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Evaluation Report 224

International Harvester 1480 Self-Propelled Combine

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

INTERNATIONAL HARVESTER 1480 SELF-PROPELLED COMBINE

MANUFACTURER:
International Harvester Company
East Moline, Illinois 61 244
U.S.A.

DISTRIBUTOR:
International Harvester of Canada
NBR 219 - 3601 8th Street East
Saskatoon, Saskatchewan
S7H 0W5

RETAIL PRICE:
$110,160.00 (June 1981, f.o.b. Humboldt, with 4 m header, 3.4 m belt pickup, shaft speed monitor, stone retarder, windshield wiper, corn concaves, 28L x 26 front tires, 11.00 x 16 rear tires, operator platform extension with pivoting ladder, aspirated pre-screener, pre-cleaner and coolant filter conditioner).

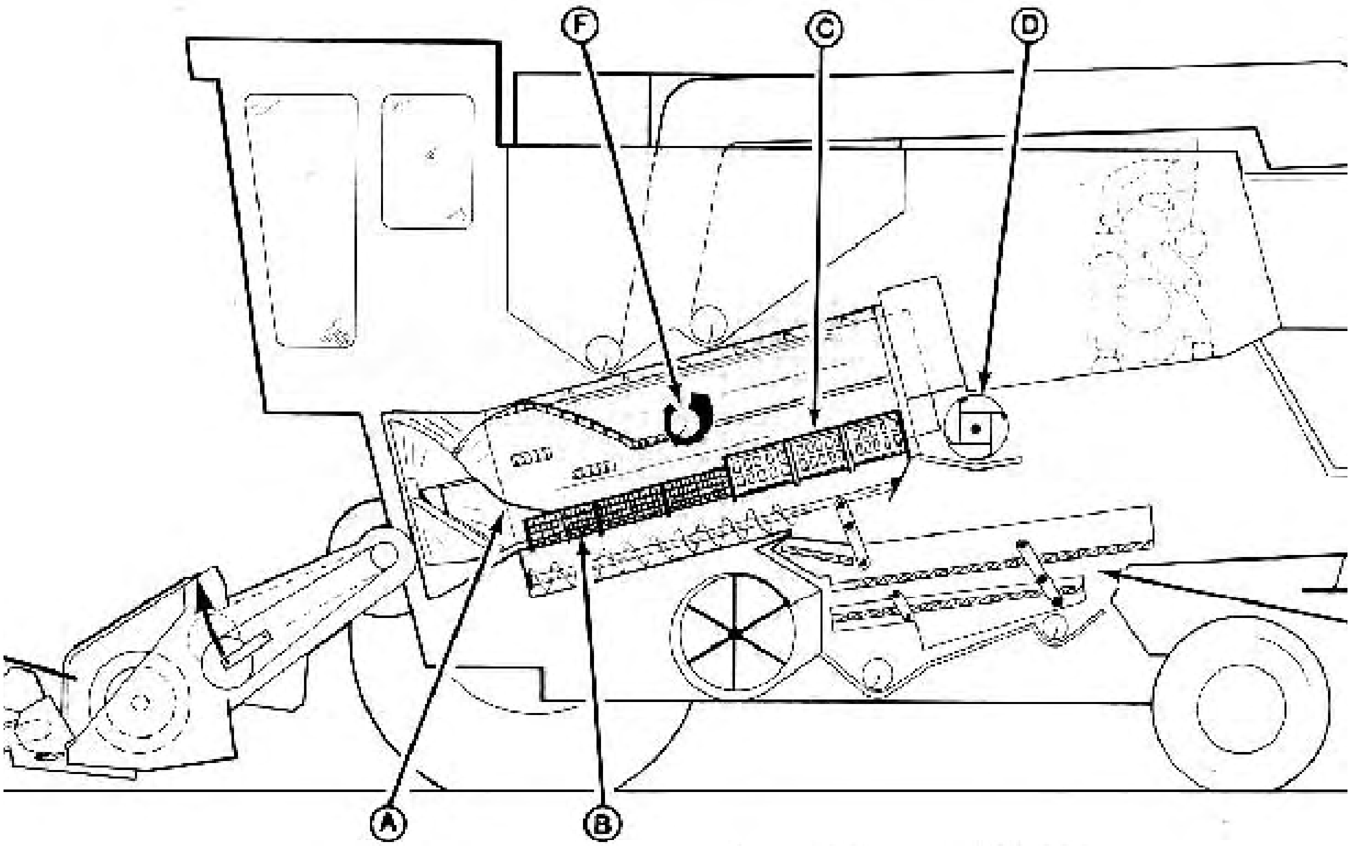

FIGURE 1. International Harvester 1480: (A) Rotor, (B) Threshing Concaves, (C) Separating Concaves, (D) Back Beater, (E) Shoe, (F) Tailings Return.

SUMMARY AND CONCLUSIONS

Functional performance of the International Harvester 148C self-propelled combine was very good in dry grain and oilseed crops, and good in tough grain and oilseed crops.

The MOG feedrate* at 3% total grain loss varied from 18 t/h (660 lb/min) in 3.3 t/ha (6t bu/ac) Hector barley to 12 t/h (440 lb/min) in 2.7 t/ha (40 bu/ac) Neepawa wheat.

For similar total grain loss, capacity of the International Harvester 1480 was much greater than the capacity of the PAMI reference combine. Rotor loss limited capacity in dry mature crops while shoe and cylinder losses were usually low over the full operating range.

The engine had adequate power for harvesting under normal conditions. Fuel consumption varied from 23 to 32 L/h (5 to 7 gal/h).

The International Harvester 1480 was convenient to operate. Forward and side visibility was very good while rear visibility was restricted. Steering and brakes were responsive making the combine very maneuverable in the field and while transporting. Lighting for nighttime operation was good. The instruments and controls were conveniently placed, easy to use and responsive. The air conditioner and heater provided comfortable cab temperatures in all conditions. The cab was relatively dust free. Operator station sound level was about 82 dBA.

The International Harvester 1480 was easy to set and adjust. Rotor and pickup speed were adjusted from within the cab: The return tailings could not be sampled.

The International Harvester 1480 had good crop handling characteristics. The pickup fed evenly and uniformly in all crops. The table auger and feeder were aggressive and plugging was infrequent. Rocking wrenches and hubs made table and feeder unplugging easy. The rotor was aggressive and seldom plugged. The rotor could be cleared by power unplugging. The stone retarder stopped most objects, but small stones caused minor damage to the concaves. The unloading auger was convenient to position and had ample reach and clearance for unloading on-the-go.

All lubrication points were easy to service. Accessibility was fair for cleaning, and very good for repair and adjustment.

The International Harvester 1480 was safe to operate as long as the manufacturer's safety instructions were followed. The combine rocked severely at maximum transport speed.

The operator's manual was well illustrated, clearly written and contained much useful information. A few durability problems occurred during the test.

*The MOG feedrate (Material-Other-than-Grain Feedrate) is the mass of straw and chaff passing through a combine per unit time.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Improving rear visibility.
2. Modifications to the cab filter to reduce operator dust hazard.
3. Modifications to prevent the header and separator switches from being accidentally operated.
4. Modifications to reduce heater shut-off valve temperature.
5. Supplying a shaft speed monitor for the rotor.
6. Improving the console lighting.
7. Modifications to reduce combine rocking at maximum transport speed.
8. Supplying a full grain tank warning device.
9. Improving the ease of auger hub shield latching.
10. Supplying a safe, convenient apparatus to sample the return tailings.
11. Improving manufacturing quality control of the priority valve.
12. Modifications to prevent operator hand injury when adjusting fan speed.
13. Modifications to prevent the transmission from slipping out of gear.
14. Modifications to reduce pickup stripper bar wear.

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Station Manager -- J. D. MacAulay
Project Technologist -- L. G. Hill

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Transparent material in front of the grain tank and improved mirrors are being evaluated for improved rear visibility.
2. Alternate locations for the cab filter are being field evaluated to eliminate dust on the operator when he closes the door.
3. The switches include an interlock to prevent engine starting with switches engaged. The switches are located to provide the operator with quick disengagement during operation.
4. Modifications to reduce heater shutoff valve temperature will be investigated.
5. The 1981, 1480 combine includes a rotor shaft speed monitor as standard equipment.
6. Improved lighting of the console is being installed in test machines for field evaluation.
7. Change is being made in hardness of the ISO-mounts to reduce rocking of the operator control center.
8. A full grain tank warning device will be considered.
9. Revisions in shielding are being considered for forthcoming header changes.
10. Several inventions are being considered to sample the return tailings. To date, evaluation has shown that further development is necessary.
11. 1981 combines have a new electro-hydraulic system, which eliminates the priority valve.
12. Fan speed control is now electrically controlled from the operator's seat. Hand adjustment at the drive is not necessary.
13. A service procedure (service bulletin S-4001) is established to determine and eliminate causes of the transmission slipping out of gear. Improved quality control is being initiated at the producing plants.
14. Variations to reduce this wear will be considered in future designs. This wear has not been reported as excessive by customers. A review will be made through the service department.

GENERAL DESCRIPTION

The International Harvester 1480 is a self-propelled combine with one longitudinally mounted rotor, threshing and separating concaves, and a cleaning shoe. Threshing occurs mainly at the front section of the rotor while separation of grain from straw occurs throughout the full length of the threshing and separating concaves. Grain is cleaned at the shoe and the return tailings delivered to the third threshing concave. A reinforced front feeder drum acts as a stone retarder.

The test machine was equipped with a 142 kW (190 hp) turbocharged 6 cylinder diesel engine, a 4 m (13 ft) header, a 3.4 m (132 in) two roller belt pickup, straw spreaders and the optional accessories listed on page 2.

The International Harvester 1480 has a pressurized operator's cab, power steering, hydraulic wheel brakes and hydrostatic traction drive. Header height and unloading auger swing are hydraulically controlled, separator and header drives are electrically engaged, and the unloading auger drive is manually engaged. Pickup and rotor speed are adjusted from within the cab. Fan speed, concave clearance and shoe settings are externally adjusted. There is no provision to safely and conveniently sample the return tailings. Most component speeds and harvest functions are displayed on electronic monitors.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The International Harvester 1480 was operated in conditions shown in TABLES 1 and 2 for 160 hours while harvesting about 510 ha (1260 ac). It was evaluated for ease of operation, ease of adjustment, rate of work, grain loss characteristics, operator safety and suitability of operator's manual. Throughout the tests comparisons were made to the PAMI reference combine.

TABLE 1. Operating Conditions

Crop	Variety	Average Yield t/ha	Swath Width m	Hours	Field Area ha
Barley	Hector	3.2	6.1 to 12.2	22.0	46
Barley	Klages	4.0	6.1	1.5	2
Barley	Melvin	2.1	12.2	5.5	23
Flax	Dufferin	1.1	6.1 to 7.6	15.5	47
Rapeseed	Altex	1.7	6.1 to 7.3	21.0	67
Rapeseed	Candle	1.6	6.1	2.0	5
Rapeseed	Midas	1.8	7.3	2.5	8
Rapeseed	Regent	1.4	6.1	7.5	21
Rapeseed	Torch	1.2	6.1	3.0	9
Rye	Puma	1.4	12.2	3.5	15
Wheat	Neepwa	2.6	6.1 to 12.2	74.0	260
Wheat	Sinton	2.0	12.2	2.0	7
Total				160	510

TABLE 2. Operation in Stony Fields

Field Condition	Hours	Field Area (ha)
Stone Free	68	225
Occasional Stones	75	235
Moderately Stony	17	50
Total	160	610

RESULTS AND DISCUSSION

EASE OF OPERATION

Operator Location: The cab was positioned ahead of the gram tank and slightly left-of-centre. Visibility forward, left and right were very good while rear visibility was restricted. Although rear view mirrors were provided, caution was needed when maneuvering in confined areas and while transporting. It is recommended that the manufacturer consider improving rear visibility. Header visibility was good (FIGURE 2). The grain level was visible through the rear window until the grain tank was nearly full.

FIGURE 2. View of Incoming Windrow.

The seat and steering column were adjustable providing a comfortable combination for most operators. Incoming air was effectively filtered while fans pressurized the cab to reduce dust leaks. The air conditioner and heater provided suitable cab temperatures. The operator was frequently showered with dust from the filter above the door when leaving the cab. It is recommended that the manufacturer consider modifications to the cab filter to reduce this dust hazard.

Operator station sound level was about 82 dBA.

Controls: The control arrangement is shown in FIGURE 3. Most controls were conveniently located, responsive and easy to use.

The separator and header engaging switches were conveniently located, but could be accidentally operated. It is recommended that the manufacturer consider modifications to prevent the header and separator from being accidentally operated.

The heater shut-off valve became too hot for safe adjustment. It is recommended that the manufacturer consider modifications to reduce heater shut-off valve temperatures.

The hydraulically controlled pickup drive and the responsive header lift gave the operator good control. Header lift was quick enough to suit all conditions; header drop rate was adjustable.

Instruments: The right instrument console (FIGURE 3b) included gauges, warning lights and a digital display. The gauges displayed engine oil pressure, coolant temperature, battery voltage, fuel level, engine hours, engine, ground, rotor and fan speed. The warning lights indicated low engine oil pressure, battery discharge, excessive coolant temperature and park brake engagement. The optional shaft speed monitor (FIGURE 3a) warned of reduced fan, shoe, tailings auger, clean grain auger, discharge beater and rotary screen speeds. It is recommended that the manufacturer consider supplying a shaft speed monitor to warn of reduced rotor speed.

Lights: Lighting was good for nighttime harvesting. There were five front lights, a grain tank light, an unloading auger light and a rear light. Interior lighting for the right and left consoles was inadequate. It is recommended that the manufacturer consider improving console lighting. The warning and tail lights were adequate for safe road travel.

Engine: The engine started easily. It had ample power for most conditions, but limited combine capacity in damp conditions or hilly terrain. Average fuel consumption varied from 23 to 32 L/h (5 to 7 gal/h). Oil consumption was insignificant. The fuel tank inlet was located 2.3 m (7.5 ft) above ground, making filling from average height gravity fuel tanks difficult. The rotary radiator screen was effective in preventing radiator plugging. Although the rotary screen plugged frequently when operating with a tail wind, the screen could usually be cleaned by stopping and idling the engine. The engine air intake used a screened precleaner, an aspirated precleaner, a centrifugal bowl cleaner and two dry filters. Frequent primary filter cleaning was required when operating in strong tail winds.

Maneuverability: The International Harvester 1480 was very maneuverable, and the steering and wheel brakes responsive. The turning radius was 6.9 m (22.5 ft). Using individual wheel brakes it was possible to pick around most windrow corners. The hydrostatic drive made backing up easy on difficult-to-pick corners.

Stability: The International Harvester 1480 was very stable in the field even with a full grain tank. Normal caution was needed on hillsides.

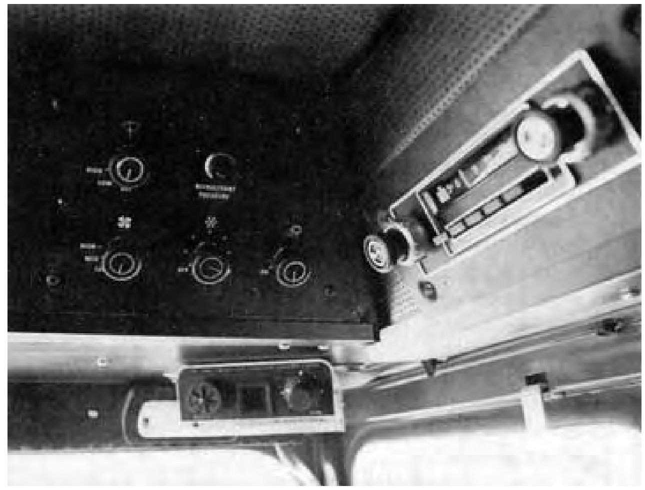
At maximum transport speed of about 25 km/h (16 mph) the combine rocked severely forward and back, making control difficult and operating uncomfortable. It is recommended that the manufacturer consider modifications to reduce rocking at maximum transport speed.

Grain Tank: Grain tank volume was 7.3 m³ (200 bu). The tank filled evenly and completely in all crops. Once the tank had filled above the rear cab window the operator had to leave the cab to check the level. It is recommended that the manufacturer consider supplying a warning device to signal a full grain tank.

The unloading auger had ample reach and clearance for easy unloading on-the-go (FIGURE 4). The hydraulic swing was convenient for topping loads and adjusting auger reach. If the full unloading auger was swung back into transport position about 1.5 L (0.05 bu) of grain spilled from the unloader tube.

Unloading a full tank of dry wheat took about 115 seconds.

Pickup: The International Harvester 1480 was equipped with a 3350 mm (132 in) International Harvester, two roller, draper pickup with nylon teeth (FIGURE 5).



(a)

(b)

(c)
FIGURE 3. Instrument and Control Consoles.

Picking height was controlled by castor wheel adjustment while picking angle was determined by the header height. Pickup speed was adjusted with a flow control valve in the cab.
The pickup worked well at speeds up to 10 km/h (6 mph). It fed evenly and uniformly in all crops. In rapeseed the windguard and crop deflector had to be removed to prevent bunching and excessive shelling.

Stone Protection: The test machine was equipped with an optional stone retarder drum located at the front of the feeder (FIGURE 6). Adjustable stops controlled feeder drum travel and limited the size of object, which could pass up the feeder. Although this prevented large objects from entering the rotor small stones passed through, causing minor damage to the concaves (FIGURE 7).

FIGURE 4. Unloading Auger Clearance.

FIGURE 5. Pickup with Windguard and Crop Deflector.

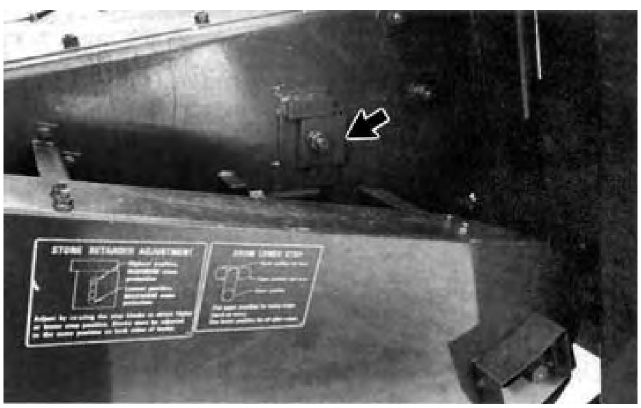


FIGURE 6. Stone Retarder Stop Block.

FIGURE 7. Concave Damage.

In bunchy rapeseed windrows, the stone retarder stops had to be set to their highest position to increase feeder capacity. In this position, only limited stone protection was provided.

Straw Spreaders: The straw spreader attachment performed well in most crops. Spreading width was up to 4.5 m (14.5 ft) in calm conditions. Wind reduced spreading effectiveness.

The spreaders were easily removed to permit windrowing straw. As is common with rotary combines, the straw from the rotor was generally not suitable for baling.

Plugging: The table auger and feeder were aggressive. Occasional table auger plugging occurred in bunchy windrows or when the windrow was fed in off centre. A rocking wrench and hub were provided to facilitate table auger unplugging (FIGURE 8). The wing nut for securing the auger hub shield was inconvenient to use. It is recommended that the manufacturer consider improving the ease of the auger hub shield latching. The windguard interfered with the operator when removing straw from the auger.

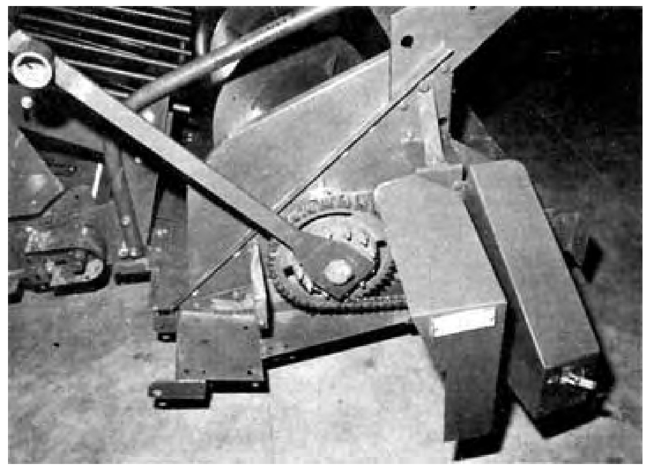


FIGURE 8. Table Auger Rocking Hub and Wrench.

Feeder conveyor plugging was infrequent. A rocking wrench and hub on the upper drive shaft were provided to facilitate unplugging (FIGURE 9).

FIGURE 9. Feeder Conveyor Rocking Hub and Wrench.

The rotor was very aggressive and seldom plugged. If the rotor plugged, it could usually be unplugged by lowering the concave and shifting the rotor drive into low. A rocking wrench was supplied for the rotor.

Machine Cleaning: Cleaning the International Harvester 1480 for combining seed grain was laborious and time-consuming. The grain tank retained grain in several places, while cross-members made cleaning inconvenient. The unloading auger sump retained a considerable amount of grain. The shoe delivery augers were easily accessible from the combine sides. The chaffer and sieve were easily removed, but required two people for handling. The tailings auger and clean grain auger were accessible with the chaffer and sieve removed. Dust and chaff built up on top of the rotor cage and beneath the rotor drive in the engine compartment. The exterior of the combine was easily cleaned.

Lubrication: Ease of lubrication was excellent. The International Harvester 1480 had forty-four pressure grease fittings. Five needed greasing every 10 hours, twenty-one every 50 hours, six every 100 hours, three every 200 hours and nine every 500 hours. The pickup had four fittings, which required lubrication every 50 hours of operation.

Engine, gear boxes and hydraulic oil levels required regular checking.

EASE OF ADJUSTMENT

Field Adjustment: The International Harvester 1480 was easy to adjust and could usually be set by one person. Rotor speed was set from the cab while concave clearance, chaffer and sieve adjustment and fan speed were set on the combine.

To accurately determine losses, the straw spreaders should be removed and several checks made across the combine discharge. Losses were usually higher on the right side where more material was discharged.

The return tailings could not be conveniently inspected. This prevented the operator from understanding the affects of the settings. It is recommended that the manufacturer consider supplying a safe, convenient apparatus for sampling the return tailings.

Concave Adjustment: The rotor was equipped with an adjustable threshing concave and a stationary separating concave (FIGURE 10). Access was through doors on both sides of the combine.

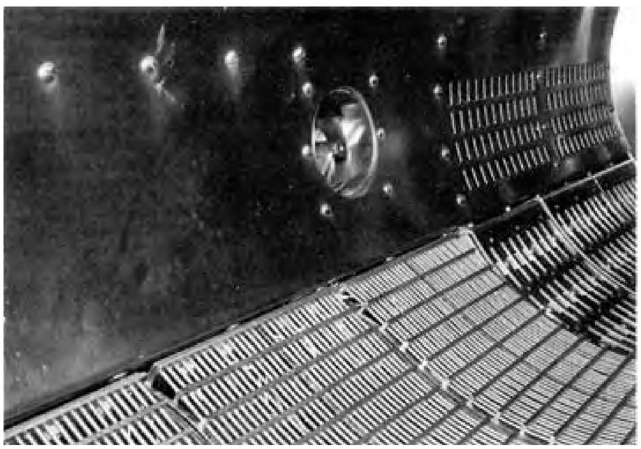


FIGURE 10. Threshing and Separating Concaves.

Initial levelling and adjusting of the concave was convenient. The middle segment of the threshing concave was removed and the front and rear threshing concaves used as references. The turn buckle on the front hanger was used to level the concave. The concave was raised to provide 2 mm (0.07 in) clearance between the highest rub bar and the trailing concave bar. The concave stops were set and locked, and the indicator set to zero position.

Concave clearance at the leading bar was approximately 42 mm (1.65 in) while clearance at the trailing bar could be adjusted from2 to 45 mm (0.07 to 1.65 in).

Suitable concave indicator settings for harvesting were 0 in flax, 0 to 1/2 in hard-to-thresh wheat, 1/2 to 1 in easy-to-thresh wheat, 1 to 2 in barley and fall rye and 4 to 5 in rapeseed. Threshing concave clearance was reduced to get maximum threshing in hard-to-thresh crops while in easier threshing crops the concave clearance was increased to reduce straw break-up and power requirements.

Capacity tests in wheat were conducted with narrow spaced concaves while in barley, the middle and rear threshing concaves were replaced with wide spaced concaves (FIGURE 11).

For all capacity tests the slotted pressed metal separating grates were used with the channel bars on the outside. Key stock separating concaves were not evaluated.

Changing the two rear threshing concaves took one person about twenty minutes. Changing all three threshing concaves was much more difficult.

Rotor Adjustment: The rotor was powered through a two-speed gearbox and a variable speed drive, adjustable electrically from the operator's seat.

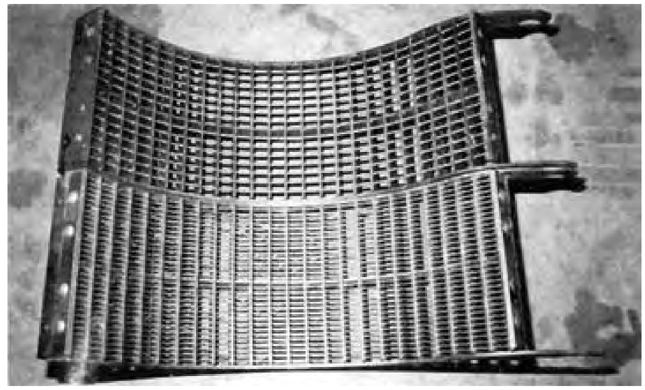


FIGURE 11. Wide Spaced and Narrow Spaced Wire Concaves.

The variable drive provided speeds from 280 to 650 rpm in low range and 420 to 1050 rpm in high range. This range was adequate for all crops encountered during the test. Suitable rotor speeds were 1050 rpm in tough wheat, 900 rpm in dry wheat, 800 rpm in barley and rye, 850 rpm in flax and 530 rpm in rapeseed.

Rotor wear was normal with the maximum wear occurring on the leading edges of the feeding fins (FIGURE 12).

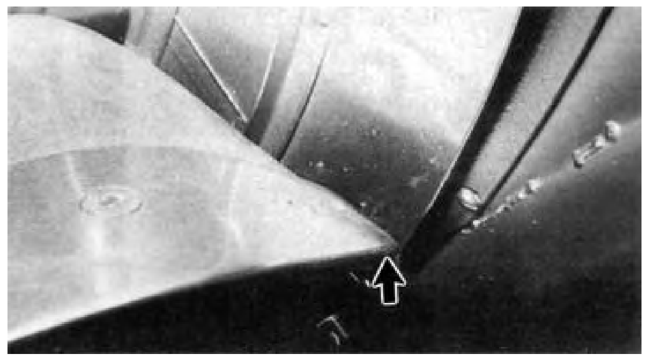


FIGURE 12. Rotor Feeding Fin Wear.

Rotor Transport Vane Adjustment: Throughout the test, the rotor transport vanes were operated, in the full pitch position. The vanes could be set to the half pitch position, but was found to be unnecessary.

Beater Adjustment: The beater discharge shield was set at 19 mm (0.75 in) from the beater tips and was not adjusted throughout the test.

Shoe Adjustment: Shoe adjustment was convenient. Fan speed was varied with a hand wheel (FIGURE 13) while the chaffer, chaffer extension and clean grain sieve were adjusted at the rear of the shoe. No provision was made to conveniently sample the return tailings. By installing a return sampling mechanism (FIGURE 14), it was much easier to adjust the shoe for optimum performance. The shoe performed well in all crops and when properly adjusted, resulted in 0.5 to 1.5% foreign material in the grain tank.

Header Adjustment: The International 1480 was evaluated only with a pickup attachment for windrowed crops. The table could be removed by one person in about 10 minutes. Complete feeder removal took approximately 30 minutes. A header support was not provided.

Adjustments were provided for header drop rate, header levelling, header tilt, feeder chain tension, feeder sprocket clearance, and table auger clearance.

Slip Clutches: Slip clutches protected the table auger, feeder conveyor, shoe shaker and shoe delivery auger, and the tailings and clean grain elevators.

RATE OF WORK

Average Workrates: TABLE 3 presents average workrates for the International Harvester 1480 in all crops harvested during the test. Average workrates are affected by crop condition, windrow formation, terrain, field shape and availability of grain handling equipment, and should not be used to compare combines tested in different years. Average workrates varied from 9.1 t/h (334 bu/hr) in 2.6 t/ha (39 bu/ac) Neepawa wheat to 3.3 t/h (130 bu/hr) in 1.1 t/ha (17.5 bu/ac) Dufferin flax.

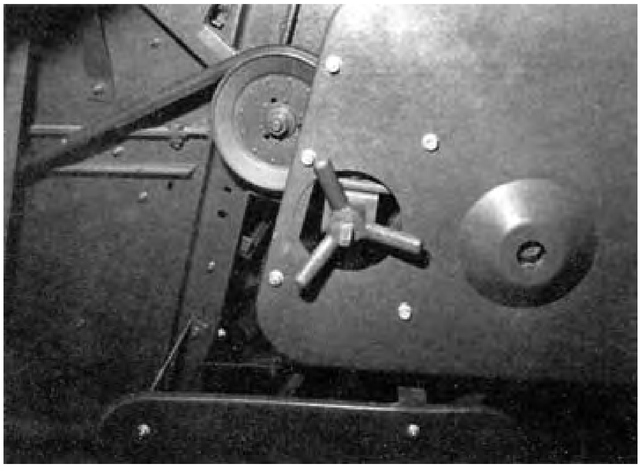


FIGURE 13. Fan Adjustment.

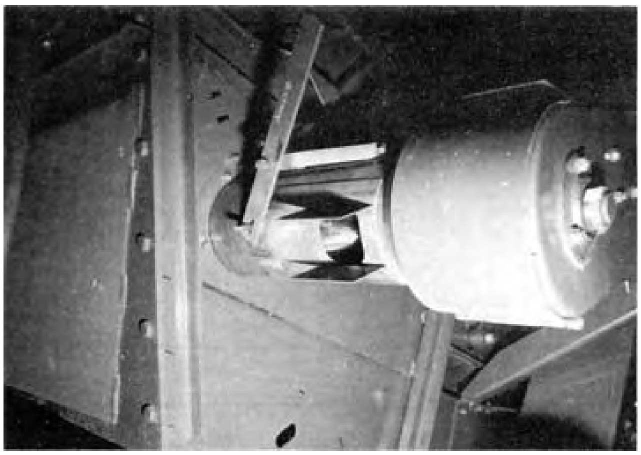


FIGURE 14. Tailings Sampling Mechanism Installed by PAMI.

TABLE 3. Average Workrates

Crop	Variety	Average Yield t/ha	Average Speed km/h	Average Workrate	
				ha/h	t/h
Barley	Hector	3.2	7.0 & 2.5	2.1	6.7
Barley	Klages	4.0	5.5	1.3	5.2
Barley	Melvin	2.1	7.0	4.2	8.8
Flax	Dufferin	1.1	6.5	3.0	3.3
Rapeseed	Altex	1.7	6.5	3.2	5.4
Rapeseed	Candle	1.6	4.0	2.5	4.0
Rapeseed	Midas	1.8	5.6	3.2	5.8
Rapeseed	Regent	1.4	6.0	2.8	3.9
Rapeseed	Torch	1.2	4.8	3.0	3.6
Rye	Puma	1.4	8.0	4.3	6.0
Wheat	Neepwa	2.6	8.0 & 3.0	3.5	9.1
Wheat	Sinton	2.0	4.8	3.5	7.0

Maximum Feedrate: The workrates in TABLE 3 represent average workrates at acceptable loss levels. The combine had ample power to achieve higher workrates. In most crops the maximum acceptable feedrate was limited by grain loss while the maximum feedrate was limited by power in heavy crops and pickup performance in light crops.

Capacity: Combine capacity is the maximum rate at which a combine, adjusted for optimum performance, can harvest a crop at a specified total loss level. Many crop variables affect combine capacity. Crop type and variety, grain and straw yield and moisture content, local climatic conditions and windrow quality can cause capacity variations.

MOG Feedrate, MOG/G Ratio, and Percent Loss: When determining combine capacity, combine performance and crop conditions must be expressed in a meaningful way. The loss characteristics of a combine depend mainly on two factors, the quantity of the straw and chaff being processed and the quantity of grain being processed. The mass of straw and chaff passing through the combine per unit time is called MOG feedrate. MOG is an abbreviation for "Material-Other-than-Grain" and represents the mass of all plant material passing through the combine except for the grain or seed.

The mass of grain or seed passing through the combine per unit time is called Grain Feedrate. The ratio of MOG feedrate to the Grain Feedrate, abbreviated as MOG/G, indicates how difficult a crop is to separate. For example, if a combine is used in two wheat fields of identical yield, one with long straw and one with short straw, the combine will have better separation ability in the short crop and will be able to operate faster. This crop variable is expressed as MOG/G ratio. In prairie wheat crops, MOG/G ratios vary from about 0.5 to 1.5.

Grain losses from the combine are of two main types, unthreshed grain or seed still in the head and threshed grain or seed discharged with the straw and chaff. Unthreshed grain is called cylinder loss. Free grain in the straw and chaff is called separator loss and consists of shoe loss and walker (or rotor) loss. Losses are expressed as a percentage of the total grain or seed passing through the combine.

Combine capacity is expressed as the maximum MOG feedrate at which total grain loss (cylinder loss plus separator loss) is 3% of the total grain yield.

Capacity of the International Harvester 1480: TABLE 4 presents capacity results for the International Harvester 1480 in four different crops. MOG Feedrates for a 3% total grain loss varied from 18 t/h (660 lb/min) in 3.3 t/ha (61 bu/ac) Hector barley to 12 t/h (440 lb/min) in 2.7 t/ha (40 bu/ac) Neepawa wheat.

GRAIN LOSS CHARACTERISTICS

The grain loss characteristics for the International Harvester 1480 in the four crops described in TABLE 4 are presented in FIGURES 15 to 18.

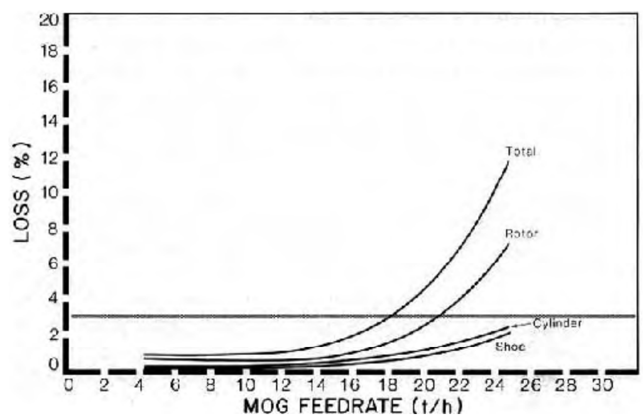


FIGURE 15. Grain Loss in Hector Barley (Field A - Double Windrows).

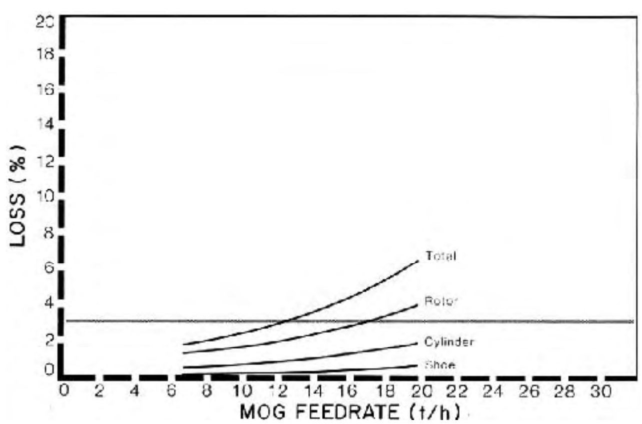


FIGURE 16. Grain Loss in Neepawa Wheat (Field C - Double Windrows).

Rotor Loss: Rotor losses were low over the full operating range in wheat crops, but became significant at high feedrates in barley crops.

Combine capacity did not increase when harvesting double windrows as compared to single windrows.

Shoe Loss: Shoe loss did not limit combine capacity in grain

TABLE 4. Capacity at Total Loss of 3% of Yield

Crop Conditions							Capacity Results			
				Grain Moisture						
Crop	Variety	Width of Cut m	Crop Yield t/ha	Straw %	Grain %	MOG/G	MOG Feedrate t/h	Grain Feedrate t/h	Ground Speed km/h	Loss Curve
Barley (A)	Hector[1]	12.2	3.34	15.3	15.1	0.81	18.0	22.2	5.4	Fig. 15
Wheat (C)	Neepawa[1]	12.2	2.65	9.0	13.4	0.91	12.0	13.2	4.1	Fig. 16
Wheat (C)	Neepawa	6.1	3.00	6.5	12.7	1.04	16.8	16.2	8.8	Fig. 17
Wheat (D)	Neepawa[1]	12.2	2.99	7.4	12.7	1.07	15.8	14.8	4.0	Fig. 18

[1]Side by Side Double Windrows

crops, but in rapeseed and flax, shoe losses were significant at high feedrates. High shoe losses could occur on uneven terrain or with improper settings.

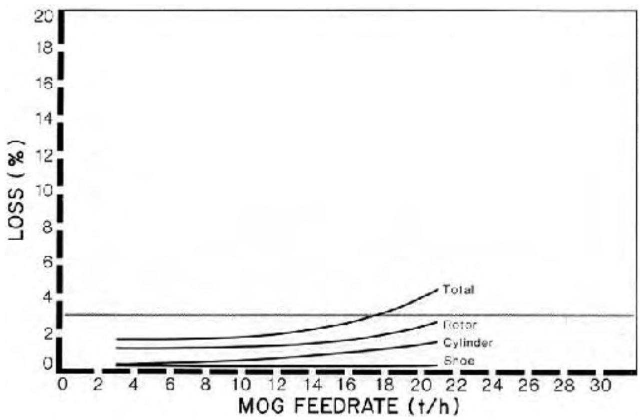


FIGURE 17. Grain Loss in Neepawa Wheat (Field D - Single Windrows).

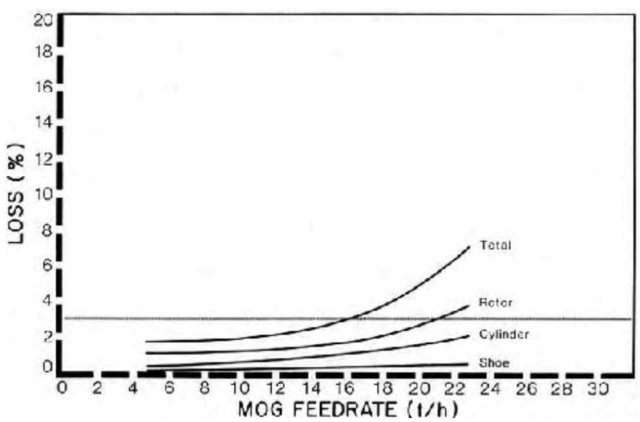


FIGURE 18. Grain Loss in Neepawa Wheat (Field D - Double Windrows).

Cylinder Loss and Grain Damage: Cylinder loss was low in all crops tested (FIGURES 15 to 18), while grain cracks were approximately 1.5% (FIGURE 19). The International Harvester 1480 had lower cylinder loss and grain damage than the reference combine.

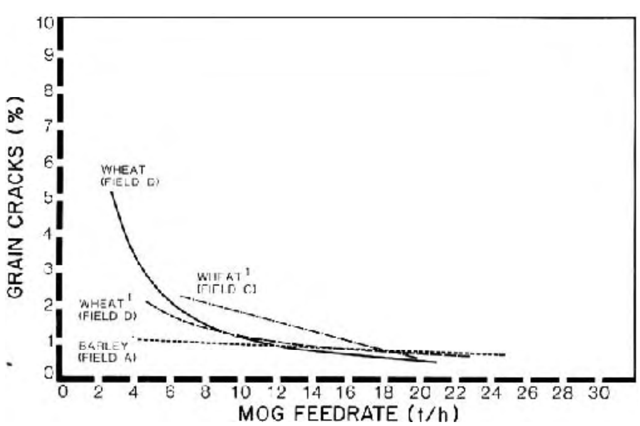


FIGURE 19. Grain Damage (Side by Side Double Windrows).

Body Loss: Leakage of grain from the combine was negligible in both grain and oilseeds.

Comparison to Reference Combine: Comparing combine capacities is complex because crop and growing conditions affect combine performance with the result that slightly different capacity characteristics can be expected every year. As an aid in determining relative combine capacities, PAMI uses a reference combine. This combine is operated alongside test combines whenever capacity measurements are made. This permits the comparison of loss characteristics of every test combine to those of the reference combine independent of crop conditions. The reference combine used by PAMI is commonly accepted in the prairie provinces and is described in PAMI evaluation report E0576C. See APPENDIX III for PAMI reference combine capacity results.

FIGURES 20 to 23 compare the total grain losses of the International Harvester 1480 to the PAMI reference combine in the four crops described in TABLE 4. The shaded areas on the figures are 95% confidence belts. If the shaded areas overlap, the loss characteristics of the two combines are not significantly different, whereas if the shaded areas do not overlap, losses are significantly different. The capacity of the International Harvester 1480 was much greater than the reference combine capacity in wheat and barley.

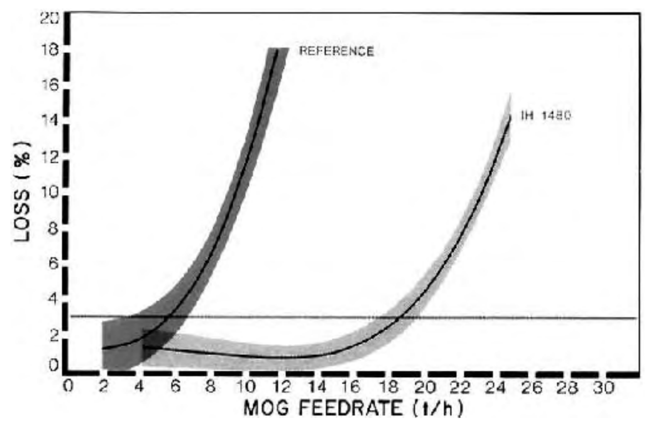


FIGURE 20. Total Grain Loss in Hector Barley (Field A - Double Windrows).

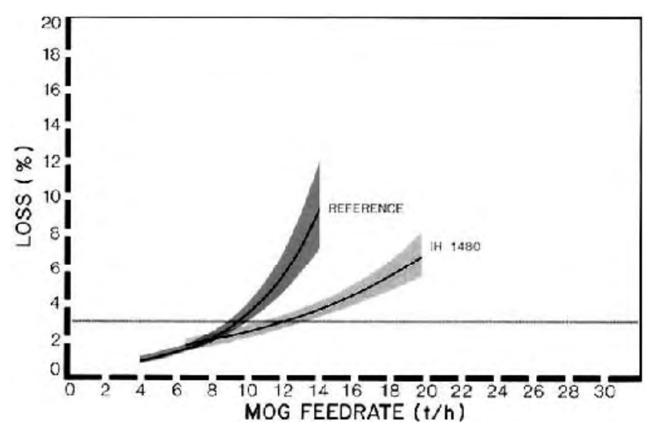


FIGURE 21. Total Grain Loss in Neepawa Wheat (Field C - Double Windrows).

OPERATOR SAFETY

The operator's manual emphasized operator safety.

The International Harvester 1480 had adequate warning decals. Moving parts were well shielded. Most shields were easy to remove and replace.

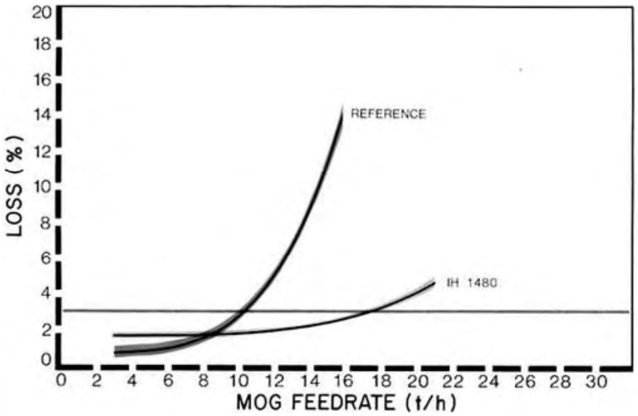


FIGURE 22. Total Grain Loss in Neepawa Wheat (Field D - Single Windrows).

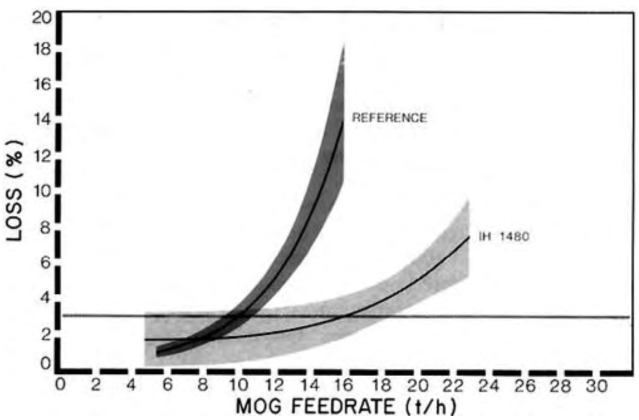


FIGURE 23. Total Grain Loss in Neepawa Wheat (Field D - Double Windrows).

The combine was equipped with a slow moving vehicle sign, warning lights, tail lights, signal lights, and rear view mirrors for road transport.

A header lock was provided and its proper use emphasized in the combine and header manuals. The header lock should be engaged when working around the header or leaving the combine unattended.

Rocking wrenches and hubs were provided for the table auger, feeder and rotor. All clutches should be disengaged and the engine shut off before clearing obstructions.

Most machine adjustments could be made safely. However, when adjusting the fan, an operator’s fingers were often injured on the sheet metal opening behind the adjusting wheel (FIGURE 13). It is recommended that the manufacturer consider modifications to prevent operator hand injury when adjusting fan speed.

A fire extinguisher (class ABC) should be carried on the combine at all times.

OPERATOR’S MANUAL

The operator’s manual was clearly written, well illustrated and well organized. It contained much useful information on safe operation, controls, adjustments, crop settings, servicing and trouble shooting.

DURABILITY RESULTS

TABLE 5 outlines the mechanical history of the International Harvester 1480 during 160 hours of %operation while harvesting about 510 ha (1260 ac). A functional performance evaluation. The mechanical history represents failures, which occurred during the functional testing. Extended durability testing was not conducted.

DISCUSSION OF MECHANICAL PROBLEMS

Power Steering: Loss of power steering and auger swing was caused by a sticking priority valve spool. The spool was removed and the spool and spool housing were polished to eliminate the sticking. It is recommended that the manufacturer consider improving manufacturing quality control of the priority valve assembly.

TABLE 5. Mechanical History

Item	Operating Hours	Field Area ha
Power Steering		
-The power steering and auger swing failed to operate; the priority valve was repaired at	Beginning of test	
Hydrostatic System		
-The pump and motor failed and were replaced at	3	15
Miscellaneous		
-The return elevator chain broke and was replaced at	3, 19, 20 and 28	15, 60, 61 and 82
-The transmission slipped out of second gear	throughout the test	
-The clean grain and return elevator chain jumped off the drive sprocket at	19, 71	60, 213
-The heater hose broke and was repaired at	120	373
-A concave retainer eye bolt broke and was welded at	end of test	

Return Elevator: The return elevator chain broke when the return elevator plugged. Plugging occurred because the manufacturer had omitted a 200 mm (8 in) section of flighting on the end of the upper return cross auger. The slip clutch had failed to protect the elevator chain from breaking.

No problems occurred after the missing flighting was installed.

Transmission: The transmission frequently slipped out of second gear during normal field operation. It is recommended that the manufacturer consider modifications to prevent the transmission from slipping out of gear during operation.

Clean grain elevator drive misalignment of the idler sprockets (FIGURE 24) caused the clean grain elevator drive chain to jump off the drive sprocket. No further problems occurred after the sprockets were realigned and a new wear block installed.

Pickup Stripper Bar: The pickup stripper bar wore considerably (FIGURE 25). It is recommended that the manufacturer consider modifications to reduce pickup stripper bar wear.

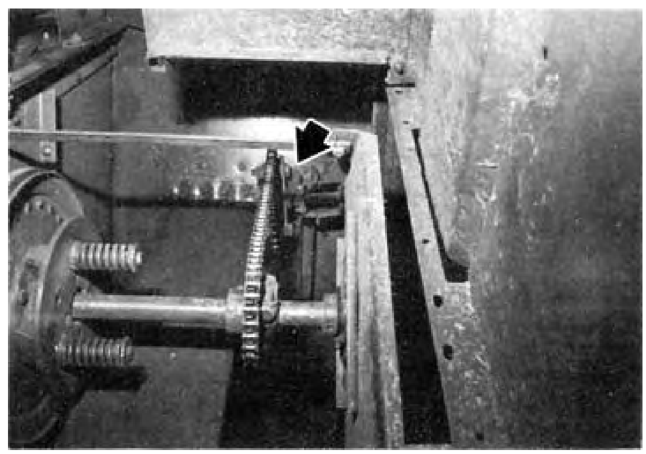


FIGURE 24. Misaligned Idlers.

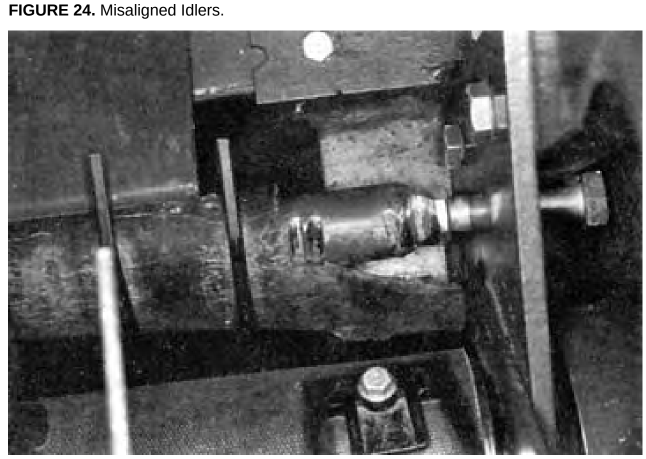


FIGURE 25. Pickup Stripper Bar Wear.

APPENDIX I
SPECIFICATIONS

MAKE:	International Harvester Self-Propelled Combine
MODEL:	1480 Axial Flow
SERIAL NUMBER:	Header 1480111 U031345 Combine 1720215U002807 Engine U11830
MANUFACTURER:	International Harvester Company East Moline, Illinois 61244

WINDROW PICKUP:

-- make	International Harvester
-- type	belt
-- pickup width	3350mm
-- number of belts	6
-- teeth per belt	56
-- type of teeth	nylon
-- number of rollers	2
-- height control	castor wheels
-- speed control	hydrostatic
-- speed range	0 to 2.2m/s

HEADER:

-- type	centre feed
-- width	3830 mm
-- auger diameter	508 mm
-- feeder conveyor	2 roller chains, under-shot slatted conveyor
-- conveyor speed	2.6 m/s
-- range of picking height	-330 to 1100 mm
-- number of lift cylinders	2
-- raising time	4.5 s
-- lowering time	adjustable
-- options	corn and straight-cut headers

STONE PROTECTION:

-- type	reinforced feeder, drum; travel limited by 4 position stop
-- ejection	hand removal after reversing feeder conveyor

ROTOR:

-- crop	flow axial
-- number of rotors	1
-- type	parallel and spiral rasp bars front portion; 4 parallel smooth bars rear portion
-- diameter	
- tube	644 mm
- feeding portion	991 mm
- threshing portion	760 mm
- separating portion	763 mm
-- length	
- feeding portion	504 mm
- threshing portion	1110 mm
- separating portion	1113 mm
-total	2727 mm
-- drive	variable pitch belt and 2 speed gearbox
-- speeds	
- low range	280 to 670 rpm
- high range	440 to 1050 rpm

CONCAVES (THRESHING):

-- number	1 consisting of three removable portions
-- type	bar and wire grate
-- number of bars	25
-- configuration	
- narrow spaced	24 intervals with 5 mm wires and 6 mm spaces
- wide spaced	24 intervals with 6.4 mm wires and 15 mm spaces
-- area total	0.934 m^2
-- area	open
-- narrow spaced	0.389 m^2
-- wide spaced	0.520 m^2
-- wrap	131 degrees
-- grain delivery to shoe	4 auger conveyors
-- options	wide spaced concaves

CONCAVES (SEPARATING):

-- number	1 consisting of three removable portions
-- type	perforated formed metal
-- area	1.408 m^2
-- area open	0.401 m^2
-- wrap	195 degrees
-- grain delivery to shoe	4 auger conveyors
-- options	key-stock concave grates

THRESHING AND SEPARATING CHAMBER:

-- number of spirals	12
-- pitch of spirals	22 degrees

DISCHARGE BEATER:

-- type	4 wing box
-- diameter	352 mm
-- speed	850 rpm

SHOE:

-- type	opposed action
-- speed	280 rpm
-- chaffer sieve	adjustable lip, 1.80 m^2 with 59 mm throw
-- chaffer extension	adjustable lip, 0.38 m^2
-- clean grain sieve	adjustable lip, 1.78 m^2 with 32 mm throw
-- options	perforated elevator doors, troughs and extensions, miscellaneous sieves

CLEANING FAN:

-- type	6 blade undershot
-- diameter	584 mm
-- width	1244 mm
-- drive	variable pitch belt
-- speed range	410 to 1160 rpm
-- options	air intake screens

ELEVATORS:

-- type	roller chain with rubber flights, top delivery
-- clean grain (top drive)	261 x 211 mm
-- tailings (top drive)	153 x 223 mm

GRAIN TANK:

-- capacity	7.26 m^3
-- unloading time	117 s
-- options	perforated unloader tube

STRAW SPREADER:

-- number of spreaders	2
-- type	steep hub with 6 rubber bats
-- speed	260 rpm

ENGINE:

-- make and model	International DT-436
-- type	4 stroke, turbocharged diesel
-- number of cylinders	6
-- displacement	7.14 L
-- governed speed (full throttle)	2735 rpm
-- manufacturer's rating	142 kW @ 2500 rpm
-- fuel tank capacity	473 L
-- options	aspirated pre-screener, pre-cleaner, cooling system filter

CLUTCHES:

-- separator	electro-hydraulic controlled
-- header	electro-hydraulic V-belt tightener
-- unloading auger	manual V-belt tightener
-- traction drive	hydraulic valve (foot-n-inch pedal)

NUMBER OF CHAIN DRIVES:	8
NUMBER OF BELT DRIVES:	13
NUMBER OF GEAR BOXES:	4
NUMBER OF PRELUBRICATED BEARINGS:	67

LUBRICATION POINTS:

-- 10 h lubrication	5
-- 50 h lubrication	21
-- 100 h lubrication	5
-- 200 h lubrication	2
-- 500 h lubrication	9

TIRES:

-- front	28 L x 26
-- rear	11.00 x 16

TRACTION DRIVE:

-- type	hydrostatic
-- speed ranges	
- 1st gear	0 to 5.3 km/h
- 2nd gear	0 to 9.7 km/h
- 3rd gear	0 to 24.7 km/h

OVERALL DIMENSIONS:

-- wheel tread (front)	3383 mm
-- wheel tread (rear)	2350 mm
-- wheel base	3550 mm
-- transport height	4030 mm
-- transport length	8780 mm
-- transport width	4585 mm
-- field height	4215 mm
-- field length	8740 mm
-- field width	4585 mm
-- unloader discharge height	3830 mm
-- unloader clearance height	3650 mm
-- unloader reach	1945 mm
-- turning radius	
- left	6885 mm
- right	7250 mm

MASS: (with empty grain tank)

-- right front wheel	3780 kg
-- left front wheel	3880 kg
-- right rear wheel	1290 kg
-- left rear wheel	1290 kg
TOTAL	10240 kg

APPENDIX II
REGRESSION EQUATIONS FOR CAPACITY RESULTS

Regression equations for the capacity results shown in FIGURES 15 to 18 are presented in TABLE 6. In the regressions, C = cylinder loss in percent of yield, S = shoe loss in percent of yield, R = rotor loss in percent of yield, F = the MOG feedrate in t/h, while $\ln$ is the natural logarithm. Sample size refers to the number of loss collections. Limits of the regressions may be obtained from FIGURES 15 to 18 while crop conditions are presented in TABLE 4.

TABLE 6. Regression Equations

Crop - Variety	Fig. No.	Regression Equations	Simple Correlation Coefficient	Variance Ratio	Sample Size
Barley - Fergus	15	$C = 0.20 + 6.0x10^{-6}F^4$ $\ln S = -4.22 + 0.20F$ $R = 0.71 - 5.7 \times 10^{-4}F^3 + 4.0 \times 10^{-5}F^4$	0.94 0.92 0.99	28.05[2] 22.93[2] 160.26[2]	6
Wheat - Neepawa	16	$\ln C = 1.55 + 0.11F$ $\ln S = -3.67 + 0.16F$ $\ln R = -0.41 + 0.09F$	0.98 0.94 0.95	154.27[2] 55.54[2] 71.81[2]	9
Wheat - Neepawa	17	$\ln C = -0.163 + 0.10F$ $S = 0.16 + 0.003F$ $R = 1.13 + 8.0 \times 10^{-6}F^4$	0.98 0.18 0.98	144.09[2] 0.17 117.93[2]	7
Wheat - Neepawa	18	$\ln C = -1.54 + 0.10F$ $\ln S = -2.98 + 0.10F$ $R = 1.08 + 1.0 \times 10^{-5}F^4$	0.99 0.72 0.88	203.12[2] 5.41 17.34[2]	7

[1]Significant at $P \leq 0.05$
[2]Significant at $P \leq 0.01$

APPENDIX III
PAMI REFERENCE COMBINE CAPACITY RESULTS

TABLE 7 and FIGURES 26 and 27 present the capacity results for the PAMI reference combine in wheat and barley crops harvested from 1976 to 1980.

FIGURE 26 shows capacity differences in Neepawa wheat for the five years. Most 1980 Neepawa wheat crops shown in TABLE 7 were of average straw yield and better than average grain yield. Most of the crops were average-to-thresh while the grain moisture content was slightly lower than other years and straw moisture content was average to lower than normal.

FIGURE 27 shows capacity differences in six-row Bonanza barley for 1976 to 1978, two-row Fergus barley for 1979 and two-row Hector barley for 1980. The 1980 Hector barley crops shown in TABLE 7 were of average straw yield, easy-to-thresh, and average straw and grain moisture content.

Results show that the reference combine is important in determining the effect of crop variables and in comparing capacity results of combines evaluated in different growing seasons.

TABLE 7. Capacity of the PAMI Reference Combine at a Total Grain Loss of 3% of Yield

	Crop Conditions							Capacity Results			
					Grain Moisture			MOG Feedrate	Grain Feedrate	Ground Speed	
Year	Crop	Variety	Width of Cut m	Crop Yield t/ha	Straw %	Grain %	MOG/G	t/h	t/h	km/h	Loss Curve
1980	Barley (A)	Hector	6.1	3.48	13.8	14.5	0.69	5.5	8.0	3.8	Fig. 27
	Barley (B)	Hector	6.1	3.16	13.4	14.4	0.68	5.8	8.5	4.4	
	Wheat (C)	Neepawa	12.2	2.87	7.2	13.2	0.88	9.4	10.6	3.0	
	Wheat (D)	Neepawa	6.1	3.12	6.0	11.4	0.98	10.1	10.3	5.4	Fig. 26
	Wheat (D)	Neepawa	12.2	3.09	3.2	12.2	1.02	10.2	10.0	2.7	
	Wheat (E)	Neepawa	6.1	3.00	4.9	10.8	0.91	10.3	11.3	6.2	
1979	Barley	Klages	6.1	3.67	dry	11.7	0.64	6.8	10.6	4.7	
	Wheat	Neepawa	7.3	2.77	dry	14.1	1.21	9.5	7.8	3.9	
	Wheat	Neepawa	6.1	2.67	dry	14.3	1.09	9.7	8.9	5.4	Fig. 25
	Barley	Fergus	7.3	3.46	dry	12.5	0.77	7.3	9.5	3.7	Fig. 26
1978	Wheat	Canuck	7.3	2.54	7.1	12.1	1.15	11.8	10.3	5.6	
	Wheat	Lemhi[1]	11.0	2.13	6.6	12.0	0.75	10.9	14.5	6.2	
	Wheat	Neepawa	6.1	4.37	10.4	15.9	1.04	9.3	8.9	4.5	Fig. 25
	Barley	Bonanza	6.1	4.06	7.7	13.5	0.68	6.1	9.0	3.6	Fig. 26
1977	Wheat	Neepawa	6.1	3.97	13.4	14.6	0.79	11.1	14.1	5.8	Fig. 25
	Barley	Bonanza	7.3	4.74	25.7	14.6	0.84	7.9	9.4	2.7	Fig 26
1976	Wheat	Neepawa	5.5	2.78	dry to tough	14.7	1.29	7.1	5.5	3.6	Fig. 25
	Barley	Bonanza	7.3	3.18	dry to tough	14.6	0.96	4.8	5.0	2.2	Fig 26

[1]Side by Side Double Windrow

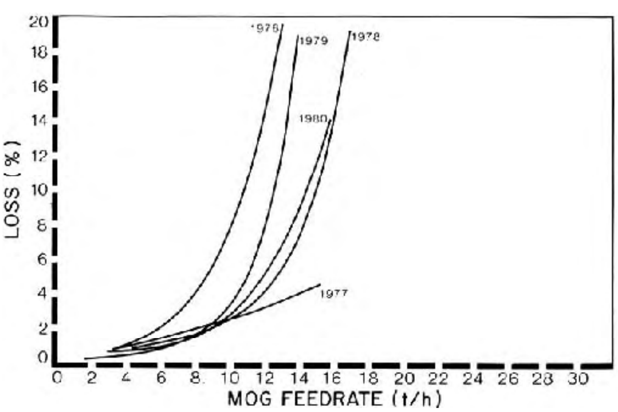


FIGURE 26. Total Grain Loss for the PAMI Reference Combine in Neepawa Wheat.

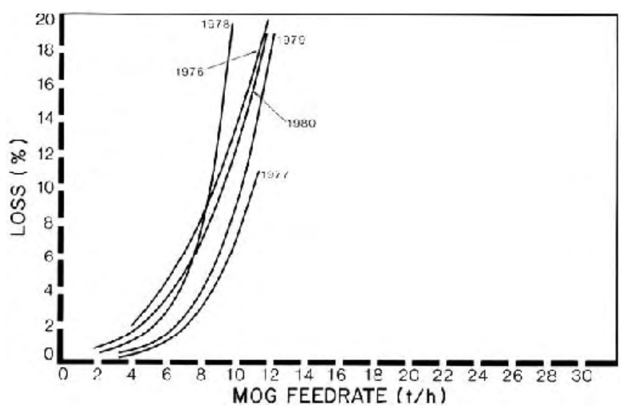


FIGURE 27. Total Grain Loss for the PAMI Reference Combine in Barley.

APPENDIX IV
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 V
CONVERSION TABLE

1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 hectare (ha)	= 2.5 acres (ac)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 tonne (t)	= 2200 pounds mass (lb)
1 tonne/hectare (t/ha)	= 0.5 ton/acre (ton/ac)
1 tonne/hour (t/h)	= 37 pounds/minute (lb/min)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 litre/hour (L/h)	= 0.2 Imperial gallons/hour (gal/h)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)

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