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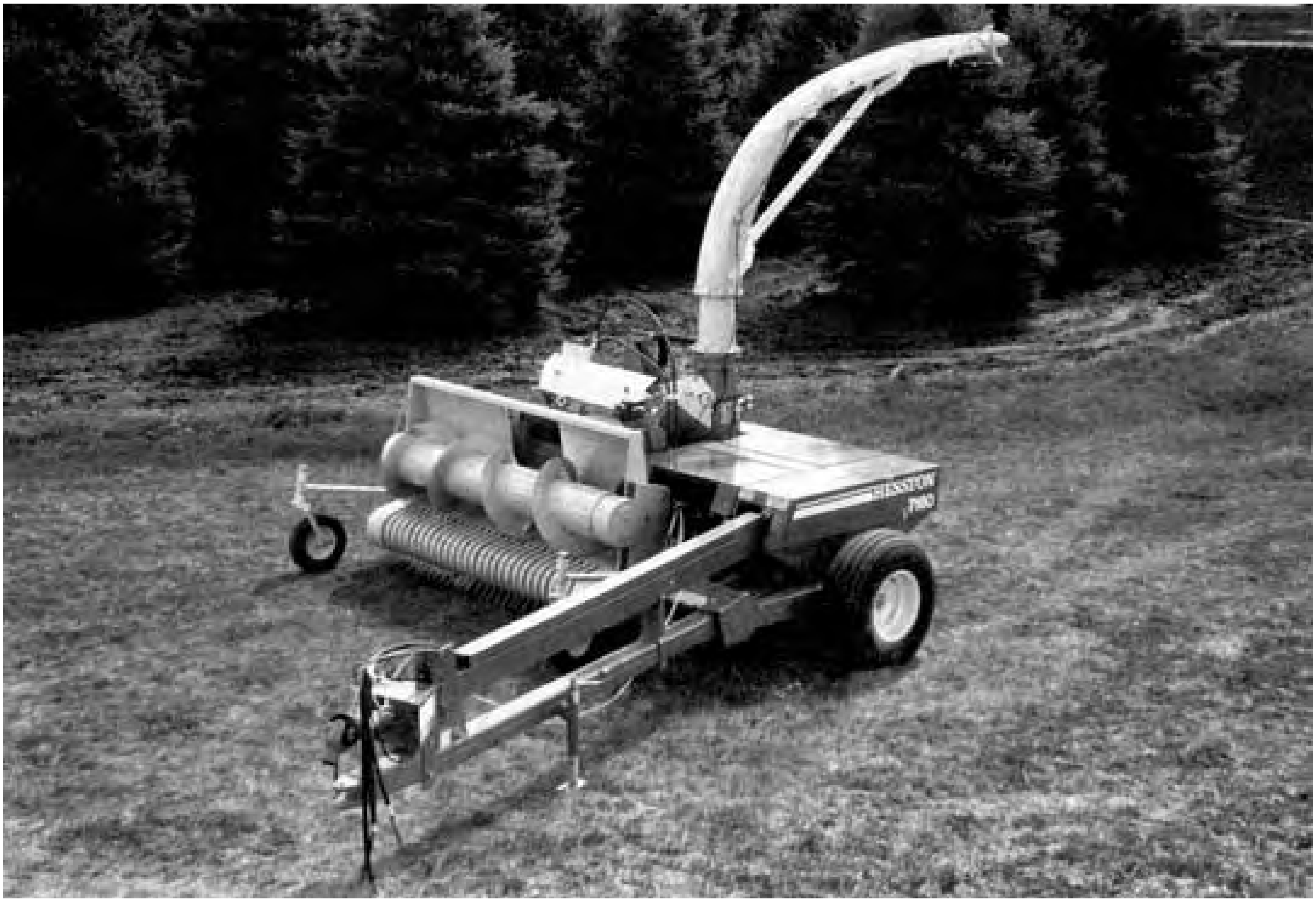
Evaluation Report 201



Hesston 7160 Forage Harvester

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

HESSTON 7160 FORAGE HARVESTER

MANUFACTURER:
Hesston Corporation
Hesston, Kansas
67062 U.S.A.

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

RETAIL PRICE:
$23,853 (May 1981, f.o.b. Portage la Prairie, with remote controls, 2.1 m (7 ft) windrow pickup and three-row row crop head.

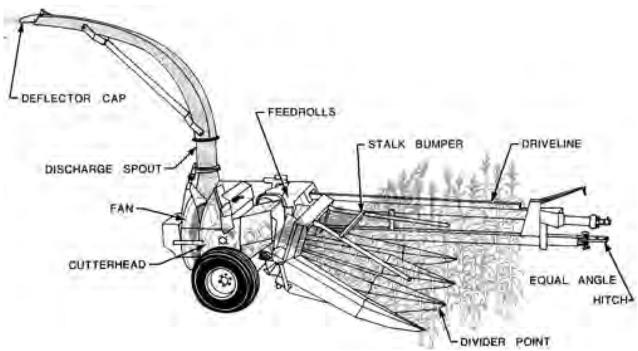


FIGURE 1. Hesston 7160.

SUMMARY AND CONCLUSIONS

Overall performance of the Hesston 7160 was good. Ease of operation and adjustment was good.

Workrates[1] ranged up to 54 t/h (59 ton/h) in standing corn, up to 40 t/h (44 ton/h) in alfalfa, and up to 36 t/h (40 ton/h) in green rye. Dry-weight workrates ranged up to 24 t/h (26 ton/h) in corn, 20 t/h (22 ton/h) in alfalfa and 16 t/h (18 ton/h) in rye.

Performance of the three-row row crop head was poor due to continuous plugging of the rotary sickles and gathering chains. Performance of the pickup head was very good at speeds up to 8 km/h (5 mph). The use of a 30 x 275 mm (1.2 x 11 in) recutter screen reduced workrates about 40% in alfalfa and 10% in corn.

At 5 mm (0.20 in) cut length setting, 6% of alfalfa silage and 4% of corn silage had a length greater than 26 mm (1 in). The use of the recutter screen greatly reduced the number of longer particles.

A tractor of 120 kW (160 hp) maximum power take-off rating would have sufficient power to operate the Hesston 7160 in typical prairie crops.

Cutterhead knife grinding and shear plate adjustment were easy. Changing header attachments was difficult.

The Hesston 7160 was safe to operate if the manufacturer's safety recommendations were followed. The operator manual was good.

A number of mechanical problems occurred during the 235 hour tests.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the three-row row crop head to reduce plugging of the rotary sickle and gathering chains.
2. Modifying the electric remote controls to provide better control over spout rotation, protection for the deflector cap actuator, and modifying the actuators to increase their durability.
3. Modifying the upper feed rolls to reduce failures in heavy crop conditions.
4. Modifying the header attachments to allow easier installation and removal.
5. Modifying the three-row row crop head to allow easier lubrication.
6. Modifying the operator manual to include SI units of measurement.
7. Modifying the discharge spout to increase the distance the forage is blown.

Chief Engineer -- E.O. Nyborg
Senior Engineer -- J.C. Thauberger
Project Engineer -- C.W. Chapman

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The 1981 three-row 38" corn head has been redesigned to improve performance in adverse field conditions. Also, an update kit may be purchased for modifying prior year models.
2. Improvement of electric actuator is under consideration.
3. A Product Bulletin has been issued to cover critical chain and sheave adjustment on feedroll drives. Also lower feed-rolls have been modified to reduce wrapping.
4. A new quick attach head system will be available on the 1982 model. Also parts will retrofit older units.
5. Improvement in lubrication accessibility on the row heads are under consideration.
6. SI units of measurements are under consideration.
7. The spout is designed to current industry standards.

Manufacturer's additional comments:

There are other improvements currently under consideration, which are not mentioned in this report's recommendations.

The manufacturer is pleased that the evaluation did confirm the favorable energy efficiency of the Hesston design.

Additional efficiency can also be gained, in corn, by decreasing the blower speed with a slow down kit.

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

GENERAL DESCRIPTION

The Hesston 7160 is a power take-off driven, pull-type forage harvester. The cylindrical cutterhead is fed by a reversible feed-roll assembly. Cut length is set by changing feedroll drive sprockets. Chopped forage is delivered from the cutterhead to the discharge fan, which directs it to the discharge spout.

The test machine was equipped with a 2.1 m (7 ft) windrow pickup and a three-row row crop head.

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

SCOPE OF TEST

The Hesston 7160 was operated in the crops shown in TABLE 1 for 235 hours while harvesting about 328 ha (820 ac).

It was evaluated for rate of work, quality of work, power requirements, ease of operation and adjustment, operator safety, and suitability of the operator manual.

TABLE 1. Operating Conditions

Crop	Average Yield	Hours	Field Area
	t/ha at 60% moisture content		ha
Alfalfa	8 to 10	36	49
Rye	12	8	13
Oats/Barley	12	17	26
Sorghum	15	37	62
Corn (row crop head)	20 to 25	135	178
Total		235	328

RESULTS AND DISCUSSION

RATE OF WORK

TABLE 2 presents typical workrates for the Hesston 7160 in a variety of field conditions. The workrate for alfalfa was measured

[1] *The actual workrates, which include the moisture in the crop, indicate the total mass of crop harvested, but should not be used for comparing performance of different forage harvesters. The dry-weight workrates, which consider the mass of dry matter harvested, provide a better comparison of performance of different forage harvesters and assessment of the effect of crop variables and machine settings.*

in crops yielding 8 to 10 t/ha (3.6 to 4.5 ton/ac), which had been double windrowed with 6 m (20 ft) wide double-swath windrower. The workrate in green rye was measured in crops yielding 12 t/ha (5.4 ton/ac) and windrowed using a 6 m (20 ft) windrower, while the workrates in corn were measured in standing crops, yielding 25 t/ha (11 ton/ac), harvested with the three-row row crop head. The reported values are for average continuous feedrates, with the harvester loaded to optimum levels. They do not include time for maintenance and unloading of wagons.

TABLE 2. Average Workrates

Crop	Moisture Content	Length-of-Cut Setting	Workrates t/h	
	%	mm	Actual	Dry Weight
Alfalfa	55		40.0	18.0
	48	5	26.1	13.6
	45		26.7	14.7
	45	11*	15.5	6.5
	53		44.6	21.1
	47	11	37.7	20.0
	42		26.4	17.9
	42	11*	21.1	12.1
Green Rye	56	8	26.5	11.7
		8*	19.3	8.5
		16	36.0	15.6
		16*	32.1	14.0
Corn	60	5	28.6	14.3
		11	54.1	24.3
		11*	42.0	18.9
		19*	36.4	16.4

*With 30 x 275 mm (1.2 x 11 in) recutter screen

Both actual workrates and dry-weight workrates are reported in TABLE 2. The actual mass workrates, which include the moisture in the crop, indicate the total mass of crop harvested, but should not be used for comparing performance of different forage harvesters. The dry-weight workrates, which consider the mass of dry matter harvested, provide a better comparison of performance of different forage harvesters and assessment of the effect of crop variables and machine settings. Actual workrates ranged up to 54 t/h (59 ton/h) whereas dry-weight workrates ranged only up to 24 t/h (26 ton/h).

Workrates were influenced by crop moisture content, cut length setting, use of a recutter screen and the type of header attachment used. Reducing the cut length setting from 11 to 5 mm (0.4 to 0.2 in) decreased the dry-weight workrates by 30% in alfalfa and 20% in corn. The use of a recutter screen reduced workrates by 40% in alfalfa, 15 to 25% in green rye and 10% in corn.

The capacity of the three-row row crop head was adequate to ensure that the cutterhead was operated to capacity in corn. The pickup header permitted ground speeds up to 8 km/h (5 mph).

QUALITY OF WORK

Uniformity of Cut:[2] FIGURE 2 presents typical particle length distributions in second-cut, full-bloom alfalfa, harvested at 53% moisture content. Particle length variations are given for 5 and 11 mm (0.2 to 0.4 in) cut settings, with and without the use of a 30 x 275 mm (1.2 x 11 in) recutter screen. At a 5 mm (0.2 in) setting, 6% of the silage had a length greater than 26 mm (1 in), while at the 11 mm (0.4 in) setting, 22% had a length greater than 25 mm (1 in) (APPENDIX IV, FIGURE 10). The 30 x 275 mm (1.2 x 11 in) recutter screen significantly reduced the particles greater than 25 mm (1 in).

FIGURES 2 and 3 show material length distribution at various cut length settings, with and without recutter screens. A narrow curve with a high peak indicates uniform particle length distribution. The average material length is about that at the peak of the curve. Forage with a wide range of particle lengths has a wide curve with a low peak.

FIGURE 3 presents typical particle size distributions in corn, harvested at 60% moisture content, for 5 and 11 mm (0.2 and 0.4 in) settings. Only 4% of the chopped corn had a length greater than 26 mm (1 in) at the 5 mm (0.2 in) setting while 17% of the corn particles were longer than 26 mm (1 in) at the 11 mm (0.4 in) setting (APPENDIX IV, FIGURE 10). The smaller percentage of longer particles in corn, compared to alfalfa, was due to the perpendicular feeding of the row crop header.

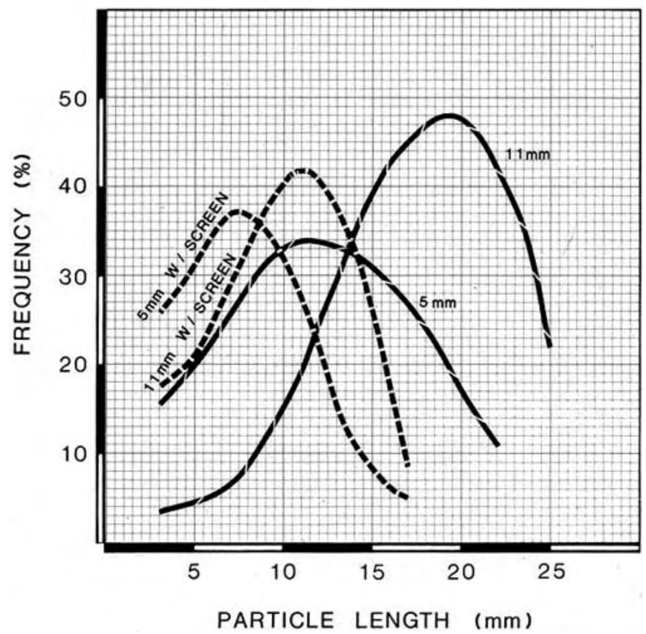


FIGURE 2. Particle Length Distribution in Alfalfa.

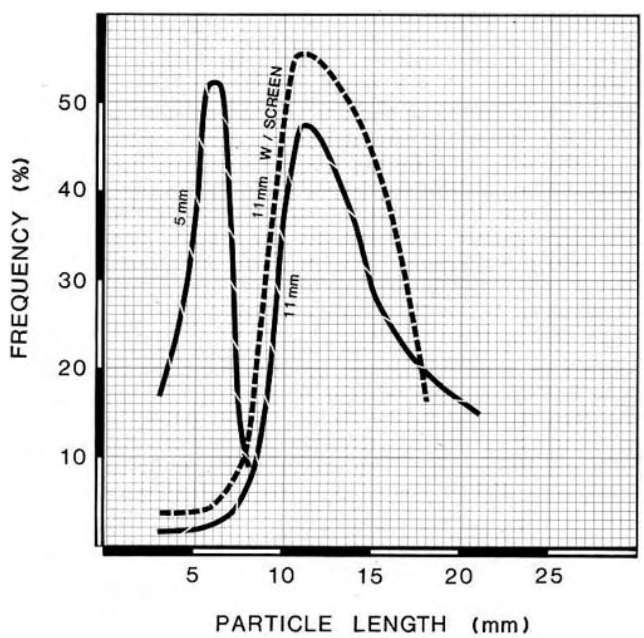


FIGURE 3. Particle Length Distribution in Corn.

Windrow Pickup Losses: Pickup losses were insignificant at speeds up to 8 km/h (5 mph), provided that the windrows were not severely wind scattered. Some hairpinning occurred at the castor wheel when picking scattered windrows or turning tight corners.

Row Crop Head Losses: Losses from the row crop head were insignificant at speeds below 10 km/h (6 mph) provided care was taken to keep the divider points centred between the rows.

POWER REQUIREMENTS

Tractor Size: The peak power take-off requirement, at maximum workrate was about 110 kW (150 hp) in alfalfa and 90 kW (120 hp) in corn. Corresponding average power requirements were about 85 kW (115 hp) and 70 kW (90 hp) respectively.

Power requirements increased with shorter cut settings, higher moisture contents and use of a recutter screen. For example, reducing the cut setting from 11 to 5 mm (0.4 to 0.2 in) while harvesting 55% moisture alfalfa, yielding 8 t/ha (3.6 ton/ac), increased average power by 12 kW (16 hp). An increase of 10% moisture content in

[2]*For each cut length setting, a forage harvester produces a range of particle lengths. Although variation in particle length has little effect on silage palatability, the performance of some silage unloading equipment may be adversely affected if a significant quantity of material is longer than 40 mm.*

alfalfa increased the power requirements 8 kW (10 hp). The use of a 30 x 275 mm (1.2 x 11 in) recutter screen increased average power 12 kW (16 hp) in alfalfa and 10 kW (13 hp) in corn at 60% moisture content.

Total drawbar power on firm, level fields was about 12 kW (16 hp) at 6 km/h (4 mph). This included the draft of the forage harvester and a dump wagon with a 3 t (3.3 ton) load. In soft, hilly fields, drawbar power requirements could be as great as 20 kW (27 hp).

A tractor of 130 kW (160 hp) maximum power take-off rating should have sufficient power to operate the Hesston 7160 at optimum workrates in most field conditions.

Specific Capacity:[3] FIGURE 4 shows the specific capacity of the Hesston 7160. Specific capacity is a measure of how efficiently a machine operates. A high specific capacity indicates efficient energy use, while a low specific capacity indicates less efficient operation.

As shown in FIGURE 4 an increase in crop moisture content had little effect on the specific capacity in alfalfa. Changing cut length setting from 11 to 5 mm (0.4 to 0.2 in) reduced specific capacity by about 25%. The use of a 30 x 275 mm (1.2 x 11 in) recutter screen reduced specific capacity by 30% at 11 mm (0.4 in) cut length setting.

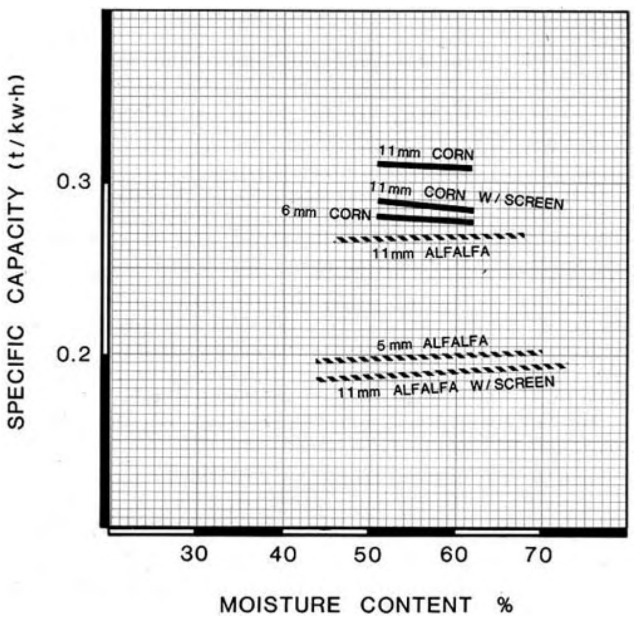


FIGURE 4. Specific Capacity based on Dry-weight Workrates.

In corn, specific capacities ranged from 0.28 t/kW-h at 5 mm (0.25 in) cut setting to 0.31 t/kW-h at 11 mm (0.4 in) cut setting. The use of a 30 x 275 mm (1.2 x 11 in) recutter screen reduced specific capacity by 10% at 11 mm (0.4 in) cut length setting.

In green rye, at 50% moisture content, specific capacity was 0.23 t/kW-h at a cut length setting of 8 mm (0.3 in). The use of a 30 x 275 mm (1.2 x 11 in) recutter screen decreased specific capacity by about 30%.

EASE OF OPERATION AND ADJUSTMENT

Hitching: The Hesston 7160 was equipped with an equal-angle hitch, which attached to the tractor drawbar, extending it 100 mm (4 in). The manufacturer recommended that the tractor drawbar be from 330 to 430 mm (13to 17 in) above the ground. The hitch and drive shaft heights were adjustable. The Hesston 7160 was equipped with a 1000 rpm power take-off drive.

Remote Controls: The Hesston 7160 was equipped with electric remote controls for adjusting discharge spout direction, deflector cap angle and the forward/reverse feed roll clutch. The electric control console, which mounted in the tractor cab, controlled the individual electric actuators. The electric actuators failed several times during the 235 hour test and had to be rebuilt or replaced. The deflector cap actuator, positioned at the end of the discharge spout, was accidentally lost or damaged three times during the test due to contact with wagons and truck boxes. The actuator, which adjusted the discharge spout direction had limited stroke, allowing the spout to rotate only 60°.

It is recommended that the manufacturer consider modifying the actuators to provide a wider range of spout adjustment, protection for the deflector cap actuator and a higher degree of durability for the electric actuators.

Windrow Pickup: The pickup attachment had very good feeding characteristics in most crops. Pickup losses were insignificant at speeds up to 8 km/h (5 mph). Wrapping of hay around the feed auger rarely occurred, although some hairpinning occurred between the pickup and adjustable castor wheels when picking scattered windrows or turning sharp corners.

Three-row Row Crop Header: The three-row row crop header was equipped with rotary sickles and a chain gathering system at a row spacing of 960 mm (38 in). Overall performance of the header was poor. The rotary sickles and stationary knives continually plugged with material (FIGURE 5), especially in weedy crops. The clearance between the rotary sickles and the stationary knives was impossible to maintain for more than a few hours in these conditions. Replacement of the sickles and knives did not alleviate the problem.

The gathering chains did not securely grasp the cornstalks for delivery to the feedrolls. A small percentage of the stalks fell through the chains and eventually plugged the header. It is recommended the manufacturer modify the three-row header to alleviate these problems.

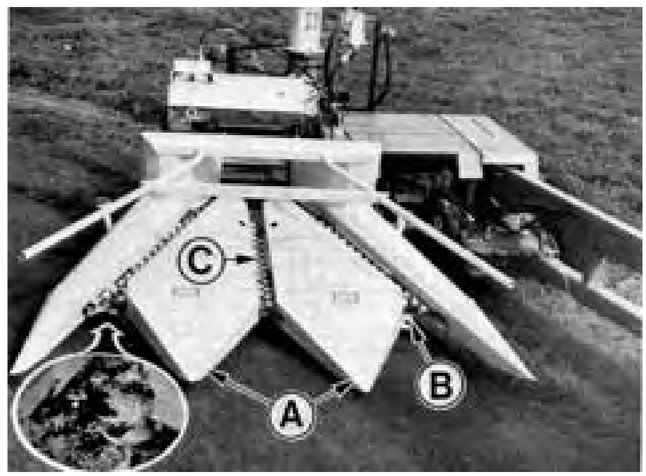


FIGURE 5. Three-Row Row-crop Head: (A) Divider points, (B) Rotary sickle, (C) Gathering chains.

Feedrolls: The feedrolls were aggressive in most crops. Occasional plugging occurred in bunchy windrows at high feedrates. Unplugging of the feedrolls was easy by reversing the feedroll drive with the remote control on the tractor. Some wrapping of the front upper feedroll occurred in one rye crop of 12 t/ha (5.4 ton/ac). In one oat crop of 15 t/ha (7 ton/ac), plugging caused the upper feedroll shafts to bend. Both feedrolls had to be replaced. It is recommended that the manufacturer consider modifying the upper feedrolls to prevent failures when plugging occurs.

Cutterhead Plugging: Cutterhead plugging occurred infrequently and usually resulted in shearing of the shear bolts. Plugging was usually caused by failure to allow all forage to pass through the harvester before disengaging the power take-off clutch. Good access was provided to the shear bolts and cutterhead.

Discharge Spout: The lift and reach of the discharge spout could be adjusted by adding or removing pipe sections, as shown in FIGURE 6. The extensions used were 1300 mm (50 in) horizontal and 380 mm (15 in) vertical. A 660 mm (26 in) horizontal extension was also available. The dimensions in FIGURE 6 were determined at maximum ground clearance setting of the adjustable axle. The axle could be positioned to give discharge spout heights either 50 mm (2 in) or 100 mm (4 in) lower than those shown.

The forage discharge direction was controlled by spout rotation and deflector cap angle, which were adjustable by remote control. Deflector cap angle was adequate and effective. Spout rotation was inadequate because of the short stroke of the actuator. The discharge spout angle did not permit adequate upward direction of

[3]Specific capacities in FIGURE 4 are based on dry-weight workrates. Direct comparison to specific capacities of haying equipment is not valid. Hay usually has a different moisture content and is not refined to the same degree as silage.

the forage, especially with the horizontal extension installed, thus limiting capability to fill the rear of some wagons. It is recommended that the manufacturer modify the discharge spout to increase the distance the forage is blown.

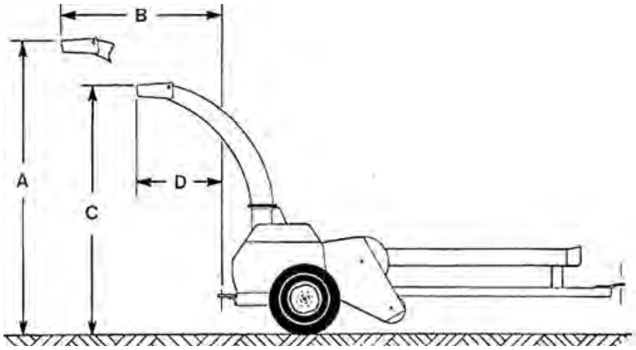


FIGURE 6. Discharge Spout Dimensions: (A) Lift, with extension, 3585 mm: (B) Reach, with extension, 1990 mm: (C) Lift, 2970 mm: (D) Reach, 690 mm.

Recutter Screen: A 30 x 275 mm (1.2 x 11 in) recutter screen was used for about 130 hours of field testing. The recutter screen, which contained a second shear bar, was effective, provided a close tolerance was maintained between the cutterhead knives and the screen. The clearance was easily adjusted with bolts at the rear of the screen. The bolts were accessible.

Installation of the recutter screen was convenient. It took an experienced operator 10 minutes to install or remove the screen.

Knife Grinding: The Hesston 7160 was equipped with a hydraulically driven cylindrical rebevel grinding stone (FIGURE 7), which grinds each knife individually. The cutterhead shear bolts had to be removed to allow free rotation of the cutterhead during grinding. Guide rolls ensured proper alignment of the knife and grinding stone. Care had to be taken to ensure that residual crop material was removed from the cylinder to avoid uneven grinding of the knives.

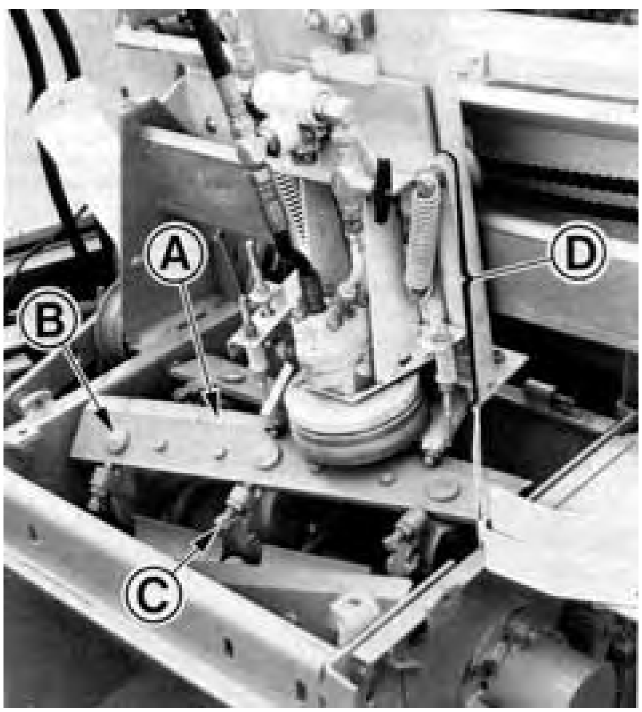


FIGURE 7. Cutterhead Assembly: (A) Knife, (B) Knife bolt, (C) Setscrew, (D) Hydraulic knife grinder.

Shear plate clearance was adjusted by loosening two mounting bolts and tightening two adjusting bolts. It took an experienced operator about 35 minutes to sharpen the knives and adjust the shear plate.

The average period between knife grinding was about 15 hours, provided shear plate clearance was properly maintained. During the 235 hour test, the knives incurred about 6 mm (0.25 in) of wear, mainly due to grinding.

The shear bar was significantly worn after 185 hours of operation and replaced, since it was not reversible.

It was not necessary to adjust the cutterhead knives during the test. Each knife was held in place with three bolts and could be adjusted with setscrews (FIGURE 7).

Adjusting Cut Length: The cut length setting could be changed 690 mm. by interchanging or reversing two dual sprockets on the feedroll drive. The sprockets provided several cut length settings from 4 to 19 mm (0.2 to 0.8 in). Changing the cut length took an experienced operator 15 minutes.

Exchanging Header Attachments: Ease of installation of either header attachment was poor. The attachments were held in place with two pins and two lower lift arms. The left mounting pin was almost inaccessible, making removal difficult. No floatation lock was provided, which made it necessary to release the header floatation springs. It was necessary to break the header drive chain when changing attachments.

It took two men 45 minutes to install or remove the headers.

It is recommended that the manufacturer modify the attachments to permit easier exchange of headers.

Transporting: The drawpole could be placed in one of five positions. The extreme right position was used for transporting with the pickup head, and the middle position for transporting with the row crop head, due to its greater width. The two left positions were used during field operation. The spring-loaded drawpole locking arm could be retracted, using a rope from the tractor seat. This made changing from field position to transport position easy.

The Hesston 7160 was easy to maneuver and towed well in transport position. Ground clearance was adequate and there was ample hitch clearance for turning sharp corners. An adjustable hitch was provided for towing a wagon.

Lubrication: The Hesston 7160 had 35 pressure grease fittings, nine requiring daily lubrication, and four chains. The windrow pickup had eight pressure grease fittings while the three-row row crop header had 21 pressure grease fittings. A total of three chains on the pickup header and seven chains on the three-row row crop header required daily lubrication. At least twelve of the pressure grease fittings on the row crop header were under the rear of the header, making them accessible only with extreme effort. It is recommended that the manufacturer modify the three-row row crop head to make lubrication easier. Complete daily and seasonal lubrication could be completed in 35 minutes.

OPERATOR SAFETY

The Hesston 7160 was safe to operate and service, as long as common sense was used and the manufacturer's safety recommendations were followed. Shielding gave good protection from moving parts and was easily moved for lubrication and servicing. The Hesston 7160 was equipped with a slow moving vehicle sign.

OPERATOR MANUAL

The operator manual was clearly written, containing much useful information on operation, adjustment, servicing and safety. Further information should be included in the operator manual on changing header attachments. It is recommended that the manufacturer include SI units in the manual.

DURABILITY RESULTS

TABLE 3 outlines the mechanical history of the Hesston 7160 during 235 hours of operation while harvesting about 150 ha (375 ac) of windrowed crop and 178 ha (445 ac) or corn. The intent of the test was evaluation of functional performance. An extended durability test was not conducted.

DISCUSSION OF MECHANICAL PROBLEMS

Bearing Supports: Welds on two bearing supports, which hold the rear drive shaft on the row crop head broke. Proper spacer bushings had not been installed. Bushings were installed, the gathering chains retimed, and the supports welded (FIGURE 8).

Electric Actuators: The remote electric control actuators failed several times during the 233 hour test (FIGURE 9).

TABLE 3. Mechanical History

Item	Operating Hours	Equivalent Field Area ha
-The lower feedroll drive chain was lost and replaced at	46, 65	64, 91
-Two upper feed rolls bent and were replaced at	57	80
-The feed auger stop on the windrow pickup was lost and replaced at	60, 71	84, 100
-The blower drive belt broke and was replaced at	68, 170	97, 238
-Several pickup teeth were replaced at	71	100
-Rotary sickles and stationary knives were replaced on row crop head at	100	140
-Bearing supports on row crop head broke and were welded at	141	197
-The grinding stone broke away from its mounting and was replaced at	185	260
-The shear bar was worn and replaced at	185	260
-The feedroll drive belt broke and was replaced at	191	270
-Feed roll gear box shift actuator broke and was replaced or repaired at	97, 151, 194	130, 211, 272
-The discharge deflector actuator was replaced at	20, 160	30, 223
-The hydraulic control valve for the knife grinder seized and was repaired at	end of test end of test	

FIGURE 8. Broken Bearing Supports.

FIGURE 9. Broken Electric Actuator.

APPENDIX I
SPECIFICATIONS

Make: Hesston
Model: 7160
Serial No.: 7160-3194

Overall Dimensions:
-- height (discharge spout removed) 1500 mm
-- length 5335 mm
-- width without attachments 3200 mm
-- with windrow pickup 3690 mm
-- with three-row row crop head 4340 mm
-- ground clearance 80, 130, 180

Windrow Pickup:
-- serial number FP7-00969
-- type floating cylindrical drum with spring teeth
-- height adjustment adjustable gauge wheels
-- working width 2180 mm
-- overall width 2680 mm
-- tooth spacing 67 mm
-- number of tooth bars 4
-- pickup speed 116 rpm (at 6 mm cut length setting)
-- tooth tip speed 7.0 km/h
-- auger diameter 560
-- auger length 2025
-- auger speed 108 rpm

Three-Row Row Crop Head:
-- distance between rows 960 mm
-- type of cutter rotary sickle
-- cutter speed 220 rpm
-- type of stalk gatherer chain
-- gathering chain/ground synchronization speed 4.4 km/h

Feedroll Assembly:
-- throat opening 535 mm x 390 mm
-- roll width 520 mm

	front		rear	
	upper	lower	upper	lower
-- roll diameter	240 mm	220 mm	150 mm	140 mm
-- roll speed (rpm) (at 6 mm cut setting)	80 rpm	85 rpm	122 rpm	128 rpm

Cutterhead:
-- type cylindrical
-- number of knives 6
-- width 560 mm
-- diameter 400 mm
-- speed 1000

Recutter Screen:
-- width 550 mm
-- arc length 390 mm
-- opening size 30 x 275 mm

Knife Sharpener:
-- type cylindrical stone (hydraulic)
-- size 140 mm diameter x 40 mm

Conveying Assembly:
-- transfer auger N/A
-- fan
-diameter 915 mm
-blade width 200 mm
-discharge spout 225 mm diameter
-speed 710 rpm

Tires: two, 12.5 L-15, 6-ply

Weights:

	With pickup head	With three-row row crop head
-- left wheel	874 kg	786 kg
-- right wheel	1284 kg	1428 kg
-- hitch	200 kg	246 kg
TOTAL	2358 kg	2460 kg

Lubrication:
-- main unit
-grease fittings 9 every 10 h, 19 every 40 h, 7 every 50 h
-chains 3 every 10 h
-wheel bearings 2 every 10 h
-gear boxes 2 every 10 h
-- windrow pickup
-grease fittings 5 every 10 h 2 every 20 h 1 seasonal
-chains 3 every 10 h
-- three-row row crop head
-grease fittings 20 every 20 h 1 seasonal
-chains 7

Optional Equipment:
-- 1.8 m and 2.1 m pickup head
-- 2.1 m mower bar head.
-- two-row and three-row row crop heads (760 and 960 mm spacing) and four-row crop head (760 mm spacing)
-- recutter screens
-- spout extensions
-- horizontal 660, 1300 mm
-- vertical 380 mm
-- blower slow down kit
-- hydraulic lift cylinder
-- extra floatation spring

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
CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 mile/hour (mph)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 tonne (t)	= 2200 pounds mass (lb)
1 newton (N)	= 0.2 pounds force (lb)
1 tonne/hour (t/h)	= 1.1 ton/hour (ton/h)
1 tonne/kilowatt hour (t/kW-h)	= 0.8 ton/horsepower hour (ton/hp-h)

APPENDIX IV

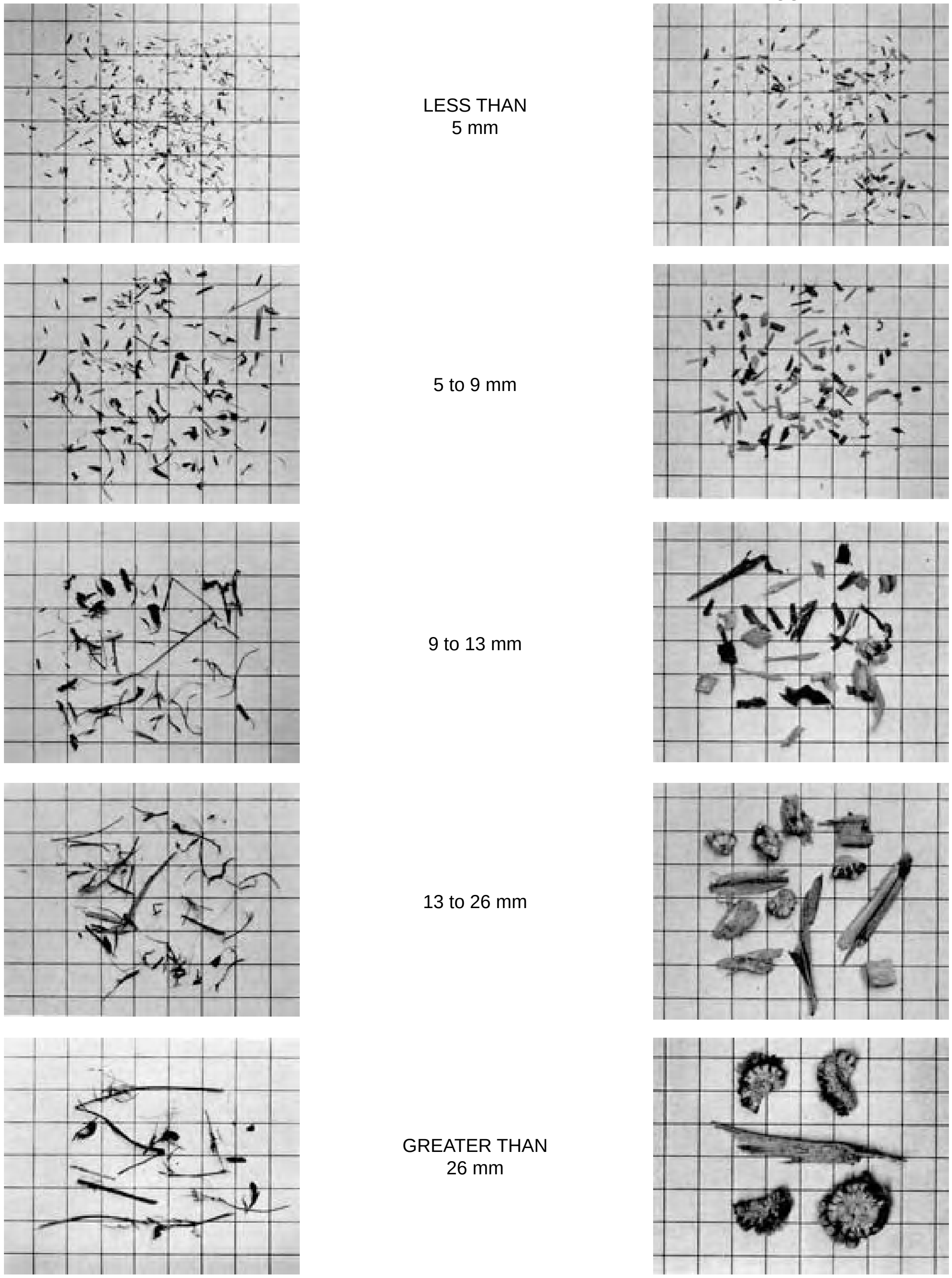


FIGURE 10. Distribution of Particle Lengths (20 mm grid).

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