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Evaluation Report 311

Allis-Chalmers Gleaner L2 Self-Propelled Combine

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

ALLIS-CHALMERS GLEANER L2 SELF-PROPELLED COMBINE

MANUFACTURER
Allis-Chalmers Corporation -- Combine Division
627 South Cottage Street
Independence, Missouri 64051

DISTRIBUTOR
Allis-Chalmers, Rumely Ltd.
515 Dewdney Avenue
Regina, Saskatchewan
S4P 3A1

RETAIL PRICE
$108,518.00 (April, 1983, f.o.b. Humboldt, with a 13 ft (3.9 m) header, 10 ft (3.2 m) Victory pickup, 23.1 x 30 R1 drive tires, 11 x 16 steering tires, 670T Allis-Chalmers turbocharged diesel engine, hydro-traction drive, straw chopper, oating feeder beater, separator beater slip clutch, fan inlet screens, unloading auger bump bar, luxury seat, luxury cab interior, digital tachometer and fuel readout, grain loss monitor, auxiliary warning system, boost pressure gauge, horn, air conditioner, heater, and radio.)

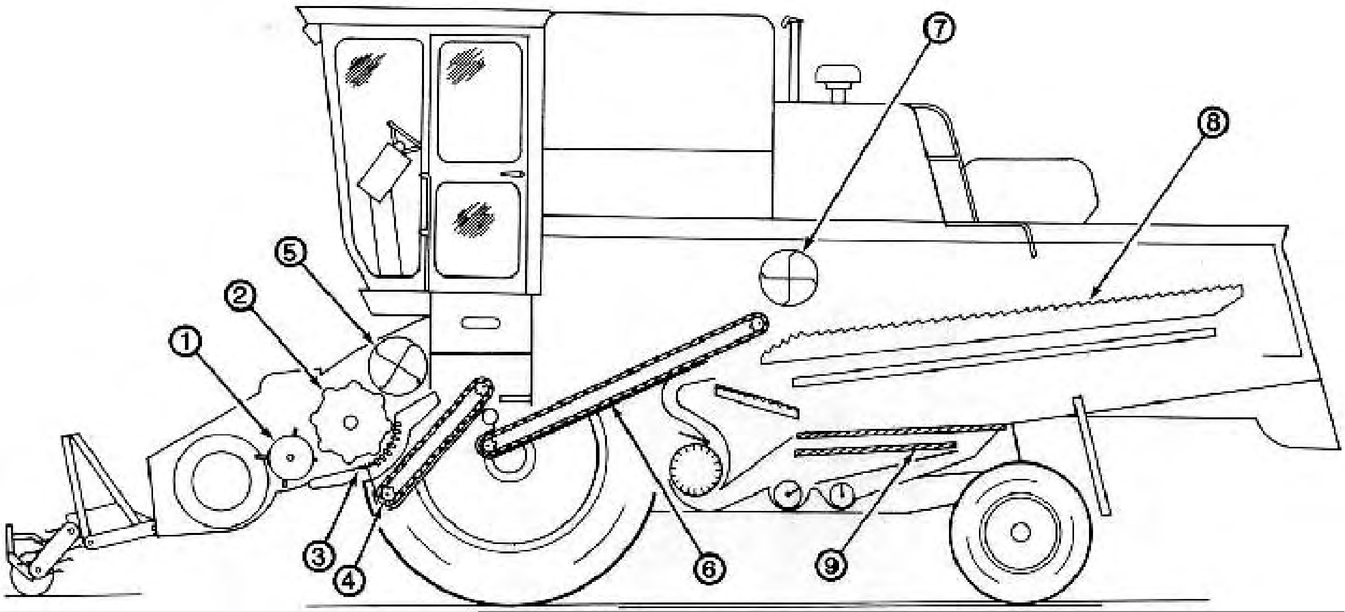

FIGURE 1. Allis-Chalmers Gleaner L2: (1) Feeder Beater, (2) Cylinder, (3) Concave, (4) Thresher Raddle Chain, (5)Thresher Beater, (6) Separator Raddle Chain, (7) Discharge Beater, (8) Straw Walkers, (9) Cleaning Shoe.

SUMMARY AND CONCLUSIONS

Functional Performance: Functional performance of the Allis-Chalmers Gleaner L2 was very good in dry and tough cereal grain crops, but was poor in rapeseed due to poor shoe performance.

Capacity: The MOG Feedrate* at 3% total grain loss varied from 244 lb/min (6.7 t/h) in 56 bu/ac (3.0 t/ha) Bonanza barley to 502 lb/min (13.9 t/h) in 37 bu/ac (2.5 t/ha) Neepawa wheat.

The capacity of the Gleaner L2 compared to that of the Machinery institute reference combine at 3% total grain loss was about the same in barley and about 1.2 to 1.5 times greater in wheat.

Grain loss limited capacity in all crops encountered. Grain loss due to incomplete threshing was low in barley, but was signi cant in the hard-to-thresh wheat crops. A reduction in unthreshed loss would have increased combine capacity in wheat. Grain loss over the straw walkers limited capacity in most barley crops but was much lower in wheat crops. Shoe loss was low in wheat and barley. Shoe loss in rapeseed was high if the shoe was set to obtain a dean sample.

Ease of Operation: The Gleaner L2 combine was very convenient to operate. Forward and side visibility was very good, but rear visibility was restricted to the use of rear view mirrors. The steering was smooth and responsive. The wheel brakes were positive and aided in cornering. Combine maneuverability and handling were very good in the eld and good while transporting,

Lighting for harvesting at night was good. Most controls and instruments were conveniently located, easy to use, and responsive. The cab was relatively dust free. The heater and air conditioner provided comfortable cab temperatures in all conditions. Operator station sound level was about 79 dBA.

The engine started easily and ran well. It had ample power for harvesting in all conditions encountered. The average fuel consumption for the season was about 4.4 gal/h (22 L/h).

The pickup picked well in most crops and fed the material under the table auger. The table auger plugged occasionally in bunchy rapeseed windrows. No reversing mechanism was provided. The cylinder was aggressive, but plugged occasionally in bunchy rapeseed and rye crops. Unplugging was laborious and inconvenient. The thresher concave trip door effectively stopped most stones and roots from entering the cylinder. Resetting the concave door was dirty and inconvenient. Occasionally the tailing return cross auger plugged and was inconvenient to clear.

The straw chopper cut and spread straw over about 15 ft (4.6 m). Ease of disengaging the straw chopper to permit windrowing the straw was good. The unloading auger was easy to position and had ample reach and clearance for most trucks and trailers.

Ease of lubrication and service was good. Accessibility for cleaning and repair was good.

Ease of Adjustment: Ease of adjusting the components on the Allis-Chalmers Gleaner L2 was fair. Although most adjustments were easy to make, the concave clearance was inconvenient and time consuming to adjust. Cylinder speed, pickup speed and fan blast were adjusted from within the cab and could be varied on-the-go. Concave clearance and shoe settings had to be made on the machine.

Ease of setting the machine to suit crop conditions was good. The return tailings were easy to sample on-the-go from the operator's cab. The grain sample was dif cult to check until the tank was nearly full. In rapeseed crops the shoe often could not

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

be set to obtain satisfactory performance.

Operator Safety: The Gleaner L2 was safe to operate if normal safety precautions were taken.

Operator Manual: The operator manual was well illustrated, clearly written and provided much useful information.

Mechanical History: Several minor mechanical problems occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying a rear view mirror to improve depth perception to the left.
2. Modifications to prevent the combine from creeping when the hydrostatic ground speed lever is in the neutral position.
3. Providing increased field light adjustment.
4. Relocating the unloading auger light to prevent the unloading tube from casting a shadow on the area of the grain discharge.
5. Relocating the fuel tank to reduce the height of the filler inlet.
6. Improving the ease of resetting the concave thresher door.
7. Supplying a reversing mechanism to facilitate unplugging the table auger and cylinder.
8. Modifications to provide a convenient access to the top of the cylinder.
9. Improving the ease of adjusting concave clearance.
10. Improving the shoe seat to prevent grain loss.
11. Improving the lock on the feeder beater shaft to prevent the fingers from moving out of time.

Senior Engineer: G. E. Frehlich

Project Technologist: W. A. Beckett

THE MANUFACTURER STATES THAT:

With regard to recommendation number:

1. The standard convex rear view mirrors provide a larger field of rear vision than flat mirrors.
2. It is suspected that the hydrostatic control cable was slightly out of adjustment permitting the combine to creep when in the neutral position.
3. We are not aware of any dissatisfaction with the field light adjustment.
4. We will consider relocating the unloading auger light.
5. The fuel tank is centered over the walker housing to provide uniform side-to-side weight distribution. Although the common side-mounted fuel tank has a lower fill height, side-to-side weight distribution changes significantly between an empty and a full tank. This affects flotation in muddy conditions.
6. This will be considered for future models.
7. A feed reverser is offered on 1983 rotary models and will be considered for future models.
8. The down front cylinder configuration allows access to the top of the cylinder that is generally not possible on other designs. Easier removal of the cover over the cylinder will be considered.
9. Although the ease of adjusting the cylinder is somewhat inconvenient, we feet that the rigidity provided by the mechanism is necessary for the proper operation of the stone protection door.
10. It is suspected that the rubber shoe seals were misadjusted during manufacture. Potential sources for leaks wilt be investigated and corrected.
11. Similar failures have not been experienced. We believe the problem was caused by operating for a significant time with the slip clutch inoperative due to corrosion from road salt encountered in transport.

GENERAL DESCRIPTION

The Allis-Chalmers Gleaner L2 is a self-propelled combine with a transverse-mounted, tangential threshing cylinder, concave, straw walkers, and cleaning shoe. Threshing and initial separation occur at the cylinder and concave, while the straw walkers complete the final separation of grain from straw. The grain is cleaned at the shoe and the tailings are returned to the cylinder.

The test machine was equipped with a 158 hp (118 kW) turbocharged, six cylinder, Allis-Chalmers diesel engine, a 13 ft (3.9 m) header, a 10 ft (3.2 m) Victory pickup, straw chopper, and other optional equipment listed on page 2.

The Gleaner L2 has a pressurized operator's cab, power steering, hydraulic disc brakes, and hydrostatic traction drive. Electrohydraulic controls in the cab engage the separator, header and unloading auger, and control unloading auger swing, pickup speed, and header height. Fan inlet opening and cylinder speed are adjusted from within the cab while cylinder to concave clearance and shoe settings are adjusted on the machine.

Return tailings can be easily and safely sampled from the operator's cab while harvesting. Major component speeds, and harvest functions are monitored in the cab.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Allis-Chalmers Gleaner L2 was operated for 123 hours while harvesting about 991 ac (401 ha) of various crops. The crops and conditions are shown in TABLES 1 and 2. It was evaluated for ease of operation, ease of adjustment, rate of work, grain loss characteristics, operator safety and suitability of the operator's manual. Throughout the tests, comparisons were made to the Machinery Institute reference combine.

TABLE 1. Operating Conditions

Crop	Variety	Average Yield		Swath Width		Hours	Field Area	
		bu/ac	t/ha	ft	m		ac	ha
Barley	Bonanza	52	2.8	20, 25, 40, 50	6.1, 7.3, 12.2, 15.2	14.5	116	47
Barley	Elrose	56	3.0	40, 50	12.2, 15.2	4.0	27	11
Rapeseed	Regent	25	1.4	20, 25, 26	6.1, 7.3, 8.5	23.3	161	65
Rye	Puma	30	1.9	20, 25, 40	6.1, 7.3, 12.2	39.0	353	143
Wheat	Benito	37	2.5	50	15.2	6.0	50	20
Wheat	Neepawa	40	2.7	18, 24, 25, 40, 50	5.5, 7.3, 7.6, 12.2, 15.2	30.0	237	96
Wheat	Park	28	1.9	24	7.3	3.0	20	8
Wheat	Sinton	48	3.2	20, 28	6.1, 8.5	3.0	27	11
Total						123.0	991	401

TABLE 2. Operation in Stony Fields

Field Condition	Hours	Field Area (ha)	
		ac	ha
Stone Free	43	385	156
Occasional Stones	60	418	169
Moderately Stony	20	188	76
Total	123	991	401

RESULTS AND DISCUSSION

EASE OF OPERATION

Operator Location: The Allis-Chalmers Gleaner L2 was equipped with an operator's cab positioned ahead of the grain tank and centered on the combine body. Forward and side visibility was very good. Rear visibility was restricted. Two convex rear view mirrors improved rear visibility but distorted the actual distance of objects. This was a problem during transport. It is recommended that the manufacturer consider supplying a rear view mirror to improve depth perception to the left.

For most operators, visibility of the incoming windrow was very good (FIGURE 2). However, in dry dusty crops, dust coming from the feeder greatly reduced visibility (FIGURE 3). The grain level was visible through the rear window until the tank was nearly full.

The seat and steering column were adjustable, providing a comfortable combination for most operators. Incoming air was effectively filtered while the fans pressurized the cab to reduce dust leaks. The heater and air conditioner provided comfortable cab temperatures.

Operator station sound level was about 79 dBA. This did not increase significantly while harvesting at capacity.

Controls: The controls for the Gleaner L2 are shown in FIGURE 4. Most controls were conveniently located, clearly identified and easy to operate. The hydrostatic ground speed control lever was smooth and responsive. However, the neutral position was very difficult to find and maintain. The transmission had to be shifted into neutral to prevent the combine from creeping. It is recommended that the manufacturer consider modifications to prevent the combine from creeping when the hydrostatic ground speed lever is in the neutral position.

FIGURE 2. Normal View of Incoming Windrow.

FIGURE 3. Obscured View in Dusty Crop.

FIGURE 4. Instrument and Control Console to the Right of the Operator.

With the header raise and drop rates set for suitable full-range header travel, response was too abrupt for small changes in header height. The manufacturer recommends using the optional hydraulic accumulator to dampen movement and provide for smoother operation. The accumulator was not tested.

Instruments: The instruments were located on two consoles, one to the right of the operator, the other above the windshield (FIGURES 4 and 5). The lower console housed gauges for turbocharger boost pressure, battery voltage, coolant temperature, engine oil pressure, and grain loss monitor meter. The upper console had the grain loss monitor adjustments, engine and separator hour meters, and digital read out that selectively displayed fuel level, cylinder speed, engine speed, and combine ground speed. As standard equipment, indicators alerted the operator of an open stone trap door, engaged parking brake, excessive hydraulic oil temperature, straw walker overload, engine air filter restriction, low coolant level, fuel restriction, excessive transmission oil temperature, and reduced speeds of the major combine drives. Optional equipment on the test machine included warning devices for low engine oil pressure, low hydraulic oil level, low battery voltage, excessive coolant temperature, full grain tank and an extended unloading auger. All monitored functions had warning lights and most were accompanied with a four second audio alarm.

FIGURE 5. Instrument Panel Above the Windshield.

Loss Monitor: Grain loss pad sensors were located behind the shoe and walkers. The loss monitor measured ground speed and related grain loss to the area covered. It aided in detecting changes in mechanical loss, but was ineffective in sensing airborne losses over the shoe. The monitor reading was meaningful only if it was compared to actual losses observed behind the combine. The meter was conveniently located and easy to read.

Lights: The combine was equipped with six field lights, two transport lights, a grain tank light, unloading auger light, tail lights, and warning lights. The four top field lights were adequate for harvesting at night, but could not be adjusted properly to prevent a glare from the table auger. It is recommended that the manufacturer consider providing increased field light adjustment. Lighting was poor for the lower right hand console and the grain tank. The unloading auger light had to be relocated to prevent the unloading tube from casting a shadow on the area of the grain discharge. It is recommended that the manufacturer consider relocating the unloading auger light. Warning lights and tail lights were adequate for safe road transport.

Engine: The engine started easily and ran well. It had adequate power for all conditions. Average fuel consumption was about 4.4 gal/h (20 L/h). Oil consumption was insignificant.

The fuel tank inlet was located 9.4 ft (2.9 m) above ground level, which made filling from average height gravity fuel tanks difficult. It is recommended that the manufacturer consider relocating the fuel tank to reduce the height of the filler inlet. The rotary air intake screen worked well, but required periodic cleaning to prevent engine overheating. The engine air intake used an aspirated pre-cleaner, and two dry element filters. The outer filter required periodic cleaning.

Maneuverability: The Gleaner L2 was very maneuverable. Steering was smooth, easy and responsive. The wheel brakes were positive and aided in cornering, but were not necessary for picking around most windrow corners. On difficult-to-pick corners, the hydrostatic drive made backing up quick and easy.

Stability: The Gleaner L2 was stable in the field even with a full grain tank. Normal precautions were required when operating on hillsides and when travelling at transport speeds. The combine transported well at speeds up to 24 mph (38 km/h), however, over-steering at this speed could cause loss of control.

Grain Tank: The Allis-Chalmers Gleaner L2 had a 200 bu (7.0 m³) open grain tank. The tank filled evenly in all crops. The grain level could be viewed through the rear window until the tank was nearly full. The gap between the window and the screen in the grain tank became plugged with small seeds and dirt, which obstructed the operator's view of the grain level. The removable screen allowed for quick, easy cleaning. An audio alarm and warning light signalled a full tank.

The unloading auger clearance was adequate for most trucks and grain trailers (FIGURE 6). The unloading auger delivered a compact stream of grain, and unloaded a full tank of dry wheat in about 120 seconds.

FIGURE 6. Unloading. FIGURE 7. (1) Concave Thresher Door, (2) Concave.

Pickup: The Gleaner L2 was-equipped with a 10 ft (3.2 m) hydraulically driven Victory pickup. It is a two roller pickup with rubberized drapers, nylon teeth, an intermediate transfer draper, and windguard. Picking height was set by castor wheel adjustment while picking angle was determined by the length of the adjustable support chains and header height. Pickup speed was controlled from the cab.

The pickup performed well in all crops at speeds up to 7 mph (11 km/h). The windguard was very effective in de ecting material under the table auger, but had to be removed when harvesting rapeseed crops to prevent bunching and excessive shelling.

Stone Protection: The Gleaner L2 was equipped with a spring trip concave door that opened when a large wad or hard object entered the cylinder (FIGURE 7). It was effective in preventing stones and roots from entering the cylinder and concave. Resetting the door was very dirty and inconvenient. The operator had to crawl under the header, and while laying on his back, close and latch the heavy thresher door with his feet. It is recommended that the manufacturer consider improving the ease of resetting the concave thresher door. Care was also required when opening the door, as it swung down violently.

FIGURE 7. (1) Concave Thresher Door, (2) Concave.

Straw Chopper: The optional straw chopper performed well. It spread straw uniformly over a width of about 15 ft (4.6 m). The straw chopper could not be easily removed, but could be slid forward to permit windrowing the straw. Before the straw chopper could be used after windrowing, chaff and straw had to be cleaned from the rotor housing.

Plugging: The table auger was aggressive and seldom plugged. However, unplugging the table auger was time consuming and dif cult as it could not be easily reversed. It is recommended that the manufacturer consider supplying a reversing mechanism to facilitate unplugging the table auger.

The cylinder was aggressive and seldom plugged. The concave thresher door frequently tripped open to prevent plugging when a wad entered the cylinder. When the cylinder plugged, clearing was very dif cult and time consuming. The cylinder had to be raised using the adjusting draw bolts, and the top cover plate unbolted. The cylinder could not be easily reversed as no convenient hub or purchase was available to permit the use of a pry bar. It is recommended that the manufacturer consider modi cations to provide a convenient access to the top of the cylinder and to provide a mechanism for reversing the cylinder.

In fall rye, the thresher beater frequently wrapped with straw and caused the beater and cylinder to plug. The separator de ector had to be raised above the suggested position to permit the straw to travel freely up the separator raddle, which prevented wrapping on the beater.

Machine Cleaning: Cleaning the Allis-Chalmers Gleaner L2 for combining seed grain was fairly easy. The unloading auger and grain tank could be easily and completely cleaned. The chaffer and sieve were easy to remove and provided access to the clean grain cross auger. The tailings return cross auger was not accessible. The exterior of the machine could be easily cleaned.

Lubrication and Service: The Allis-Chalmers Gleaner L2 had fty pressure grease ttings; eight required greasing every 10 hours, forty required greasing every 50 hours, and two required greasing seasonally. Most lubrication points were easily accessible, except for those on the feeder beater slip clutch. The operator had to be very careful not to over grease the slip clutches as any grease on the jaw faces, greatly reduced their effectiveness.

Engine, hydrostatic, and hydraulic oil levels required daily checking. The sight tube on the hydraulic reservoir was very convenient. Most routine maintenance and service such as tensioning chains and belts and changing oil were easily performed.

EASE OF ADJUSTMENT

Field Adjustment: The Gleaner L2 was easy to adjust and could be set by one person. Cylinder speed and fan inlet opening were adjusted from the cab while concave clearance and shoe settings were adjusted on the combine. Return tailings could be easily sampled and inspected by the operator while harvesting. **Concave Adjustment:** The Gleaner L2 had a single segment, nonadjustable concave (FIGURE 7). Concave clearances were varied by raising and lowering the cylinder. Front clearances could be checked if the concave thresher door was lowered, but rear clearances could not be checked. Changing concave clearance was very inconvenient due to limited access for wrenches, which had to be used to loosen the anchor bolts and operate the nuts on the drawbolts (FIGURE 8). It is recommended that the manufacturer consider improving the ease of adjusting concave clearances.

Suitable front concave clearances used for harvesting were 0.5 in (12 mm) in rye, 0.5 to 0.75 in (12 to 19 mm) in rapeseed, 0 to 0.25 in (0 to 6 mm) in wheat and 0.25 in (6 mm) in barley. The concave assembly could be easily lowered for inspection by one person in about 20 minutes.

Cylinder Adjustment: Cylinder speed was controlled through a variable pitch belt drive. Cylinder speed with the standard belt drive ranged from 400 to 1300 rpm. This range was adequate for all crop conditions encountered. Suitable cylinder speed settings for threshing were 990 rpm in barley and rye, 700 to 900 rpm in rapeseed and 1000 to 1100 rpm in wheat.

Shoe Adjustment: The chaffer was easy to adjust. A hinged door had to be opened to reach the sieve adjusting lever. Fan inlet opening was controlled from within the cab.

The shoe used a two stage cleaning system. The upper outlet directed a pre-cleaning blast to the material as it came off the separator raddle while the lower outlet directed air to the shoe. The shoe performed well in most crops having good capacity in wheat, barley and rye, but poor capacity in rapeseed. Most of the time it was not possible to obtain a clean sample in rapeseed without overloading the return and/or having high shoe loss.

Header Adjustment: The Gleaner L2 was evaluated using a windrow pickup header only. The header table could easily be removed by one person in about 15 minutes.

Adjustments were provided for header raise and drop rate, header levelling, feeder beater clearance and beater nger timing, as well as table auger clearance and auger nger timing.

Slip Clutches: Individual slip clutches protected the feeder beater, thresher raddle, thresher beater, separator raddle, straw walkers, and the clean grain and return elevators.

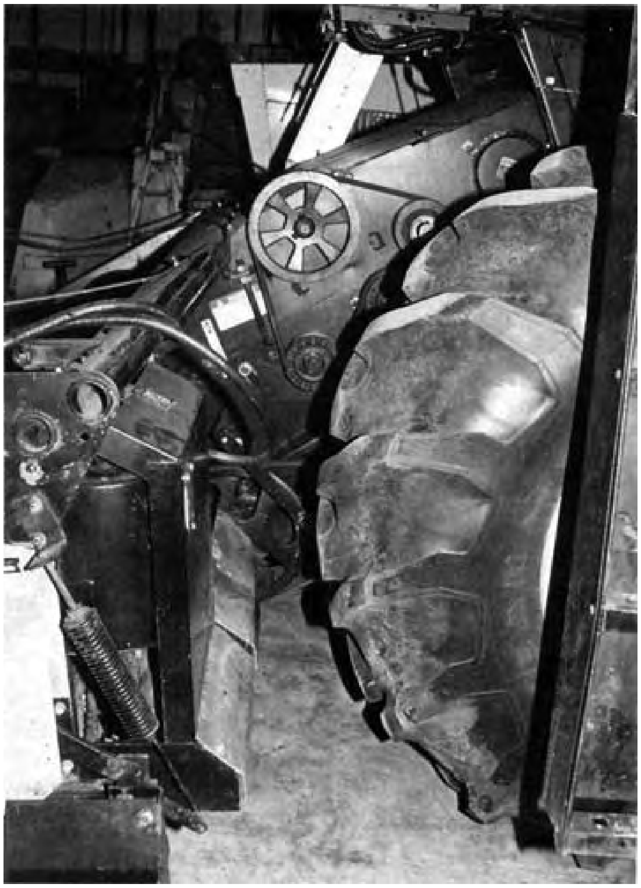

FIGURE 8. Restricted Access for Adjusting Concave Clearance.

RATE OF WORK

Average Workrates: TABLE 3 presents the average workrate for the Gleaner L2 in all crops harvested during the test. Average workrates are affected by crop conditions, windrow quality, eld conditions and availability of grain handling equipment, therefore, they should not be used to compare combines tested in different years. Average workrates varied from 185 bu/h (4.2 t/h) in 25 bu/ac (1.4 t/ha) Regent rapeseed to 380 bu/h (10.4 t/h) in 48 bu/ac (3.2 t/ha) Sinton Wheat.

TABLE 3. Average Workrates

Crop	Variety	Average Yield		Average Speed		Average Workrates			
		bu/ac	t/ha	mph	km/h	ac/h	ha/h	bu/ac	t/h
Barley	Bonanza	52	2.6	2.5 - 3.5	4.0 - 5.5	7.4	3.0	380	8.3
Barley	Elrose	56	3.0	2.0	3.0	7.4	3.0	375	8.2
Rapeseed	Regent	25	1.4	2.0 - 4.5	3.0 - 7.0	8.9	3.6	185	4.2
Rye	Puma	30	1.9	5.0	8.0	9.1	3.7	255	6.5
Wheat	Benito	37	2.5	2.0 - 5.0	3.0 - 8.0	8.2	3.3	300	8.2
Wheat	Neepawa	40	2.7	2.5	4.0	8.4	3.4	270	7.4
Wheat	Park	26	1.9	2.5 - 4.5	4.0 - 7.0	8.4	3.4	215	5.9
Wheat	Sinton	46	3.2	3.0	5.0	8.2	3.3	380	10.4

Maximum Feedrate: The workrates in TABLE 3 represent the average workrates at acceptable loss levels. In most crops higher feedrates could be attained when operating near the engine power limit. The maximum acceptable feedrate was limited by grain loss while the maximum feedrate was limited by engine power in heavy crops and by pickup performance in very light crops. Throughput was slightly reduced in tough crops.

Capacity: Combine capacity is the maximum rate at which a combine, adjusted for optimum performance can harvest a crop at a speci ed 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 cause capacity variations.

MOG Feedrate, MOG/G Ratio and % 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 a combine per unit of time is called MOG Feedrate. MOG is the 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 of time is called the “Grain Feedrate”. The ratio of MOG Feedrate to the Grain Feedrate, abbreviated as MOG/G, indicates how dif cult a crop is to separate. For example, if a combine is used in two wheat elds of identical yields, one with long straw and one with short straw, the combine will have better separation ability in the short crop and be able to operate faster. The crop variable is expressed as MOG/G ratio. MOG/G ratios for prairie wheat crops vary from about 0.5 to 1.5.

Grain loss from a combine is of two main types, unthreshed grain still in-the head, and threshed grain, which is 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 and walker loss. Losses are expressed as a percentage of the total grain 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 Gleaner L2: TABLE 4 presents capacity results for the Gleaner L2 in ve different crops. MOG feedrates at 3% total grain loss varied from 244 lb/min (6.7 t/h) in 56 bu/ac (3.0 t/ha) Bonanza barley to 502 lb/min (13.9 t/h) in 37 bu/ac (2.5 t/ha) Neepawa wheat.

GRAIN LOSS CHARACTERISTICS

`The grain loss characteristics for the Allis-Chalmers Gleaner L2 in the ve crops described in TABLE 4 are presented in FIGURES 9 to 13.

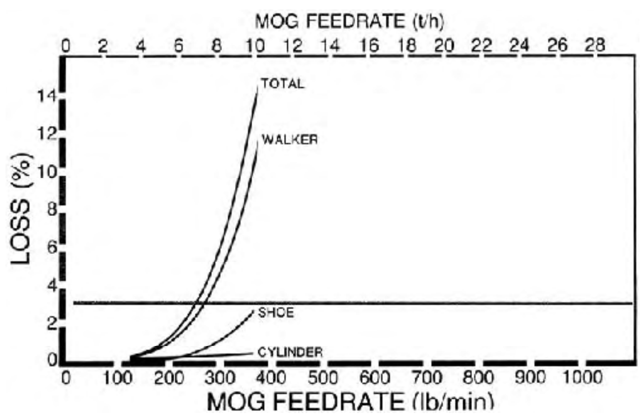

FIGURE 9. Grain Loss in Bonanza Barley (B).

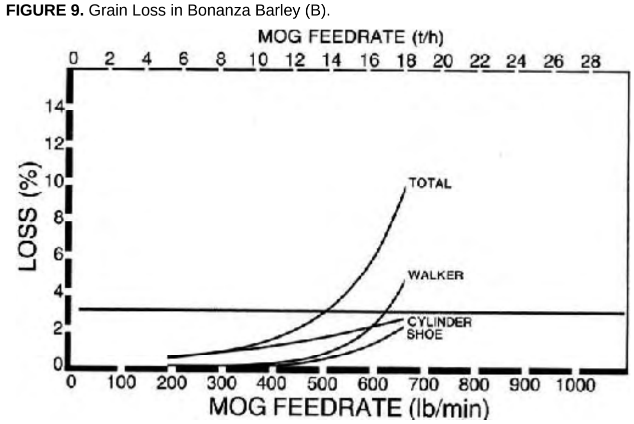

FIGURE 10. Grain Loss in Neepawa Wheat (C).

Walker Loss: Grain loss over the straw walkers limited combine capacity in barley crops. Walker loss did not limit capacity in wheat crops, but would have been signi cant if cylinder loss had been reduced. In the wheat crops tested, the straw walkers had similar loss characteristics in single, side-by-side double, and double overlapped windrows.

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

Crop Conditions									Results						
		Width of Cut		Crop Yield		Moisture Content			MOG Feedrate		Grain Feedrate		Grain Cracks	Dockage	
Crop	Variety	ft	m	bu/ac	t/ha	Straw %	Grain %	MOG/G	lb/min	t/h	bu/h	t/h	%	%	Loss Curve
Barley (B)	Bonanza	50	15.2[1]	56	3.0	8.7	12.2	0.71	244	6.7	430	9.4	0.5	1.5	Fig. 9
Wheat (C)	Neepawa	40	12.2[2]	37	2.5	10.9	13.0	0.91	502	13.7	553	15.1	2.0	2.5	Fig. 10
Wheat (D)	Neepawa	40	12.2[2]	39	2.6	11.3	15.0	0.84	473	12.9	565	15.4	2.0	2.5	Fig. 11
Wheat (E)	Neepawa	50	15.2[1]	51	3.4	7.7	11.4	0.99	414	11.3	418	11.4	0.5	1.0	Fig. 12
Wheat (F)	Neepawa	25	7.6[3]	48	3.2	7.7	11.4	0.88	484	13.2	550	15.0	1.0	2.0	Fig. 13

[1]Double Windrow (overlapped by 1/3)
[2]Double Windrow (side-by-side)
[3]Single Windrow

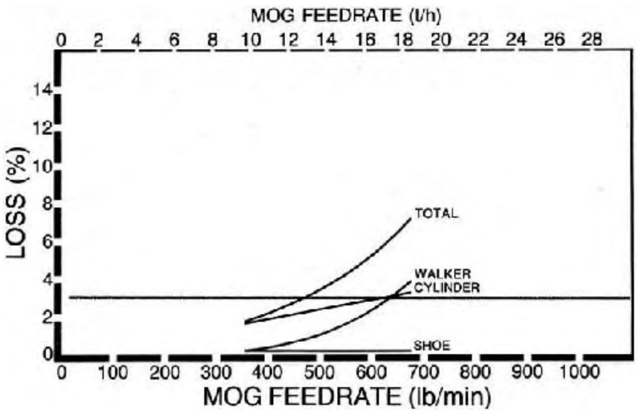

FIGURE 11. Grain Loss in Neepawa Wheat (D).

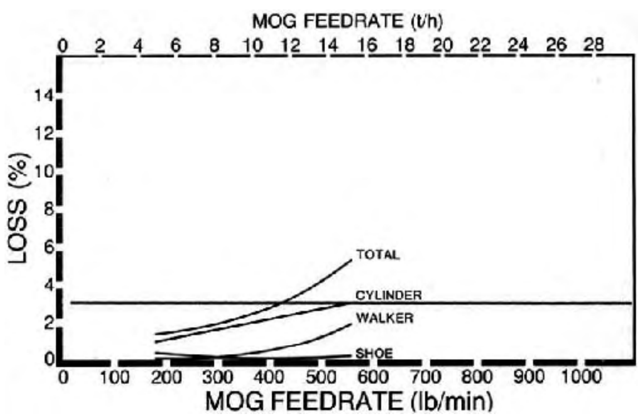

FIGURE 12. Grain Loss in Neepawa Wheat (E).

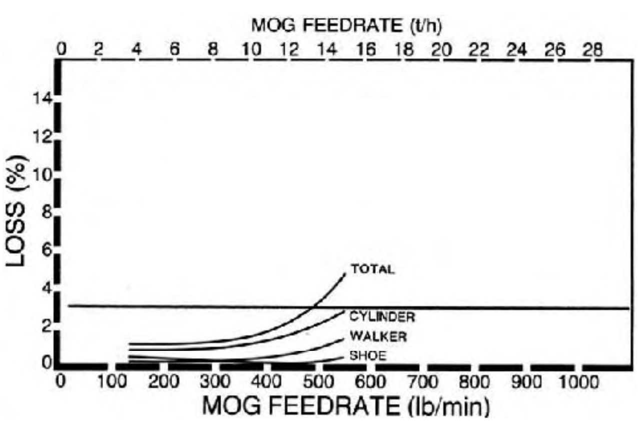

FIGURE 13. Grain Loss in Neepawa Wheat (F).

Shoe Loss: When properly adjusted, shoe loss in most crops was low and did not limit combine capacity. The shoe performed well in most crops encountered except rapeseed. In many rapeseed crops it was not possible to obtain a clean tank sample without overloading the return with pods. Setting the shoe to reduce the return and produce a clean sample, resulted in high shoe loss.

The grain sample was usually clean in wheat and barley with average dockage about 1.5 to 2.5%.

Cylinder Loss and Grain Damage: Cylinder loss and grain cracks were low in easy-to-thresh crops. In hard-to-thresh crops, grain cracks in the tank were under 2%, but the high cylinder losses greatly reduced combine capacity. For conventional combines, grain cracks of 2 to 4% are not uncommon. This indicates that more aggressive threshing could have been used to reduce cylinder loss and increase combine capacity while still keeping grain cracks to an acceptable level.

Body Loss: Grain leaked between the canvas shoe seals and the combine body. It is. recommended that the manufacturer consider improving the shoe seal to prevent grain loss.

Combine Comparison: 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, the Machinery Institute uses a reference combine. This combine is operated alongside the test machine whenever capacity measurements are made. This permits the comparisons of loss characteristics of every test combine to those of the reference combine, independent of crop conditions. The reference combine used by the Machinery Institute is commonly accepted in the prairie provinces and is described in the Evaluation Report E0576C (number 27). See APPENDIX III for the reference combine capacity results.

FIGURES 14 to 18 compare the total grain losses of the Gleaner L2 and the Machinery Institute reference combine in the ve crops described in TABLE 4. The shaded areas on the curves are 95% con dence belts. If the shaded areas overlap, loss characteristics of the two machines are not signi cantly different whereas if the shaded areas do not overlap, losses are signi cantly different.

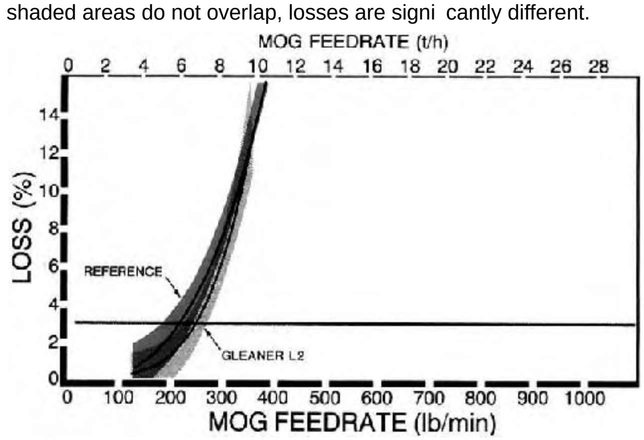

FIGURE 14. Total Grain Loss in Bonanza Barley (B).

The capacity of the Gleaner L2 was slightly greater than the reference combine in all crops. At 3% total loss, the capacity of the Gleaner L2 was similar to that of the reference in barley, but about 1.2 to 1.5 times greater in wheat.

OPERATOR SAFETY

The operator manual emphasized operator safety.

The Allis-Chalmers Gleaner L2 had warning decals to indicate dangerous areas. Most moving parts were well shielded. Most shields were hinged to allow easy access. The header shields were inconvenient to remove due to limited space between the drive wheels and header.

Most machine adjustments could be made safely, however, it was extremely important that the transmission be shifted to neutral as the neutral position on the hydrostatic ground speed lever was dif cult to nd and maintain.

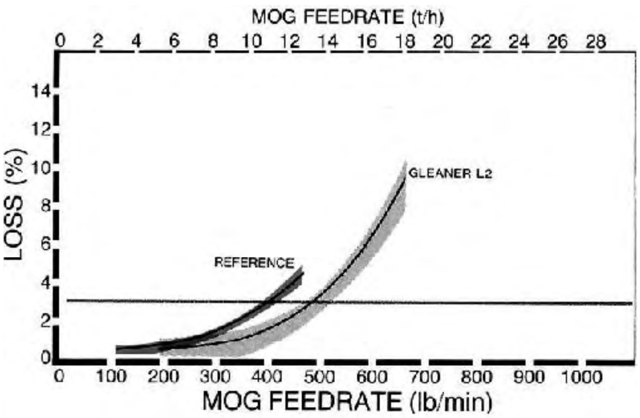

FIGURE 15. Total Grain Loss in Neepawa Wheat (C).

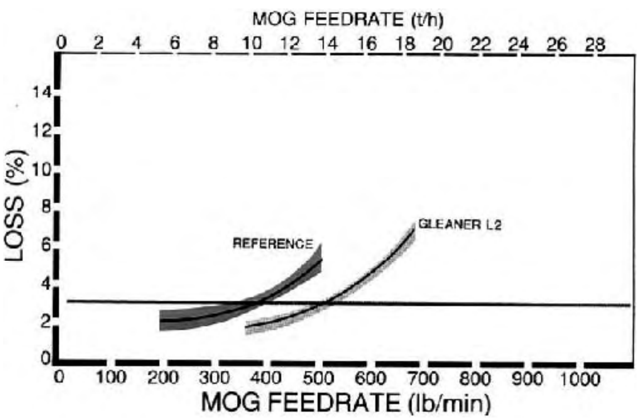

FIGURE 16. Total Grain Loss in Neepawa Wheat (D).

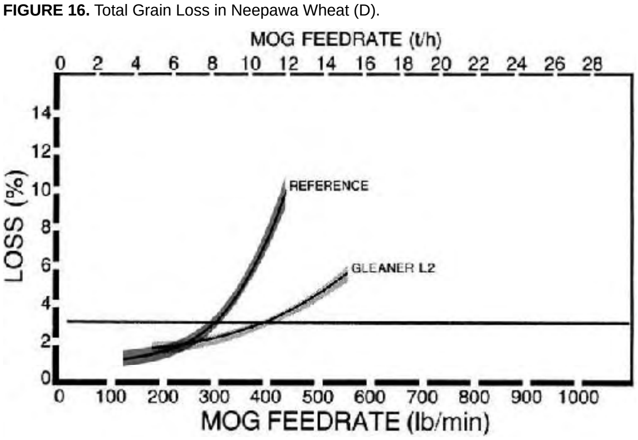

FIGURE 17. Total Grain Loss in Neepawa Wheat (E).

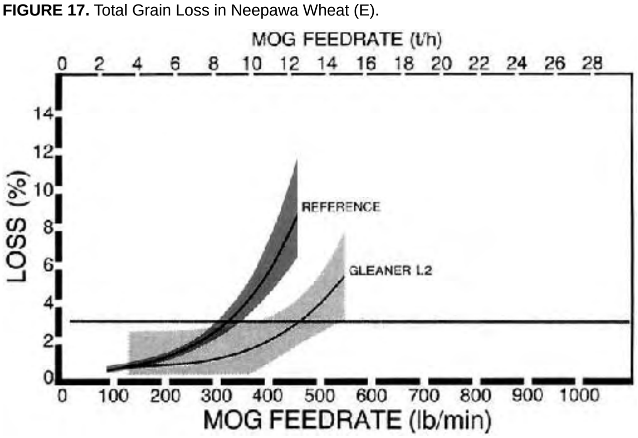

FIGURE 18. Total Grain Loss in Neepawa Wheat (F).

A header lock was provided but access was limited making it inconvenient to use. It was important to use the header lock whenever working near the header and especially when crawling under the header to operate the concave door latch.

A rocking wrench and hub were not provided to aid in unplugging the table auger. Unplugging the table auger requires the operator to enter into a potentially dangerous area. Before attempting to unplug the table auger or feeder beater, all clutches should be disengaged and the engine shut off.

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

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

OPERATOR MANUAL

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

DURABILITY RESULTS

MECHANICAL HISTORY

TABLE 5 outlines the mechanical history of the Gleaner L2 during 123 hours of eld operation while harvesting about 991 ac (401 ha). The intent of the test was functional performance evaluation. Extended durability testing was not conducted.

DISCUSSION OF MECHANICAL PROBLEMS

Feeder Beater: The half moon key used to hold the feeder beater drive shaft stationary, fell out allowing the retractable ngers to rotate freely. Most of the ngers sheared off causing damage to the header throat and cylinder rub bars. It is recommended that the manufacturer consider improving the lock on the feeder beater shaft to prevent the ngers from coming out of time. The slip clutch on the feeder beater was seized at the beginning of the test due to road salt accumulation while transporting. This caused the feeder to force-feed until the feeder drum moved up and broke the travel limiting stop. Cylinder Variable **Sheaves:** After several days of operating the cylinder at the same speed and possibly inadequate lubrication, the variable sheave would not slide freely to permit cylinder speed change. Thorough lubrication and several successive attempts at varying the cylinder speed, freed the sheaves. Proper lubrication and periodically varying the cylinder speed prevented reoccurrence.

Stripper Assembly: The stripper assembly had been installed upside down at the factory. When the cylinder was raised, it contacted the stripper plate and tore it loose. A new stripper plate was installed correctly and no further problems were experienced.

TABLE 5. Mechanical History.

Item	Operating Hours	Field Area ac	(ha)
Drives:			
-The pickup drive motor mounting bracket bent and was replaced at	5	49	(20)
-The separator beater drive belt broke and was replaced at	37	338	(137)
-The cylinder variable speed sheaves were seized and broke free at	40	358	(145)
-The feeder beater slip clutch was seized and broke free at	75	640	(259)
Miscellaneous:			
-The stripper assembly plate broke loose and was replaced at	3	25	(10)
-The grain tank levelling auger pivot bolts came loose and were retightened at	11	114	(46)
-The pickup mounting bracket support lts fell out and were replaced at	26, 30	240, 272	(97), (110)
-The brakes failed at	beginning of test		
and the calipers were replaced at	31	279	(113)
-The external hydraulic oil filter started leaking at	36	321	(130)
and was repaired at	end of test		
-The left pickup wheel support arm bent and was straightened at	41	375	(152)
-The header failed to raise due to a blocked orifice which was cleaned at	73	622	(252)
-The feeder beater retaining block broke off and a replacement welded in at	75	640	(259)
-Several feeder beater teeth broke off and were replaced at	80	677	(274)

APPENDIX I
SPECIFICATIONS

MAKE:	Allis-Chalmers Self-Propelled Combine
MODEL:	Gleaner L2 Windrow Special
SERIAL NUMBER:	Header -- LMP48572F62 Body -- LW24430H82 Engine -- 70-20707
MANUFACTURER:	Allis-Chalmers Corporation Combine Division Independence, Missouri
WINDROW PICKUP:	
-- make	Victory
-- type	belt and draper
-- pickup width	126 in (3200 mm)
-- number of belts	7
-- teeth per belt	55
-- type of teeth	nylon
-- number of rollers	2
-- height control	castor gauge wheels
-- speed control	variable speed hydraulic drive
-- speed range	0 to 600 ft/min (0 to 3.1 m/s)
HEADER:	
-- type	center feed
-- width	13 ft (3.9 m)
-- auger diameter	24 in (600 mm)
-- feed conveyor	oating beater
-- conveyor speed	240 rpm
-- range of picking height	-8 to 44.5 in (-210 to 1130 mm)
-- number of lift cylinders	2
-- raising time	5 s
-- lowering time	4.5 s
-- options	corn, straight-cut headers
STONE PROTECTION:	
-- type	thresher concave door
-- ejection	spring trip with manual reset
FRONT BEATER:	
-- type	cylindrical drum with retractable ngers
-- diameter	10.2 in (260 mm)
-- speed	240 rpm
-- options	slow speed drive, forged feeder beater nger guides with 0.63 in (16 mm) diameter ngers
CYLINDER:	
-- type	reversible rasp bar
-- number of bars	8
-- diameter	19.3 in (490 mm)
-- width	47 in (1187 mm)
-- drive banded	V-belt
-- speed control	variable pitch sheave
-- speed range	400 to 1300 rpm
-- options	slow speed chain drive, spike tooth cylinder, chrome rub bars, ller bars
DISCHARGE BEATER:	
-- type	box wing
-- diameter	13.5 in (345 mm)
-- speed	265 rpm
-- options	chain drive
CONCAVE:	
-- type	bar and wife grate
-- number of bars	9
-- con guration	6 intervals with 0.38 in (10 mm) wires and 1.4 in (35 mm) spaces
-- wrap	69°
-- total area	653 in² (0.4214 m²)
-- open area	280 in² (0.1814 m²)
-- transition grate - total area	1400 in² (0.9027 m²)
- open area	655 in² (0.4228 m²)
-- grain delivery to shoe	two stage raddle conveyor
-- options	ller bars and spike tooth, chrome concave bars, spring tooth concave
STRAW WALKERS:	
-- type	single step - open bottom
-- number	5
-- length	9.8 ft (3 m)
-- housing width	53 in (1345 mm)
-- separating area	6192 in² (4.04 m²)
-- crank throw	3 in (75 mm)
-- speed	170 rpm
-- grain delivery to shoe	at bottom grain pan
SHOE:	
-- type	single action
-- speed	280 rpm
-- chaffer sieve	adjustable lip, 2966 in² (1.923 m²) with 1.4 in (35.3 mm) throw
-- cleaning sieve	adjustable lip, 2664 in² (1.729 m²) with 1.4 in (35.3 mm) throw
-- options	stepped grain pan, perforated panels, air ow grain saver, chaffer leveller blades, round and square end chaffer, deep tooth chaffers, nishing sieves
LUBRICATION POINTS:	
-- 10 hours	
-- 50 hours	
-- 500 hours (seasonal)	
TIRES:	
-- front	23.1 x 30 R1, 10-ply
-- rear	11.0 x 16, 8-ply
TRACTION DRIVE:	
-- type	hydrostatic
-- speed ranges	
-1st gear	0 to 3 mph (0 to 5 km/h)
-2nd gear	0 to 6 mph (0 to 10 km/h)
-3rd gear	0 to 12 mph (0 to 19 km/h)
-4th gear	0 to 24 mph (0 to 38 km/h)
0VERALL DIMENSIONS:	
-- wheel tread (front)	9.0 ft (2.7 m)
-- wheel tread (rear)	8.7 ft (2.6 m)
-- wheel base	10.3 ft (3.1 m)
-- transport height	12.4 ft (3.8 m)
-- transport length	29.7 ft (9.0 m)
-- transport width	14.1 ft (4.3 m)
-- eld height	13.3 ft (4.0 m)
-- eld length	29.7 ft (9.0 m)
-- eld width	23.8 ft (7.3 m)
-- unloader discharge height	11.3 ft (3.4 m)
-- unloader clearance height	7 2 ft (2.2m)
-- unloader reach	9.4 ft (2.9 m)
-- turning radius	
- left	17.8 ft (5.4 m)
- right	15.3 ft (4.7 m)
MASS: (empty grain tank)	
-- right front wheel	6853 lb (3115 kg)
-- left front wheel	6952 lb (3160 kg)
-- right rear wheel	2343 lb (1065 kg)
-- left rear wheel	2398 lb (1090 kg)
TOTAL	18546 lb (8430 kg)

APPENDIX II
REGRESSION EQUATIONS FOR CAPACITY RESULTS

Regression equations for the capacity results shown in FIGURES 9 to 13 are presented in TABLE 6. In the regressions, C = cylinder loss in percent of yield, S = shoe loss in percent of yield, W = walker loss in percent of yield. F = the MOG feedrate in t/h, while $\ln$ is the natural logarithm. Sample size refers [o the number of loss collections. Limits of the regressions may be obtained from FIGURES 9 to 13 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 - Bonanza	9	$C = 0.11 + 0.321 \times 10^{-2}F^2$ $S = -0.17 + 0.31 \times 10^{-3}F^4$ $W = 0.08 + 0.11 \times 10^{-2}F^4$	0.94 0.96 0.98	35.94[2] 56.89[2] 110.26[2]	7
Wheat - Neepawa	10	$C = 0.36 + 0.72 \times 10^{-2}F^2$ $S = -0.11 - 0.13 \times 10^{-5}F^5$ $\ln W = -5.95 + 0.42F$	0.99 0.99 0.99	384.79[2] 169.73[2] 147.36[2]	6
Wheat - Neepawa	11	$C = -0.23 + 0.19F$ $\ln S = -3.71 + 0.20 \ln F$ $W = -0.23 + 0.35 \times 10^{-4}F$	0.99 0.33 0.99	184.71[2] 0.59[2] 230.19[2]	7
Wheat - Neepawa	12	$C = 1.47 + 0.95 \ln F$ $S = 0.98 + 0.77 \times 10^{-2}F^2 - 0.17F$ $W = -0.15 \times 10^{-2} + 0.37 \times 10^{-4}F^4$	0.99 0.97 0.99	134.39[2] 23.14[1] 168.18[2]	6
Wheat - Neepawa	13	$C = 0.67 + 0.44 \times 10^{-4}F^4$ $S = 0.34 - 0.35 \times 10^{-3}F^3 + 0.11 \times 10^{-6}F^6$ $\ln W = -4.56 + 0.33F$	0.84 0.97 0.93	12.1[1] 31.52[2] 31.67[2]	7

[1]Signi cant at $P \leq 0.05$
[2]Signi cant at $P \leq 0.01$

APPENDIX III
MACHINERY INSTITUTE REFERENCE COMBINE CAPACITY RESULTS

TABLE 7 and FIGURES 19 and 20 present the capacity results for the Machinery Institute reference combine in wheat and barley crops harvested from 1978 to 1982. FIGURE 19 shows capacity differences in Neepawa wheat for the five years. The 1982 Neepawa wheat crops shown in TABLE 7 were of lower than average straw yield and better than average grain yield. Most of the crops were hard-to-thresh while the grain moisture was similar to the other years and the straw moisture content was about average.

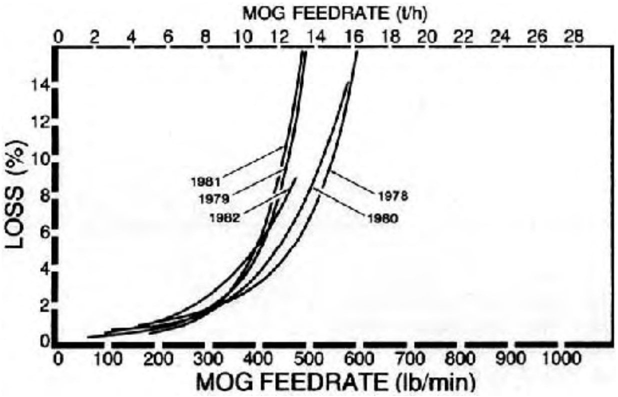

FIGURE 19. Total Grain Loss for the Reference Combine in Neepawa Wheat.

FIGURE 20 shows capacity differences in six-row Bonanza barley for 1978, 1981, and 1982, two-row Fergus barley for 1979 and two-row Hector barley for 1980. The 1982 Bonanza barley crops shown in TABLE 7 were of average straw yield, easy-to-thresh with average grain moisture content. The straw moisture content was average in one crop, but higher in the other.

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.

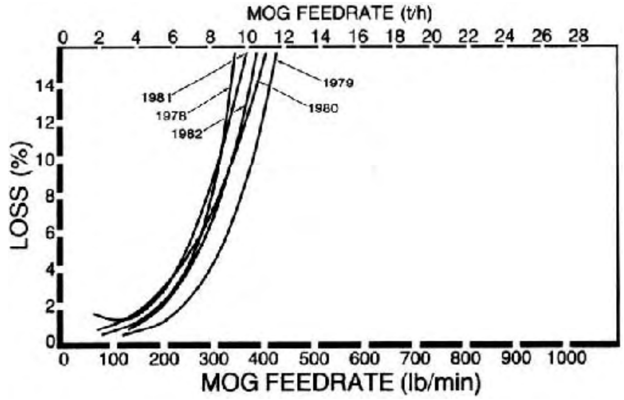

FIGURE 20. Total Grain Loss for the Reference Combine in Barley.

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

	Crop Conditions										Capacity Results						
			Width of Cut		Crop Yield		Grain Moisture		MOG/G	MOG Feedrate		Grain Feedrate		Ground Speed		
Year	Crop	Variety	ft	m	bu/ac	t/ha	Straw %	Grain %	Ratio	lb/min	t/h	bu/h	t/h	mph	km/h	Loss Curve
1982	Barley(A)	Bonanza	28	8.5	75	4.09	22.3	10.6	0.79	205	5.6	325	7.1	1.3	2.0	
	Barley(B)	Bonanza[2]	50	15.2	55	2.99	9.3	12.4	0.68	227	6.2	417	9.1	1.3	2.0	Fig. 27
	Wheat(C)	Neepawa[1]	40	12.2	40	2.73	11.1	13.6	0.68	414	11.3	609	16.6	3.1	5.0	
	Wheat(D)	Neepawa[1]	40	12.2	41	2.79	10.3	14.3	0.81	356	9.7	440	12.0	2.2	3.5	
	Wheat(E)	Neepawa	25	7.6	47	3.21	6.0	7.9	0.89	326	8.9	367	10.0	2.6	4.1	
	Wheat(F)	Neepawa	25	7.6	53	3.59	6.6	11.0	0.88	322	8.8	367	10.0	2.3	3.7	Fig. 26
1981	Barley	Bonanza	25	7.6	62	3.33	7.2	12.6	0.67	205	5.6	385	8.4	2.2	3.5	Fig. 27
	Barley	Klages	25	7.6	53	2.86	7.1	12.0	0.68	220	6.0	403	8.8	2.6	4.2	
	Wheat	Manitou	25	7.6	51	3.46	6.3	13.8	0.96	312	8.5	326	8.9	2.2	3.5	
	Wheat	Neepawa	27	8.2	55	3.69	6.4	11.9	0.85	348	9.5	410	11.2	2.3	3.7	Fig. 26
	Wheat	Neepawa	24	7.4	49	3.29	6.2	13.7	0.93	337	9.2	363	9.9	2.6	4.1	
1980	Barley	Hector	20	6.1	65	3.48	13.8	14.5	0.69	202	5.5	367	8.0	2.4	3.8	Fig. 27
	Barley	Hector	20	6.1	59	3.16	13.4	14.4	0.68	213	5.8	390	8.5	2.8	4.4	
	Wheat	Neepawa[1]	40	12.2	43	2.87	7.2	13.2	0.88	345	9.4	389	10.6	1.9	3.0	
	Wheat	Neepawa	20	6.1	46	3.12	6.0	11.4	0.98	370	10.1	378	10.3	3.4	5.4	Fig. 26
	Wheat	Neepawa[1]	40	12.2	46	3.09	6.2	12.2	1.02	374	10.2	367	10.0	1.7	2.7	
	Wheat	Neepawa	20	6.1	45	3.00	4.4	10.8	0.91	378	10.3	414	11.3	3.9	6.2	
1979	Barley	Klages	20	6.1	66	3.67	5.5	11.7	0.64	249	6.8	486	10.6	2.9	4.7	
	Wheat	Neepawa	24	7.3	41	2.77	5.2	14.1	1.21	348	9.5	286	7.6	2.4	3.9	
	Wheat	Neepawa	20	6.1	40	2.67	5.9	14.3	1.09	356	9.7	326	8.9	3.4	5.4	Fig. 26
	Barley	Fergus	24	7.3	64	3.46	8.1	12.5	0.77	268	7.3	435	9.5	2.3	3.7	Fig. 27
1978	Wheat	Canuck	24	7.3	38	2.54	7.1	12.1	1.15	433	11.8	378	10.3	3.5	5.6	
	Wheat	Lemhi[1]	36	11.0	32	2.13	6.6	12.0	0.75	400	10.9	532	14.5	3.9	6.2	
	Wheat	Neepawa	20	6.1	48	3.23	10.4	15.9	1.04	341	9.3	326	8.9	2.8	4.5	Fig. 26
	Barley	Bonanza	20	6.1	75	4.06	7.7	13.5	0.68	224	6.1	413	9.0	2.3	3.6	Fig. 27

[1]Side-by-side Double Windrow
[2]Double Windrows Lapped by 1/3

APPENDIX IV

The following rating scale is used in Machinery Institute Reports:

excellent	fair
very good	poor
good	unsatisfactory

APPENDIX V
CONVERSION TABLE

1 inch (in)	= 25.4 millimetres (mm)
1 mile (m)	= 1.6 kilometres (km)
1 pound (lb)	= 0.45 kilograms (kg)
1 gallon (gal)	= 4.5 litres (L)
1 acre (ac)	= 0.40 hectare (ha)
1 horsepower (hp)	= 0.75 kilowatts (kW)
100 bushels	= 3.6 cubic metres (m^3)
100 bushels - wheat	= 2.7 tonnes (t)
- barley	= 2.2 tonnes (t)
- rapeseed	= 2.3 tonnes (t)
- rye	= 2.5 tonnes (t)
100 pounds per minute (lb/min)	= 2.7 tonnes per hour (t/h)

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