly. However, tightening the bolt easily deformed the inside tube (FIGURE 3). It is recommended that the manufacturer consider modifications to provide a more durable plastic roll retaining system on the plastic wrap carrier.

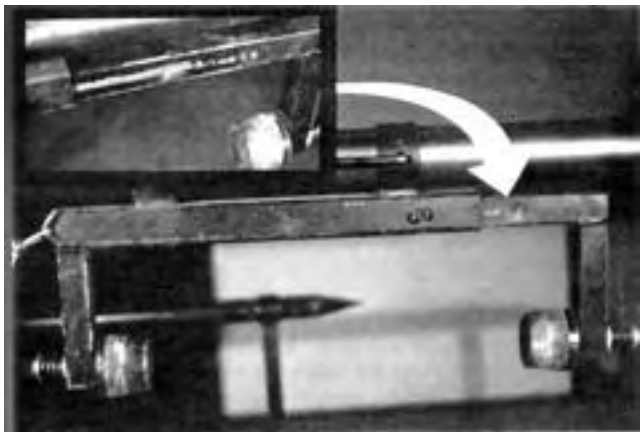


FIGURE 3. Plastic Wrap Carrier.

Wrapping: Ease of wrapping bales was good. Once the operator became familiar with the Unverferth, it was easy to operate throughout the wrapping cycle.

It was important to pierce the bales through their centre of gravity. Otherwise, the rotational speed of the bale during wrapping was not consistent. The off-centre weight of the bale would speed up and slow down the drive wheel, and induce a thrust load onto the wrapper. This could lead to durability problems. Similar problems occurred when wrapping “out of round” bales.

Bales loaded onto the wrapper often “fell away” from the wrapper as shown in FIGURE 4. When this occurred the surface of the bale did not run parallel with the plastic and an extra 2 or 3 wraps of plastic were necessary to cover the entire bale. This problem occurred most frequently with lower density bales in which the drive prongs were not capable of supporting the bale squarely on the wrapper. Adjusting the third point on the three-point hitch such that the wrapper was tilted back provided some aid to this problem. However if the wrapper was tilted back more than 10 degrees the plastic roll carrier had a tendency to slide ahead on the carrier pole. This led to less plastic overlap than desired.

FIGURE 4. Round Bale Not Sitting Squarely on Wrapper

Starting the wrapping cycle was easy. The operator tied the free end of the plastic around the strings at the outer end of the bale and then turned the speed control handle up to begin wrapping. In some cases, where the twine was loose on the bale, the plastic would slide along the twine as the bale turned. Pressure had to be applied to the plastic against the bale in order for the wrapping to begin.

The carrier winch assembly pulled the plastic wrap carrier along the carrier pole beside the rotating bale, which pulled the plastic off of the roll. The design of the winch assembly led to some problems. As the plastic wrap carrier reached the fixed end of the carrier pole it came up against a stop. Normally the operator would disengage the winch before this occurred. In cases where the operator did not disengage the winch in time, the carrier bearing against the stop resulted in continual tightening of the winch cable (FIGURE 5). Continued winch operation beyond this point resulted in damage to the winch plate and shaft (FIGURE 5). In addition, other components of the wrapper could be damaged. This could be hazardous to the operator.

FIGURE 5. Tight Cable Resulting from Carrier Bearing Against its Stop and the Resulting Damage of the Winch Plate.

The winch drive was engaged and disengaged by the operator moving the winch assembly to tighten and loosen the drive belt respectively. If the operator failed to disengage the winch before the cable tightened excessively, the operator could not easily loosen the drive belt. To loosen the drive belt, the winch assembly had to be moved in the direction opposite to the cable tension. The excess cable tension did not allow this. To correct the problem, it was necessary to turn the drive wheel backwards by carefully reversing the direction of the hydraulic flow in the tractor. After the load had been relieved from the cable, the operator could then disengage the winch. It is recommended that the manufacturer consider modifications to the carrier winch assembly that would improve operator safety and functional performance.

The operator was required to use a knife to cut the plastic once wrapping was complete. It is recommended that the manufacturer consider incorporating a device to cut the plastic at the end of the wrap cycle.

Loading and Unloading: The ease of loading and unloading was good. Loading bales was accomplished by backing the prongs into either end of the bales. This was easy for well formed bales. Barrel shaped or cone shaped bales were often more difficult to load. It was usually easier to load a cone shaped bale by backing into its short end. Lower density bales often hung down on the wrapper (FIGURE 4). To unload the bale the operator simply set the bale on the ground and drove away. No problems occurred if the operator drove straight away from the bale while the prongs and centre spike were drawn out. If the wrapper was not driven straight out from the bale, the centre spike would damage the core of the bale and move the bale out of place.

Maneuverability: Ease of maneuvering the wrapper was good. The loaded bale caused some rear visibility problems. The operator normally had no problems placing the bale provided the wrapper was carried as low as possible without the bale touching the ground while backing into the stack. The wrapper was not laterally stable on some tractors. Tractors equipped with anti-sway blocks minimized the swaying.

Removal of Plastic: The ease of removing the plastic from the bale was very good. The operator used a knife to cut the plastic along one side of the bale. The plastic came off in one sheet and was folded together prior to disposal. Removal of the plastic was not tested under snow and ice conditions. There has been concern regarding the safe environmental disposal of plastic products. The used plastic might be suitable for disposal at a recycling depot.

EASE OF ADJUSTMENT

Plastic Wrap Tension: Ease of adjusting the tension of the plastic wrap was fair. The adjustment device consisted of a bolt, compression spring and a lock nut welded inside the spools on the plastic wrap carrier (FIGURE 3). Tightening the lock nut compressed

the spring, which increased the drag force as the plastic roll turned. This system allowed for a good range of tension settings.

The front spool was difficult to adjust because the lock nut was tight on the bolt. The rear spool was easy to adjust. However, as the plastic roll turned, the bolt tightened which increased the tension above that desired. The spring often became completely compressed and the plastic roll would turn on the spool, damaging the cardboard core of the roll.

The lowest tension settings provided a satisfactory wrap. At high tension settings the plastic roll frequently turned on the spools. It is recommended that the manufacturer consider modifications to the plastic wrap tension system to improve ease of adjustment and to prevent changes in tension as the bale is wrapped.

Plastic Wrap Overlap: Ease of adjusting the amount of plastic wrap overlap was very good. The adjustment was made possible with four cable guide bolts fastened to the winch wheel (FIGURE 6). These bolts were located in slots and could be moved in or out. The bolts should be set at an equal distance from the centre of the winch wheel. Increasing the distance between opposite bolts increased the speed the carrier moved along the carrier pole relative to the rotational speed of the bale. This decreased the amount of overlap.

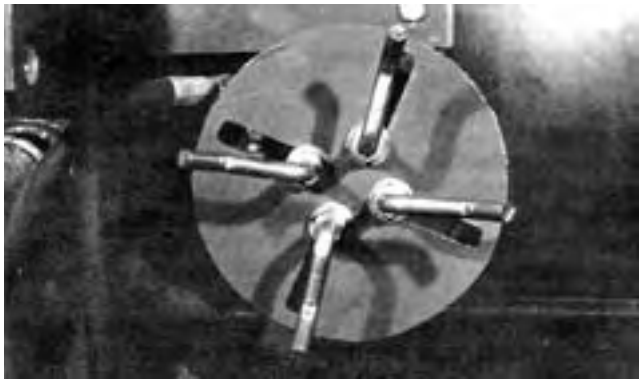


FIGURE 6. Overlap Adjustment in Carrier Winch.

The manual states, “four times the distance (between the) 90 degree bolts on centre will give amount of overlap.” This is incorrect. The amount of overlap is equal to the difference between the width of the plastic roll and the distance the carrier travels along the carrier pole per bale revolution. Carrier travel along the carrier pole per bale revolution can be estimated by multiplying the distance between opposite guide bolts (outside to outside) by 3.0. (This assumes the winch pulley is the same size as the driving pulley on the centre spike of the wrapper).

TABLE 1 shows the amount of plastic wrap overlap for three guide bolt settings. A double wrap of plastic is advisable to ensure a durable cover. This is achieved when the guide bolt setting is at 3.25 in (83 mm). At minimum, the overlap should be large enough so that adjacent wraps will adhere to one another.

TABLE 1. Plastic Overlap Settings

	Guide Bolt Setting (Outside to outside of opposite bolts)		**Carrier Travel** per Bale Revolution		**Plastic Wrop Overlap**		
	in	**mm**	**in**	**mm**	**in**	**mm**	**%**
Minimum	2.5	64	7.75	197	12.25	311	61
	3.25	83	10.0	254	10.0	154	50
	4.25	108	13.0	330	7.0	178	35
Maximum	6.75	171	20.0	508	0	0	0

Lubrication: Ease of lubrication was good. The carrier pole and centre spike were easily lubricated with graphite. It was difficult to pack the drive wheel with grease. This required dismantling the centre spike and drive wheel from the wrapper framework. The wrapper did not have a grease fitting at this location as stated in the operator’s manual.

POWER REQUIREMENTS

The tractor must have adequate weight to maintain stability while supporting up to a 2000 lb (900 kg) bale on the three point hitch. Most 65 hp (50 kW) tractors were heavy enough for the job. A single hydraulic outlet was required for operation of the bale wrapper.

OPERATOR SAFETY

Operation of the Unverferth required special safety precautions. The plastic wrap carrier had the potential to pinch the operator’s fingers as it approached its stop. The winch cable or other winch components could break and strike the operator if the operator neglected to disengage the winch before completing the wrap cycle. In the case of “out of round” bales and bales loaded off centre, the speed of bale rotation should be limited to prevent instability problems. No specific safety warnings were provided in the operator’s manual nor on the machine. Rotating parts were guarded by location. It is recommended that the manufacturer consider including warning signs on the machine at hazardous locations.

OPERATOR’S MANUAL

The operator’s manual was poor. In reference to the ASAE Engineering Practice EP 363.1 the operator’s manual did not include a forward/introduction, a description or illustration of the machine (other than a parts diagram), a description of operation and adjustment of major components, specific safety instructions or warnings, illustrations used for instructions, repair instructions and a specifications list. The instructions provided were not clear or complete. It is recommended that the manufacturer consider modifications to the operator’s manual to meet the items suggested by the ASAE Engineering Practice EP 363.1 “Technical Publications for Agricultural Equipment.”

MECHANICAL HISTORY

The Unverferth bale wrapper was operated for 16 hours while wrapping 142 bales. The intent of the test was an evaluation of functional performance and an extended durability evaluation was not conducted. TABLE 2 outlines those problems, which occurred during functional testing.

The drive gear of the hydraulic motor failed after wrapping seven bales. It was replaced with a new one and no further problems occurred. Replacing this gear was difficult. The centre spike and the drive prong wheel had to be dismantled from the wrapper. Reconnecting and tightening the drive chain was awkward.

During the evaluation the winch plate distorted (FIGURE 5). This was caused by the operator neglecting to disengage the winch once the plastic roll carrier reached its stop. The cable tightened and pulled the cable guide bolts inward, which caused distortion in their mounting plate and the drive shaft. After wrapping 142 bales this shaft no longer turned freely. The distortion did not interfere with the operation of the wrapper.

During the evaluation the drive wheel rubbed against the top and bottom frame of the wrapper. This problem was more prevalent on the bottom due to the cantilevered weight of the bale. It did not interfere with the operation of the wrapper.

TABLE 2. Mechanical History

Item	**Operating Hours**	**Equivalent Wrapped Bales**
-Drive gear failed and replaced at	0.5	7
-Winch plate distorted	Throughout the test	
-Drive Wheel rubbed against the wrapper frame	Throughout the test	

APPENDIX I
SPECIFICATIONS:

MAKE:	Unverferth
MODEL:	RA220
SERIAL NUMBER:	221254
OVERALL DIMENSIONS:	
-- length	7.5 ft (2.3 m)
-- width	5.8 ft (1.8 m)
-- height (resting on stands)	4.6 ft (1.4 m)
TOTAL WEIGHT:	717 lb (326 kg)
HITCH:	Three-point hitch Category II or III
CENTRE SPIKE LENGTH:	4.8 ft (1.5 m)
CARRIER POLE LENGTH:	6.3 ft (1.9 m)
DRIVE WHEEL DIAMETER:	3.4 ft (1.0 m)
DRIVE PRONGS:	
-- number	4
-- length	1.3 ft (0.4 m)
-- radial adjustment	7 to 17 in (180 to 430 mm) from centre spike
PLASTIC WRAP CARRIER:	
-- distance from centre spike	3.0 to 3.9 ft (0.9 to 1.2 m)
-- maximum plastic roll diameter	12 in (30 mm)
-- roll width	17 to 31 in (430 to 790 mm)
HYDRAULIC MOTOR:	One, drives wheel & plastic wrap carrier
FLOW CONTROL VALVE:	One
CARRIER WINCH:	One
LUBRICATION:	
-- graphite	Carrier pole & centre spike periodically as required for proper functioning.
-- grease	Drive wheel

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

SUMMARY CHART
UNVERFERTH RA220 BALE WRAPPER

RETAIL PRICE	$2,295.00 (f.o.b. Portage la Prairie, MB) Plastic roll $83/6000 ft, sufficient to double wrap about 35 bales.
RATE OF WORK	10 to 12 bales/hour.
QUALITY OF WORK	
Plastic Wrap	**Very Good;** well suited to bale shape variations.
Storability	**Very Good;** bales spaced 4-6 inches apart to permit ventilation.
EASE OF OPERATION	
Hitching	**Very Good;** stands provide easy hitching to a three-point hitch.
Plastic Wrap Installation	**Very Good;** easy to install.
Wrapping	**Good;** easy to operate with well formed bales, problems with winch assembly.
Loading and Unloading	**Good;** easy with a well formed bale.
Maneuverability	**Good;** easy to place bales.
Removal of Plastic	**Very Good;** cut along one side of bale & plastic can be removed in one sheet.
EASE OF ADJUSTMENT	
Plastic Wrap Tension	**Fair;** had difficulty maintaining desired tension.
Plastic Wrap Overlap	**Very Good;** wide range of overlap settings.
Lubrication	**Good;** Graphite easily applied to centre spike and carrier pole as required, difficult to grease drive wheel.
POWER REQUIREMENTS	Most 65 hp (50 kW) tractors have adequate weight to maintain stability.
OPERATOR SAFETY	Operation required special safety precautions.
OPERATOR'S MANUAL	**Poor;** provided limited information.
MECHANICAL HISTORY	Drive gear failed, winch plate distorted, drive wheel marked frame.

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