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Evaluation Report 118

Hesston 6400 Self-Propelled Windrower

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

HESSTON 6400 SELF PROPELLED WINDROWER

MANUFACTURER:
Hesston Corporation
Hesston, Kansas

DISTRIBUTOR:
Hesston Industries, Ltd.
920-26 Street N.E.
Calgary, Alberta
T2A 2M4

RETAIL PRICE:
$16,339.00 (July 1979, f.o.b. Portage la Prairie, Manitoba, with optional cab, tow bar kit, weight bundle, light kit, divider rod kit, draper protector, adjustable skid shoes, radiator screen extension, windrow forming rods, and draper extension.)

FIGURE 1. Operator's Platform. (1) Parking brake lever, (2) Header hydraulic control pedal, (3) Steering wheel, (4) Steering column and variable speed control, (5) Reel control pedal, (6) Throttle, (7) Header control lever, (8) Ignition switch, (9) Choke.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Hesston 6400 windrower was *fair* in all grain and oil seed crops, but *good* in most forage crops.

Cutting ability was *very good* in all grain crops and most hay crops. In very heavy, tough hay crops, cutting ability was *good.*

The table floatation was *good.* The table lift was sufficient to clear heavy headland windrows. Because of its width, the left divider pushed down a wide path of crop. The windrower was not able to fully pick up the crop on the return pass.

Windrow formation and quality were *poor* to *fair* in grain, but *good* in most hay crops partially because of the steep header angle of 36°. Angled parallel and herringbone patterns predominated in both hay and grain crops. The windrower tended to stand the crop stems on the butts and leave the heads in the centre of the windrow.

The header windrow opening was not large enough to clear some crops. The engine had adequate power. Suitable field speeds were 6to 10 km/h in average grain crops and 3 to 10 km/h in average hay crops.

Normal fuel consumption was about 8.0 L/h.

Most operator controls were convenient and well positioned.

Handling and maneuverability were *very good.* Most adjustments were simple and convenient. Daily maintenance took from 15 to 20 minutes.

Transporting the Hesston was easy and safe with the optional tow bar. Performance of this system was *excellent.*

Operator station sound level was about 90 dBA. Visibility from the operator's platform was *poor.* Stability on hillsides was very *good.*

When the header was lowered, it moved to the limit of the specified travel. Frequent operation of the control was required to maintain desired header height.

The Hesston had three minor safety problems. When transporting, no provision was made for the attachment of a slow moving vehicle sign. The reel could not be blocked for servicing.

The relative positions of the variable speed control and the seat decreased operator visibility. In order to observe draper and knife action, the operator had to stand. In doing so, the variable speed control had to be pushed forward, accelerating the machine.

Operator and assembly manuals were *excellent.* They provided useful information about assembly, maintenance, operation and safety precautions concerning the windrower.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to reduce the header angle and increase windrow opening to improve the quality of the windrow.
2. Modifications to the hydraulic controls to provide more precise operator control while lowering the header.
3. Providing a method to lock the reel in a raised position, to allow safe access for servicing.
4. Modifications to reduce the effective width of the left divider shoe.
5. Modifications to the seat-steering column arrangement to reduce operator fatigue and to allow better visibility.
6. Modifications to ensure tall windrows do not catch on the optional tow bar.
7. Reducing the noise level at the operator station.

Chief Engineer -- E.O. Nyborg
Senior Engineer -- J.C. Thauberger
Project Technologist -- P.H. Perk

THE MANUFACTURER STATES THAT:

This report presents information gained during field evaluation tests with a Hesston 6400 self-propelled grain windrower. The Model 6400 is no longer in production and has been replaced by the Hesston 6450 self-propelled grain windrower. The recommended changes have been made on the 6450 as follows:

With regard to recommendation number:

1. The operator has the flexibility of setting the header angle at either 15° or 22° (6400 was 36°) depending on crop conditions and operator preference. The header is attached to the tractor through parallel linkage, which allows the draper angle to remain constant throughout the lift range. The draper opening width of the 6450 is unchanged from the 6400; however, the new design of the 6450 header coupled with the adjustable draper angle allows for excellent crop flow through the header opening in all crop conditions.
2. The hydraulic valve on the 6450 allows the operator to lower the header to any desired cutting height. The header will then remain at the cutting height desired until changed by the operator.
3. A method of locking the reel in a raised position is presently under investigation.
4. The 6450 utilizes the latest technology in dividing the crop to allow clean cutting and separating of the cut and uncut crop.
5. The 6450 operator controls include a tilt steering wheel, a separate speed control lever, and a deluxe seat. The operator has complete visibility of the cutterbar in a normal seated position.
6. Clearance from the ground to the tow bar on a 6400 is 22-½". Clearance under the rear walking beam on the 6450 is 30-½", and clearance under the frame is 34-½". This provides very adequate crop clearance. A tow bar option is not presently being offered for the 6450, but is under active consideration for the future.
7. In the 6450 design, the engine and hydraulic transmission have been located further away from the operator and the operator's platform has been mounted to the frame with rubber cushion mounts to greatly reduce the noise level for the operator. An optional cab is available that is the quietest presently being offered in the windrower industry.

MANUFACTURER'S ADDITIONAL COMMENTS

The 6450 introduces the following new features to the grain wind rower industry:

1. A double sickle drive that greatly increases ground speed and capacity while reducing vibration. Sickle speed is 1300 SPM.
2. Headers that can be set up for right, left, or center delivery to match the header to the operator's requirements.
3. Greater electrical capacity to match the needs of more electrical equipment. A 72 amp alternator and an electronic ignition.
4. A totally new cab, which reduces the noise level for the operator to levels not available previously in the windrower industry.

GENERAL DESCRIPTION

The Hesston 6400 is a self-propelled centre delivery windrower with two traction drive wheels and two rear castor wheels. It is powered by a Chrysler six cylinder gasoline engine. The hydrostatic traction drive is driven by two pumps through a series of sheaves and belts from the engine crankshaft. Two hydraulic motors drive the wheels directly. The header is driven through a belt and driveshaft arrangement.

A steering wheel is provided, with the steering wheel support column moveable, fore and aft, to control the ground speed.

The hydraulic header and reel controls are foot operated. FIGURE 1 shows the layout of the operator station and controls.

The test machine was equipped with a 6.0 m grain header with a draper platform and a bat reel, with optional cab, tow bar kit, weight bundle, light kit, divider rod kit, draper protector, adjustable skid shoes, radiator screen extension, wind row forming rods, and draper extension.

Other header options and accessory attachments are available.

Detailed specifications are given in APPENDIX 1.

SCOPE OF TEST

The Hesston 6400 was operated in the conditions shown in TABLE 1 for 141 hours while cutting about 489 ha. It was evaluated in forage crops, cereal grains and oil seed crops for windrow formation, cutting ability, ease of operation and adjustment, noise level, fuel consumption, operator safety and suitability of the operator's manual.

Table 1. Operating Conditions

Crop	Soil Texture	Hours	Field Area ha
Alfafala	Almasappi Sand, Clay Loam	29	74
Mixed Hay	Clay Loam	2	2
Slough Grass	Silty Clay, Clay Loam	4	2
Rye	Silty Clay, Clay Loam	8	42
Barley	Almasippi Sand, Sandy Loam	16	78
Wheat	Clay Loam, Sandy Loam	29	42
Oats	Silty Clay Loam, Clay	9	25
Rapeseed	Clay Loam	9	16
Flax	Silty Clay Loam, Clay	26.5	84
Buckwheat	Sandy Loam	8	24
Total		140.5	489

RESULTS AND DISCUSSION

WINDROW FORMATION

Windrow Types: Windrows may be classified into four general patterns (FIGURE 2) although many combinations and variations exist. The Hesston 6400 produced angled parallel and herringbone windrows in most grain crops. TABLE 2 describes the types of windrows produced by the Hesston 6400 while FIGURES 3 to 10 illustrate typical windrows.

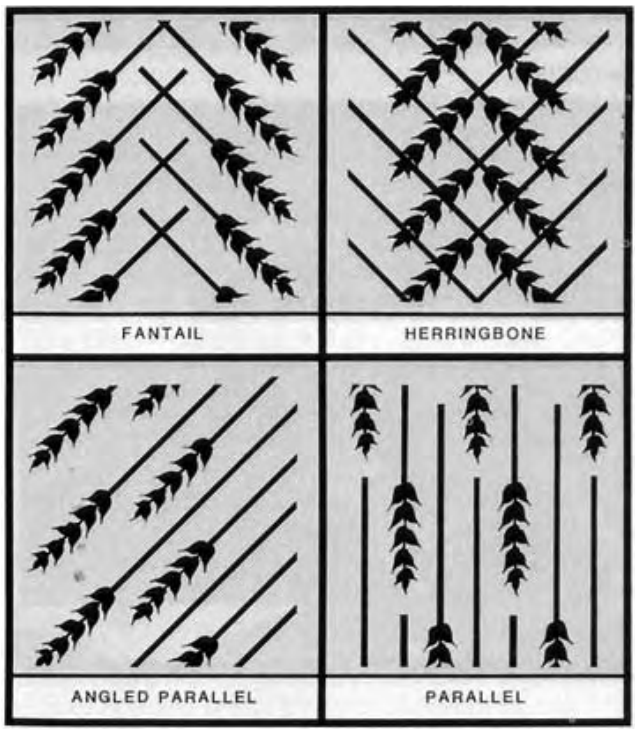

FIGURE 2. Windrow Types.

FIGURE 3. Slough Grass (1.0 t/ha).

Leaning Crops: The angle of the header reduced the wind rower's ability to clear leaning or lodged crops from the cutterbar back on to the drapers. Lodged grain crops sometimes collected at the cutterbar and could not be completely swept back by the reel. This resulted in bunching in some crops.

Uniformity: The Hesston 6400 usually produced uniform windrows. The windrows tended to have a triangular cross-section with the grain heads laid at the apex in the centre. In rapeseed and tall grain crops, the transporting hitch sometimes caught the windrow and rotated it, resulting in non-uniformity. It is recommended that the manufacturer consider modifications to eliminate this problem.

Table 2.

Crop	Yield Range t/ha	Cut Crop Length mm	Speed km/h	Windrow Type	Figure Number
Alfalfa	1.8 - 3.4	395 - 1000	0 - 10	herringbone	
Mixed Hay	0.5 - 2.0	300 - 500	4 - 6	parallel	
Slough Hay	1.0	900 - 1450	3 - 4	angled parallel	3
Rye	0.8 - 1.1	900 - 1250	3 - 4	angled parallel and herringbone in leaning crops	4
Barley	1.2 - 1.5	900 - 1016	6 - 10	angled parallel, bunching	5
Wheat	0.8 - 1.1	760 - 1070	6 - 10	angled parallel, angled parallel, herringbone in leaning crop	6
Oats	0.5	600 - 610	8 - 10	herringbone	7
Rapeseed	0.7	305 - 914	0 - 5	herringbone angled parallel	8
Flax	0.3	400 - 500	0 - 10	herringbone parallel	9, 10
Buckwheat	0.4	760 - 840	0 - 8	parallel and herringbone	

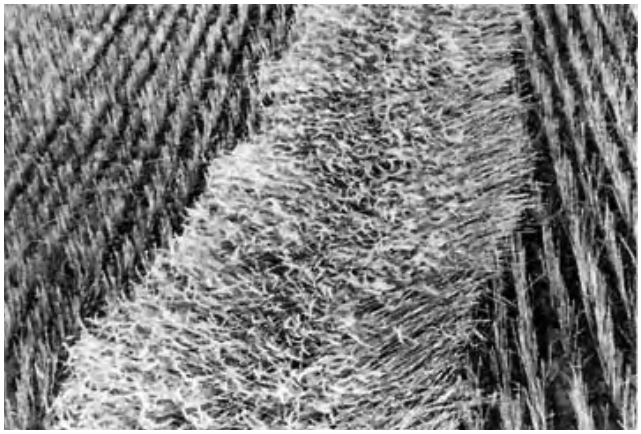

FIGURE 4. Rye (1.0 t/ha).

FIGURE 5. Barley (1.3 t/ha).

FIGURE 6. Wheat (1.1 t/ha).

FIGURE 7. Oats (0.5 t/ha).

FIGURE 8. Rapeseed (0.7 t/ha).

FIGURE 9. Flax (0.3 t/ha).

FIGURE 10. Flax (0.3 t/ha).

Draper Speed: The right hand draper speed could be varied from 2.4 to 3.0 m/s, by means of an adjustable drive pulley. The speed of the left draper was not adjustable and was fixed at 2.4 m/s. Higher right hand draper speeds produced herringbone patterned, woven windrows. These windrows were easily picked but were difficult to thresh.

Lower speeds tended to produce more uniform windrows with angled parallel patterns.

Header Angle: The header angle on the Hesston 6400 was not adjustable and changed with cutting height. In the totally lowered position, the header angle was 36 degrees.

Forward Speed: Forward speed had little effect on windrow formation. Speed limitations were usually due to field roughness, cutterbar performance, and the ability of the machine to clear the crop through the windrow opening.

Windrow Opening: Windrow opening clearance was not adequate in some crops. In long, heavy, slough grass, the windrow sides occasionally were caught between the draper drive and guide.

Heavy rapeseed did not pass easily through the windrow opening. In very heavy crops, the ability of the windrower to clear the crop through the windrow opening was not matched by its ability to cut.

CUTTING ABILITY

Cutterbar: All test work was conducted with over-serrated knife sections. Cutting ability of the Hesston 6400 was very good in all grain and hay crops. Cutterbar hammering was never a problem. The cutterbar occasionally plugged in heavy slough grass, heavily lodged crops, or damp flax. In lodged crops it was best to cut parallel to crop lodging. Cutting ability in rapeseed was good, however, insufficient windrow opening limited performance. In grain crops, performance was best working back and forth in a direction parallel to crop lean.

Stubble: Stubble, formed by a windrower, may be divided into three types as shown in FIGURE 11. The Hesston 6400 generally produced ideal stubble in all grain crops at speeds up to 10 km/h, provided that the knife and guards were in good condition. In flax and rapeseed, ideal stubble was formed at speeds up to 5 km/h. Higher speeds resulted in irregular stubble. Undulating stubble was formed only when the table was allowed to float while cutting well above the ground.

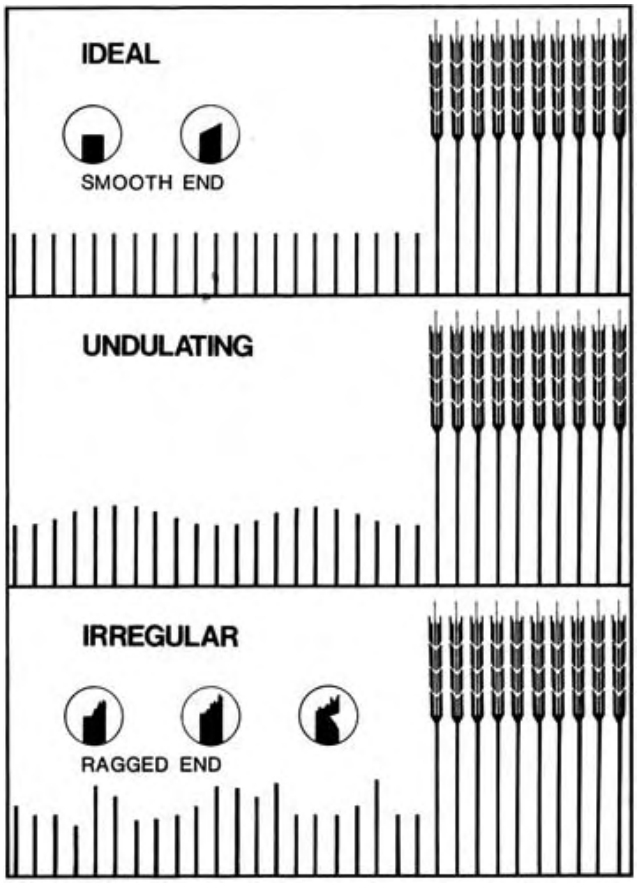

FIGURE 11. Types of Stubble formed by Windrows.

In hay crops, the stubble was generally ideal provided that forward speed was matched to crop conditions. Excessive speed in tough hay crops resulted in irregular stubble.

Dividers: In average, standing grain and hay crops, divider performance was fair. The dividers worked on the principle of pushing the crop down during separation. The path of pushed down crop was 45 mm on the right side and 120 mm on the left. The path created by the left divider could not be completely recovered on the return pass.

The performance of the Hesston 6400 in rapeseed was limited, not by the performance of the dividers, but by the limited size of the header windrow opening.

Reel: Reel speed was variable from 35 to 50 rpm by adjusting the drive pulley. For optimum performance in most grain it was best to have a reel index[1] from 1.1 to 1.2

On the Hesston 6400 the optimum reel index was obtained at forward speeds ranging from 10 to 11 km/h. Operation outside this speed range was also possible in many crops.

Header Floatation: The Hesston 6400 was equipped with a floatation system as standard equipment. Performance of this floatation system was good. It was suitable for cutting hay crops close to the ground. Floatation was achieved through an arrangement of 9 springs (FIGURE 12). By adjusting the tension of individual groups of springs, the header could be levelled while suspended off the ground. Even with the header levelled, however, the stubble on the right hand side was sometimes found to be significantly longer.

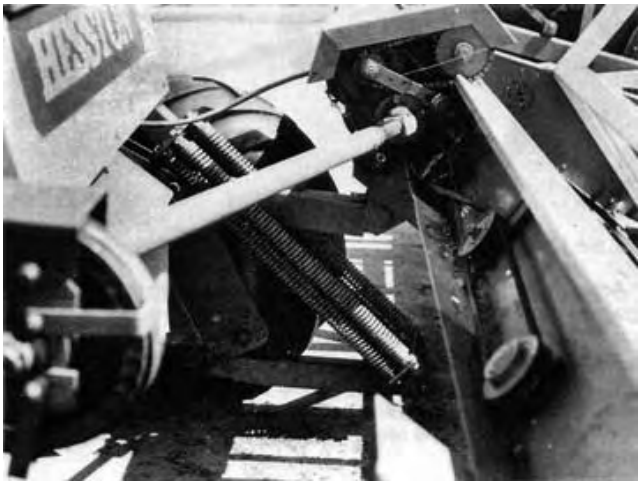

FIGURE 12. Header Floatation System.

EASE OF OPERATION AND ADJUSTMENT

Steering: Directional control and maneuverability of the Hesston 6400 was very good. Steering[2] was positive and effortless.

The Hesston 6400 did hot pull sideways in soft fields. In addition, steering was not influenced by different tire pressures in each drive wheel.

Speed Control: Speed control was accomplished by pushing or pulling the steering column, fore and aft. As the column was pushed further forward, forward speed increased. To slow or reverse, the column was pulled towards the operator. At maximum cutting speeds the operator was required to lean forward and extend his arms to direct the windrower and to maintain pressure on the steering column. This was a tiring position to maintain. It is recommended that modifications be made to the steering column seating arrangement to reduce this difficulty.

Infinite forward speed variation from 0 to 18 km/h was possible with the hydrostatic speed control. Speeds in reverse could be varied between 0 to 17 km/h.

Braking: Hydrostatic braking was accomplished with speed control. A mechanical parking brake was also provided to hold the machine.

Header Controls: The header d rive was engaged with a conveniently located hand lever. Reel and header lifts were both hydraulically operated with foot pedals located on either side of the steering column. The header lift was slow and frequent operation of the control was necessary to set a desired height. When lowering, the header tended to fall to the limit of its travel. Reel lift and lift speed were good. It is recommended that the hydraulic system be modified to allow more precise operator control.

Header lift height was adequate to clear heavy headland windrows.

Transporting: Maximum forward speed was about 18 km/h. The test machine was equipped with an optional transporting hitch bolted to the rear of the windrower, which was coupled to the transporting vehicle by means of a clevis hitch. The rear wheels of the wind rower were then lifted off the ground by means of a screw ratchet provided. Before transporting, the drive wheel hubs had to be unlocked. This transporting arrangement proved to be simple, safe and convenient and took about 5 to 10 minutes to complete.

[1]Reel index is defined as the ratio of reel tip speed to travel speed.

[2]Hydrostatic steering, in reverse, is opposite to that of conventional machine operation. In addition, when the variable speed lever is returned to neutral, the steering wheel must also be returned to neutral to stop machine motion.

The performance of this system was excellent.

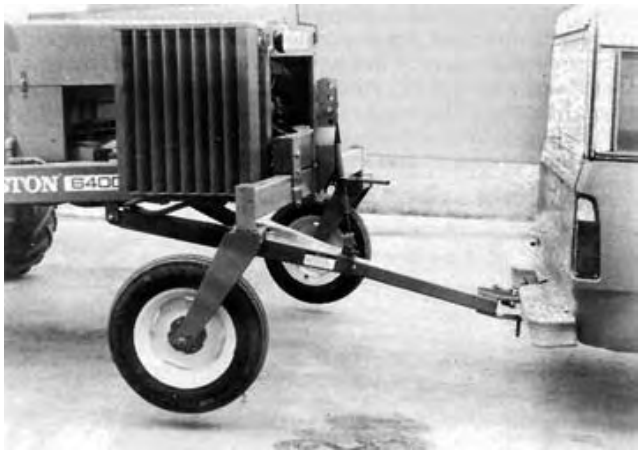

FIGURE 13. Optional Tow Bar.

Adjustments: Reel speed was adjusted by varying the number of spacers between the two halves of the d rive sheave. Draper speed was adjusted by means of an adjustable drive sheave. The reel lift cylinders could be repositioned by pinning the top cylinder pivot in either of the two holes or pinning the bottom pivot in one of eight holes. Horizontal reel repositioning required the removal of a bolt at each end of the reel and sliding the reel to a new position on the reel arm.

Servicing: Daily lubrication of the Hesston 6400 took from 10 to 15 minutes.

NOISE LEVEL

Total noise at operator ear level was about 90 dBA. It is recommended that the operator wear suitable ear protection, especially on long working days.

POWER AND FUEL CONSUMPTION

The engine on the Hesston 6400 had sufficient power for all conditions. Average fuel consumption was about 8.0 L/h. The 110 L fuel tank permitted about 12 hours of operation between fillings.

OPERATOR SAFETY

Access to the operator's platform was safe and convenient. Controls were well positioned and identified with standardized symbols. The two headlights and rear working light provided good illumination for night operation. The Hesston 6400 was equipped with a slow moving vehicle sign on the rear and flashing safety lights for transport on public roads.

When transporting, with the optional towing attachment, no provision was made for the attachment of a slow moving vehicle sign to the front of the windrower.

The arrangement of steering column/speed control and operator's seat not only forced the operator to assume a sometimes tiring position, over long periods of time, but also considerably reduced visibility.

No provision was made to allow the reel to be blocked when working on the header. No other safety hazards were apparent, if safe practices and procedures were followed during servicing and operation.

Both the steering wheel and speed control lever had to be in neutral to stop the windrower. A safety lockout device ensured that both these conditions were met before the engine could be started. Drives were adequately shielded. The windrower was stable on slopes and rough terrain.

OPERATOR'S MANUAL

Operator and assembly manuals were excellent. The operator's manual contained much useful information on operation, safety, adjustment and servicing. It was clear and well written.

DURABILITY RESULTS

TABLE 3 outlines the mechanical history of the Hesston 6400 during 141 hours of operation while windrowing about 489 ha. 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	Operating Hours	Equivalent Area ha
-The header drive V-belts tended to slip off and were readjusted at	8	35
-The reel drive pulley separated into two parts and was repaired at	25	91
-The reel drive chain idler failed and was replaced at	25	91

DISCUSSION OF MECHANICAL PROBLEMS

Header Drive: Misalignment of the multiple sheaves caused the belts to slip off. The sheaves were aligned and the problem did not recur.

Reel Drive Pulley and Idler: The reel pulley separated into two parts while the idler on the reel drive was bent. This was the result of over tightening the reel drive belt, in an attempt to improve the performance of the windrower in green rapeseed.

APPENDIX I
SPECIFICATIONS

Model:	Hesston 6400
Serial No.:	Tractor-640T-3846
	Header - 640D-1233
Cutterbar:	
-- width of cut (divider points)	6140 mm
-- effective cut (inside divider)	6100 mm
-- range of cutting height	40 to 180 mm
-- guard spacing	76 mm
-- length of knife section (over-serrated)	76 mm
-- knife stroke	76 mm
-- knife speed	540 cycles/min.
Header:	
-- platform angle (from horizontal)	
- fully raised	33
- fully lowered	36
-- number of drapers	2
-- width of drapers	1092 mm
-- length of drapers	
- right	2490 mm
- left	2250 mm
-- draper speed range	
- right	2.4 to 3.0 m/s
- left	2.4 m/s
-- draper roller diameter	63 mm
-- height of windrow opening	1130 mm
-- width of windrow opening	1156 mm
-- between rollers	1160mm
-- raising time of table	2 s
-- lowering time of table	2.5 s
Reel:	
-- number of bats	5
-- number of reel arms/bat	5
-- diameter	1340 mm
-- speed range	35 to 50 rpm
-- range of adjustment	
- fore and aft	254 mm
- height above cutterbar	686 mm
-- raising time	1 s
-- lowering time	2.2 s
Ground Drive:	
-- type	Hydrostatic
-- speed control	Moveable Steering Column (fore and aft)
-- range of forward speed	0 to 18 km/h
-- range of reverse speed	0 to 17 km/h
Steering:	Steering Wheel Operating Hydrostatic Pumps
Brakes:	Moveable Steering Column and Lever Operated Parking Brake
Hydraulic System:	
-- traction drive	Sund-Strand Hydrostatic with Borg- Warner No. 6 Power Wheel
-- table and reel lift	Auxiliary pump in hydrostatic transmission
No. of Chain Drives:	3
No. of V-Belts:	
-- single V	5
-- multiple V	1
No. of Pressure Lubrication Points:	28
No. of Pre-lubricated Bearings:	24
Engine:	
-- make	Chrysler industrial, 6 cylinder gasoline engine
-- model	HB 225
-- no load speed	2300
-- power	48 kW
-- fuel tank capacity	110 L

Tire Size:	
-- main drive wheels	(2) 13.50 - 16.1, 6-ply
-- castor wheel	(2) 5.90 - 15, 4-ply
-- wheel tread	
- drive wheels	2600 mm
- rear wheels	2105 mm
-- wheel base	2870 mm
-- overall width	6430 mm
-- overall length	5740 mm
Weight as Tested: (header raised)	
-- right drive wheel	1206 kg
-- left drive wheel	1454 kg
-- castor wheel	
- left	162 kg
- right	156 kg
Total	2978 kg
Centre of Gravity: (header raised)	
-- height above ground	1055 mm
-- distance behind drive wheels	376 mm
-- distance left of right drive wheel	414 mm

Options end Attachments Available:

Air conditioner, auger and reel slowdown sprocket, auger end reel speedup sprocket, cab, crop divider, decal kit, divider rod, (draper), draper protector, filler pan kit, gauge wheel kit (auger), gauge wheel kit (draper), guard straightener, guards, standard; guards, stub; hay conditioner, (auger); hey conditioner chain oiler, light kit, narrow opening kit, paint touch up; radiator screen extension, reel bat kit, reel drive sheave, slow speed; serrated sickle, smooth sickle, skid shoes, spark arrester muffler, tow bar, weight bundle, windrow forming rods.

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 (kin/h)	= 0.62 miles/hour (mph)
1 tonne (t)	= 2205 pounds (lb)
1 tonne/hectare (t/ha)	= 0.45 tons/acre (ton/ac)
1 metre (m)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds (lb)
1 litre/hr (L/h)	= 0.22 Imperial gallons/hour (gal/h)

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:

P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080