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EVALUATION REPORT 365

ALLIS-CHALMERS GLEANER N7 SELF-PROPELLED COMBINE

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

ALLIS-CHALMERS GLEANER N7 SERIES THREE 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:
$165,898.00 (May, 1984, f.o.b. Humboldt, with a 13 ft. (4.0 m) header, 10 ft (3.0 m) Victory pickup, 30.5 x 32 R1 12 ply drive tires, 12.4 x 24 R1, 8 ply steering tires, grain loss monitor, air conditioner, heater, auxiliary monitor system, acre estimator, separator hour meter, windshield wiper, luxury adjustable seat, engine block heater, chrome cylinder bars, cylinder cage fingers, feeder reverser, hydraulic accumulator, grain bin extensions, and straw chopper).

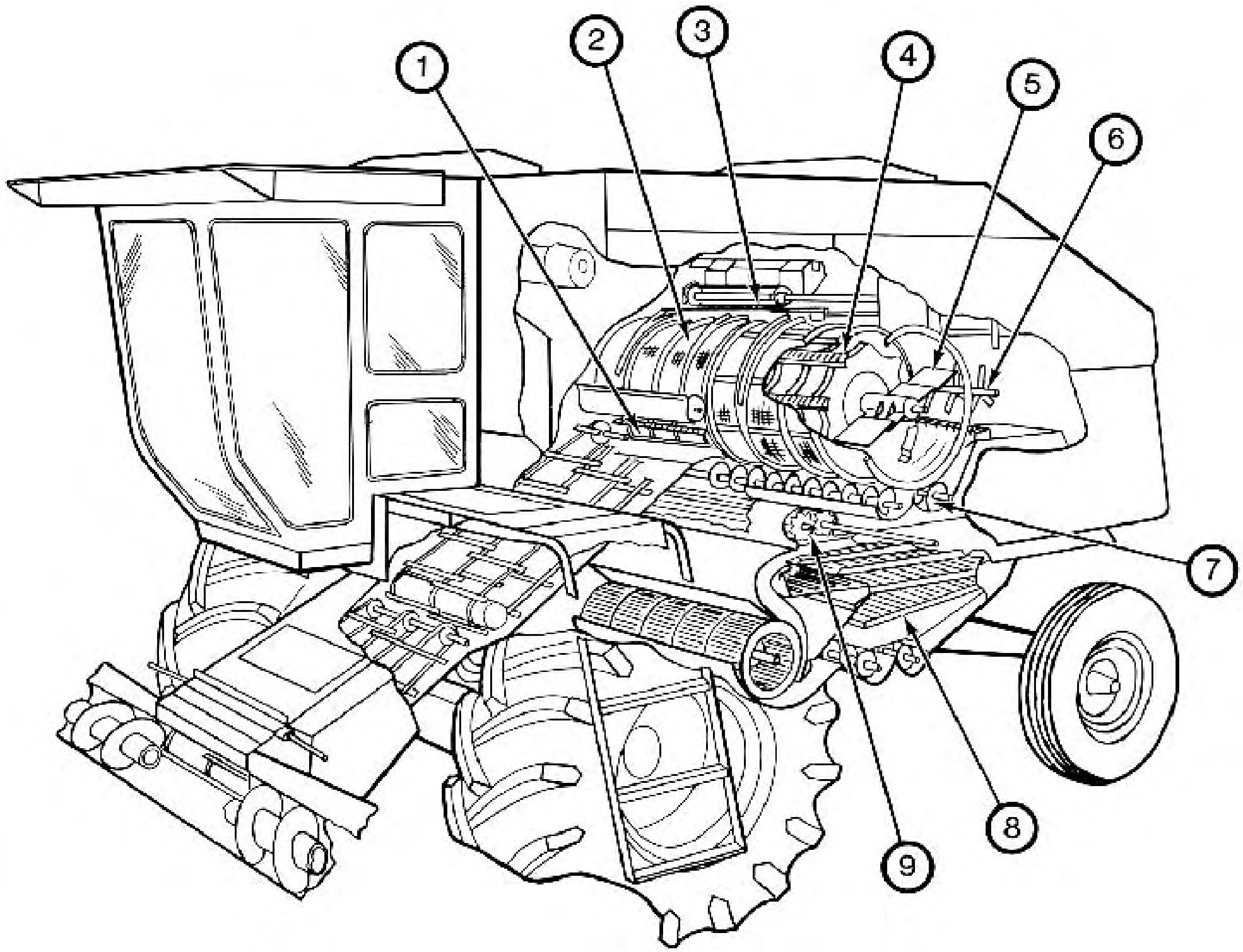

FIGURE 1. Allis-Chalmers Gleaner N7: (1) Concave. (2) Cage, (3) Cage Sweeps, (4) Rotor (5) Discharge Paddles. (6) Straw chopper (7) Distribution Augers. (8) Cleaning Shoe. (9) Accelerator Roils.

SUMMARY AND CONCLUSIONS

Capacity: in the capacity tests, the MOG Feedrates* at 3% total grain loss were 620 and 680 lb/min (16.9 and 18.5 t/h) in Bonanza barley, 630 lb/min (17.2 t/h) in Neepawa wheat and 850 lb/min (23.2 t/h) in Columbus wheat. At 3% total loss, the Allis-Chalmers Gleaner N7 had about 2.5 times the capacity of the Machinery Institute reference combine in barley and about 2 times its capacity in wheat.

Quality of Work: Pickup performance was good in all crops. It picked cleanly at speeds up to 6 mph (9.6 km/h) and fed the crop under the table auger. Feeding was fair. If the table auger clutch was set to provide positive feeding, the feeder often plugged. Feeding was also hampered by crop hesitating at the edges of the feeder opening. The thresher concave door provided good stone protection and there was no stone damage to the rotor, concave or cage.

Threshing was very good. The Allis Chalmers Gleaner N7 threshed aggressively and had lower unthreshed loss and less grain damage than the reference combine. Straw break-up was severe. In tough conditions the maximum attainable feedrate was greatly reduced due to increased power requirements.

The Allis-Chalmers Gleaner N7 had very good separation in all crops. Rotor loss was low over the entire operating range and did not limit capacity.

Cleaning shoe performance was good. Capacity was good, and grain loss over the shoe was minimal when properly adjusted and evenly loaded. The grain sample was clean for most crops encountered. Performance may have been improved in variable rapeseed crops if the small seeds kit had been used.

Grain handling was very good. The 300 bu (10.9 m³) grain tank

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

filled evenly and completely in all crops. It unloaded a full tank of dry wheat in about 190 seconds. The unloader had adequate reach and clearance,

Straw spreading was fair. Although the spreader spread the straw evenly, it spread it only about 12 ft (3.6 m). This was narrow for this size of combine,

Ease of Operation and Adjustment: Operator comfort in the Allis-Chalmers Gleaner N7 was very good. The cab was quiet and relatively dust free. The heater and air conditioner provided comfortable cab temperatures. The seat and steering column could be adjusted to suit most operators. The cab windows provided a clear and unrestricted view forward, to the side, and of the incoming windrow. Rear view mirrors provided adequate rear visibility. Instrumentation was very good. They monitored most important functions and had built-in warning systems. Most were easy to view, they worked well and were helpful. Controls were very good. Most were conveniently located, responsive, and easy to use.

Loss monitor performance was fair. Both shoe and rotor loss were monitored. Losses were related to the area harvested, The monitor was only useful if actual losses were compared to meter readings,

Lighting for night time harvesting was good. Interior lighting was not adequate, Combine handling was very good. The steering was smooth and the combine turned quickly, making it very maneuverable. Care had to be used when transporting at maximum speed.

Ease of adjusting the combine components was good and the ease of setting them to suit crop conditions was also good. The return tailings could not be easily checked.

Ease of unplugging the table auger, feeder, and rotor was very good. The header reverser easily backed out slugs in the feeder while rotor slugs could be powered through. Ease of cleaning was fair. The grain tank retained grain on many ledges, the pan in front of the shoe was difficult to access, and the rotor cage was difficult to thoroughly clean.

Ease of lubrication was good. Most grease fittings were easily accessible. The fuel inlet was high. Ease of general maintenance and repair was good.

Engine and Fuel Consumption: Above +10°C the engine started easily and ran well. The engine started poorly at temperatures below +10°C. It had adequate power for all dry crops encountered but was slightly underpowered in very tough conditions. The average fuel consumption for the season was about 8.9 gal/h (40.4 L/h). Oil consumption was insignificant.

Operator Safety: The Allis-Chalmers Gleaner N7 was safe to operate if normal safety precautions were taken and warnings heeded.

Operator Manual: The operator manual provided much useful information.

Mechanical History: A few mechanical problems occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to permit greater feeder slip clutch adjustment for consistent operation over a wider range of conditions.
2. Modifications to improve crop feeding into the feeder house.
3. Modifications to prevent plugging of the upper tailings transfer auger.
4. Including in the operator manual a suggestion that in hard-to-thresh crops the tailings overfeed auger trough may be removed to provide more aggressive rethreshing and more uniform shoe loading.
5. Modifications to improve the ease and safety for operator entry into the cab.
6. Reducing the audio alarm volume or providing an adjustable volume control.
7. Improving upper and lower console lighting.
8. Modifications to improve the ease and accuracy of fan choke adjustment.
9. Supplying a safe, convenient method for sampling the return tailings.
10. Clarifying the instructions for adjustment of the hydraulic accumulator.
11. Correcting the straw chopper speeds listed in the operator manual.
12. Including in the lubrication section of the operator manual the grease fitting for the upper straw chopper idler arm.
13. Reducing the suggested fan settings for wheat, barley, and rapeseed.
14. Modifications to assure proper positioning and alignment of the lower straw chopper belt tensioner.

Senior Engineer: Glen Frehlich
Project Manager: L. G. Hill
Project Technologist: W. A. Beckett

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Slip clutch modifications to improve clutch consistency are being evaluated.
2. Recommended feeding adjustments for pickup headers will be expanded in the operator manual. Improvements for increased feeding capacity are being evaluated.
3. Modifications to the upper tailings transfer auger will be evaluated.
4. The procedure was accidentally missed from the previous manual and is now included in the current operator manual.
5. Modifications will be considered for future models, however, customer complaints have been very rare.
6. We feel the audio alarm volume must be this loud to assure the operator can hear it above background noises such as the radio. The 5 second automatic shut-off minimizes annoyance.
7. Improved console lighting will be considered for future models.
8. Current models now use an extruded aluminum fan choke rather than the sheet metal design. This will improve the ease and accuracy of adjustment.
9. Methods for sampling or measuring return tailings are being evaluated.
10. Instructions for hydraulic accumulator adjustment will be clarified in future manuals.
11. The correct straw chopper speeds are listed in the new operator manual.
12. The lubrication section in the new operator manual now includes this fitting. In addition, for quick reference, 1984 models have a plasticized chart illustrating lube fitting location and lubrication intervals.
13. The suggested fan settings will be re-evaluated.
14. Corrections to the manufacturing assembly process have been taken to improve chopper idler alignment.

GENERAL DESCRIPTION

The Allis-Chalmers Gleaner N7 is a self-propelled combine with a transverse-mounted rotor, single segment threshing concave, 360 degree separating cage, accelerator rolls, and cleaning shoe. Initial threshing and separation occur at the concave while final separation of grain from straw takes place in the rotor cage. Initial cleaning is accomplished by an air blast through the stream of grain coming from the accelerator rolls. Final cleaning is achieved at the chaffer and cleaning sieve. Tailings are returned to the rotor for rethreshing.

The test machine was equipped with a 270 hp (201 kW) turbocharged, intercooled six cylinder diesel engine, a 13 ft. (4.0 m) header, a 10 ft. (3.0 m) Victory pickup, straw spreader, and optional accessories listed on page 2.

The Allis-Chalmers Gleaner N7 has a pressurized operator's cab, power steering, hydraulic wheel brakes, and hydrostatic traction drive. Electrical switches in the cab control separator, header and unloading auger drive engagement, header height, unloading auger swing, pickup speed, and rotor speed. Fan inlet opening is adjusted from within the cab while concave and shoe settings are adjusted on the machine. 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 Allis-Chalmers Gleaner N7 was operated for 138 hours while harvesting about 1635 ac (662 ha) of various crops. The crops and conditions are shown in TABLES 1 and 2. During the harvest it was evaluated for rate of work, quality of work, ease of operation and adjustment, operator safety, and suitability of the operator manual. Mechanical failures were recorded.

RESULTS AND DISCUSSION TERMINOLOGY

MOG, MOG Feedrate, Grain Feedrate and MOG/G Ratio: A combine's performance is affected mainly by the amount of straw and chaff it is processing and the amount of grain or seed it is processing. The straw, chaff, and plant material other than the grain or seed is called MOG, which is an abbreviation for "Material-Other-than-Grain". The quantity of MOG being processed per unit of time is called "MOG Feedrate". Similarly the amount of grain processed per unit of time is the "Grain Feedrate".

The MOG/G ratio, which is the MOG Feedrate divided by the Grain Feedrate, indicates how difficult a crop is to separate. For example, MOG/G ratios for prairie wheat crops may vary from 0.5 to 1.5. In a crop with a 0.5 MOG/G ratio, for every 100 lbs. (45.4 kg) of grain harvested, the combine has to handle 50 lbs. (22.7 kg) of straw. However, in a crop with a 1.5 MOG/G ratio for a similar 100 lbs. (45.4 kg) of grain harvested the combine now has to handle 150 lbs. (68.2 kg) of straw -- 3 times as much. Therefore, the higher the MOG/G ratio, the more difficult it is to separate the grain.

Grain Loss, Grain Damage and Dockage: Grain loss from a combine can be of two main types; Unthreshed Loss, consisting of grain left in the head and discharged with the straw and chaff, or Separator Loss which is free (threshed) grain discharged with the straw and chaff. Separator Loss can be further defined as shoe and walker (or rotor) loss depending where it came from. Loss is expressed as a percentage of the total amount of grain being processed.

Damaged or cracked grain is also a form of grain loss. In this report the cracked grain is determined by comparing the weight of actual damaged kernels to the entire weight of the sample taken from the grain tank.

TABLE 1. Operating Conditions

Crop	Variety	Average Yield		Swath Width		Hours	Field Area	
		bu/ac	t/ha	ft	m		ac	ha
Barley Barley	Bonanza Conquest	47 42	2.5 2.3	25, 28 30	7.6, 8.5 9.1	25.3 6.3	358 84	145 34
Rapeseed Rapeseed Rapeseed Rapeseed	Andor Regent Tobin Tower	25 20 22 20	1.4 1.1 1.2 1.1	18, 24 22, 25 20 28	5.5, 7.3 6.7, 7.6 6.1 8.5	15.0 8.5 6.5 6.6	136 74 56 71	55 30 23 28
Rye Rye	Frontier Puma	13 23	0.8 1.5	20 20, 22, 24, 50	6.1 6.1, 6.7, 7.3, 15.2	2.8 31.8	29 396	12 160
Wheat Wheat	Columbus Neepawa	30 31	2.0 2.1	42 28 to 48	12.8 8.5 to 14.6	0.5 34.6	7 424	3 172
Total						138.0	1635	662

TABLE 2. Operation in Stony Conditions

Field Condition	Hours	Field Area (ha)	
		ac	ha
Stone Free Occasional Stones Moderately Stony	69 60 9	917 634 84	371 257 34
Total	138	1635	662

Dockage is determined by standard Grain Commission methods. It consists of large foreign particles and smaller particles that pass through a screen specified for that crop. It is expressed as a percentage of the total sample taken.

Capacity: Combine capacity is the maximum rate at which a combine, adjusted for optimum performance, can process crop material at a certain total loss level. The Machinery Institute expresses capacity in terms of MOG Feedrate at 3% total loss. Although MOG Feedrate is not as easily visualized as Grain Feedrate, it provides a much more consistent basis for comparison. A combine's ability to process MOG is relatively consistent even if MOG/G ratios vary widely. Three percent total loss is widely accepted in North America as an average loss rate that provides an optimum trade-off between work accomplished and grain loss. This may not be true for all combines nor does it mean that they cannot be compared at other loss levels.

Reference Combine: It is well recognized that a combine's capacity may vary considerably due to crop and weather conditions (APPENDIX II AND FIGURES 19 and 20). Since these conditions affect combine performance, it is impossible to compare combines that are not tested under identical conditions. For this reason, the Machinery Institute uses a reference combine. It is simply one combine that is tested each time that an evaluation combine is tested. Since conditions are similar, the combine can be compared directly to the reference combine and a relative capacity determined. Combines tested in different years and conditions can then be indirectly compared using their relative capacifies.

RATE OF WORK

Capacity Test Results: The capacity results for the Allis-Chalmers Gleaner N7 at 3% loss are summarized in TABLE 3.

The performance curves for the capacity tests are presented in FIGURES 2 to 5. The curves in each figure indicate the effect of increased feedrate on rotor loss, shoe loss, unthreshed loss, and total loss. From the graphs, combine capacity can also be determined for loss levels other than 3%. These results were obtained with the combine set for optimum performance at a reasonable feedrate. Unthreshed losses may be slightly greater than indicated since some grain left in the heads was probably threshed out by the straw chopper. The straw chopper was mounted behind the rotor and could not be removed for the tests.

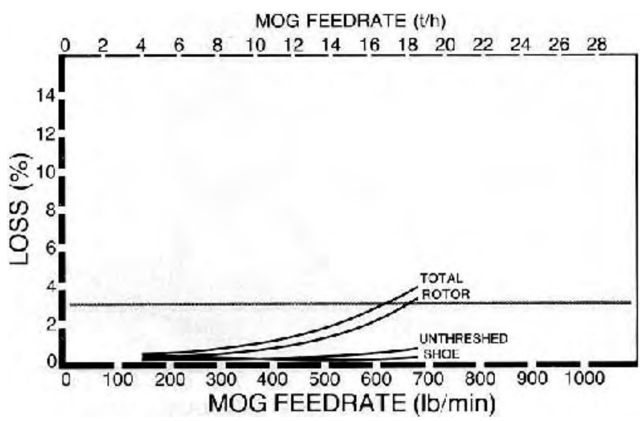

FIGURE 2. Grain Loss in Bonanza Barley (A).

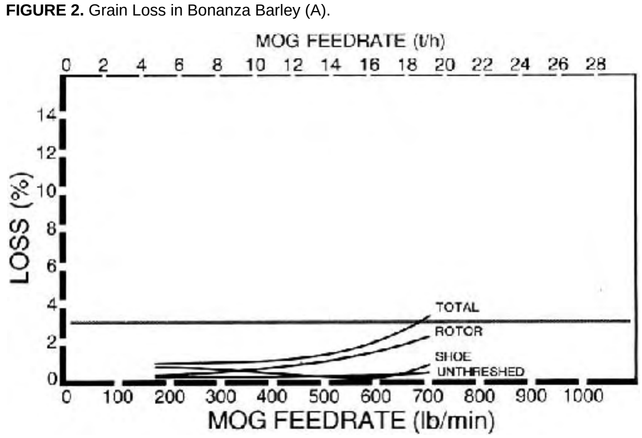

FIGURE 3. Grain Loss in Bonanza Barley (B).

The crops for the 1983 tests suffered from extreme heat during the filling stage. In barley crops this resulted in a lower bushel weight than normal. In the wheat crops there was a decline in yield for the crop stand. Also, in most crops, there was a large number of very small kernels, which increased dockage.

TABLE 3. Capacity of the Allis-Chalmers Gleaner N7 at a 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 (A)	Bonanza	25	7.6	59	3.2	10.7	11.5	0.76	620	16.9	1020	22.2	0.25	1.5	Fig. 2
Barley (B)	Bonanza	25	7.6	65	3.5	8.9	11.8	0.83	680	18.5	1024	22.3	0.25	1.0	Fig. 3
Wheat (C)	Columbus	42	12.8	33	2.2	8.4	11.3	1.25	850	23.2	680	18.5	0.6	3.0	Fig. 4
Wheat (D)	Neepawa	28	8.2	41	2.8	4.3	9.6	1.15	630	17.2	548	14.9	0.75	3.0	Fig. 5

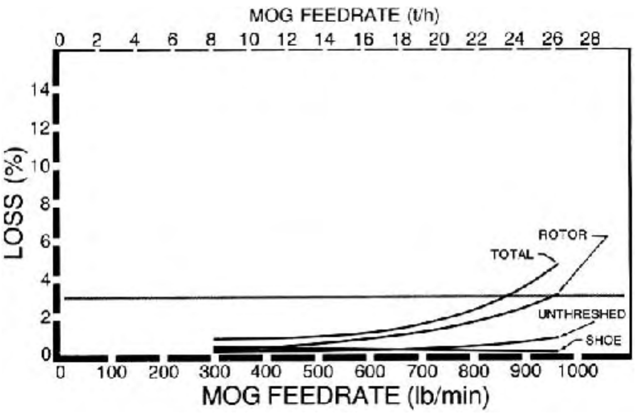

FIGURE 4. Grain Loss in Columbus Wheat (C).

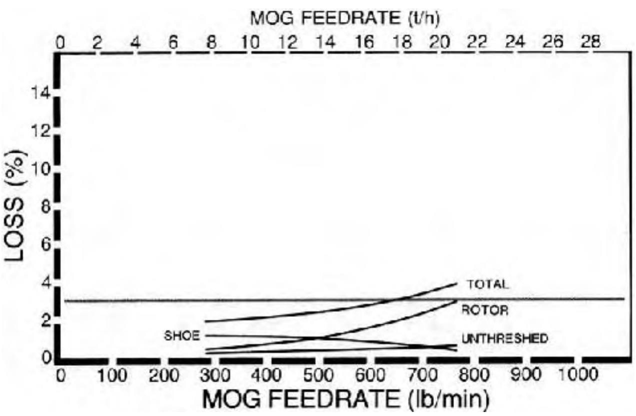

FIGURE 5. Grain Loss in Neepawa Wheat (D).

In the barley crops tested (FIGURES 2 and 3), at maximum feedrate, losses were fairly low. Although both barley tests were done in the same field, capacity was slightly lower in the first test due to tougher straw conditions.

For the two wheat crops (FIGURES 4 and 5), conditions were stable and at maximum feedrate losses were fairly tow. Capacity in the Columbus wheat was considerably greater than in the Neepawa wheat. This may have been due to the easier-to-thresh nature of Columbus.

Average Workrates: TABLE 4 indicates the average workrates obtained in each crop over the entire test season. These values are considerably lower than the capacity test results in TABLE 3. This is because the results in TABLE 3 represent instantaneous rates while average workrates take into account operation at lower loss levels, variable crop and field conditions, availability of grain handling equipment and differences in operating habits. Most operators could expect to obtain average rates within this range, while some daily rates may approach the capacity test values.

The values from the average workrates should not be used to compare combines. The factors which affect workrates are too variable and cannot be duplicated for all combine tests.

Comparing Combine Capacities: The capacity of combines tested in different years or in different crop conditions can only be compared using the Machinery Institute reference combine. This is done by dividing the test combine capacity (MOG Feedrate at 3% loss), as shown in TABLE 3, by the corresponding capacity for the reference combine, found in TABLE 7. The resulting number (capacity ratio) can be used to compare capacities of combines in different years.

TABLE 4. Average Workrates

		Average Yield		Average Speed		Average Workrates			
Crop	Variety	bu/ac	t/ha	mph	km/h	ac/h	ha/h	bu/ac	t/h
Barley	Bonanza	47	2.5	5.0	8.0	14.8	6.0	695	15.2
Barley	Conquest	42	2.3	4.0	6.4	17.2	7.0	727	15.8
Rapeseed	Andor	25	1.4	5.5	8.8	10.2	4.1	255	5.8
Rapeseed	Regent	20	1.1	4.0	6.4	8.1	3.3	162	3.7
Rapeseed	Tobin	22	1.2	4.5	7.2	8.5	3.4	187	4.3
Rapeseed	Tower	20	1.1	3.5	5.6	10.7	4.3	214	4.9
Rye	Frontier	13	0.8	5.5	8.8	5.7	2.3	74	1.9
Rye	Puma	23	1.5	5.0	8.0	11.3	4.6	260	6.6
Wheat	Columbus	30	2.0	3.5	5.6	18.8	7.6	564	15.4
Wheat	Neepawa	31	2.1	4.0	6.4	12.4	5.0	384	10.5

For example, if a test combine has a capacity of 440 lb/min (12 t/h) MOG and the reference a capacity of 367 lb/min (10 t/h) MOG, the test combine capacity is 1.2 times the reference combine capacity [440 + 367 = 1.2 (12 + 10 = 1.2)]. Comparing this combine to a second combine which has 2 times the capacity of the reference, it can be seen that the second combine has 67% more capacity [(2 - 1.2) - 1.2 x 100 = 67%].

A test combine can also be compared to the reference combine at losses other than 3%. The total loss curves of both machines are shown on the same graph in FIGURES 6 to 9. Shaded bands around the curves represent 95% confidence belts. Where the bands overlap, very little difference in capacity could be noticed; where the bands do not overlap significant capacity differences existed.

Capacity Compared to Reference Combine: The capacity of the Allis-Chalmers Gleaner N7 was much greater than that of the reference combine in both wheat and barley. At 3% total loss the Allis-Chalmers Gleaner N7 had about 2.5 times the capacity of the reference combine in barley and about 2 times its capacity in wheat.

FIGURES 6 to 9 compare the total loss curves of both combines.

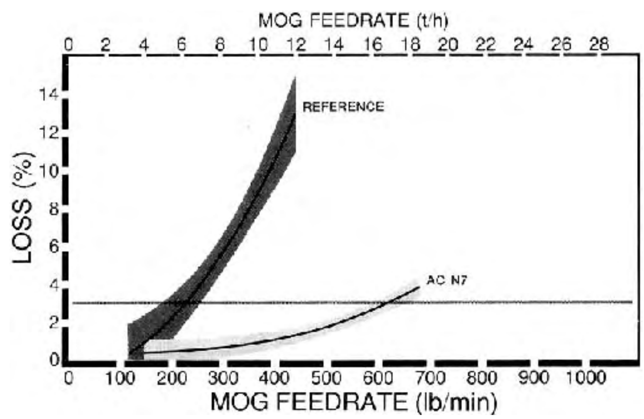

FIGURE 6. Total Grain Loss in Bonanza Barley (A).

QUALITY OF WORK

Picking: Windrows were picked using a 10 ft (3.0 m) Victory windrow pickup.

Pickup height was adjusted so that the pickup teeth just scratched the ground. Pickup speed was controlled from the cab and adjusted according to windrow conditions and forward speed. The windguard was set to deflect the crop under the table auger without restricting crop flow. It was removed for rapeseed crops.

Pickup performance was good in all crops encountered. It had adequate picking ability to utilize the combine's capacity in most crops. It picked cleanly in average crops at speeds up to 6 mph (9.6 km/h). At speeds greater than 6 mph (9.6 km/h) pickup loss increased significantly. The transfer drapers and windguard provided smooth crop flow under the table auger. Even in rapeseed without the windguard, windrows fed under the table auger at speeds up to 6 mph (9.6 km/h).

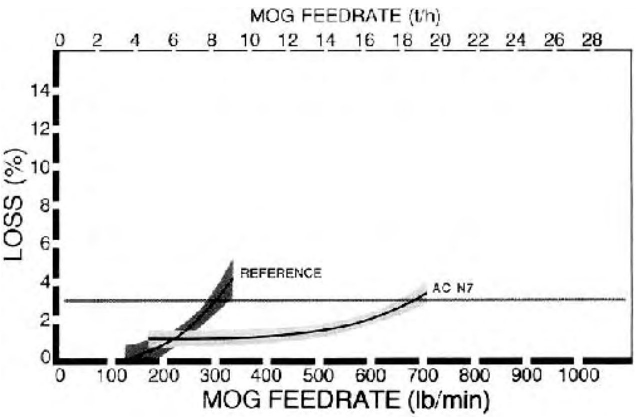

FIGURE 7. Total Grain Loss in Bonanza Barley (B).

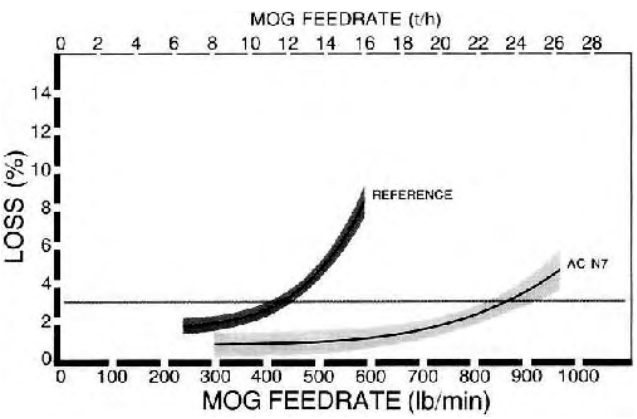

FIGURE 8. Total Grain Loss in Columbus Wheat (C).

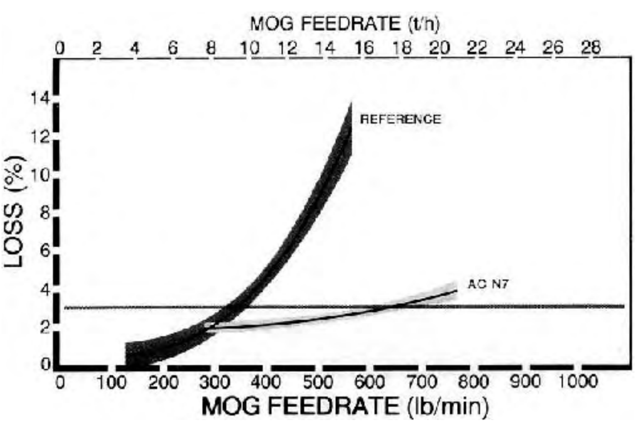

FIGURE 9. Total Grain Loss in Neepawa Wheat (D).

Feeding: The table auger fed the windrows to the two-stage slatted conveyor which carried the crop to the rotor. Table auger clearance, auger finger timing, and auger slip clutch tension were adjusted according to the operator manual.

Feeding was fair for most crops. The table auger plugged frequently in bunchy windrows. Increasing the table auger clutch tension increased auger aggressiveness but then the feeder plugged and caused the feeder clutch to slip. The feeder jaw clutch could not be adequately adjusted. It is recommended that the manufacturer consider modifications to permit greater feeder slip clutch adjustment for consistent operation over a wider range of conditions.

Even in uniform windrows, crop did not feed evenly into the feeder opening. Crop hesitated at the edge of the feeder causing bunches which plugged the feeder. The feeder house extension covers were removed, the bottom stripper cut back and auger flight extensions added (FIGURE 10). These modifications helped but did not totally eliminate the problem. It is recommended that the manufacturer consider modifications to improve crop feeding into the feeder house.

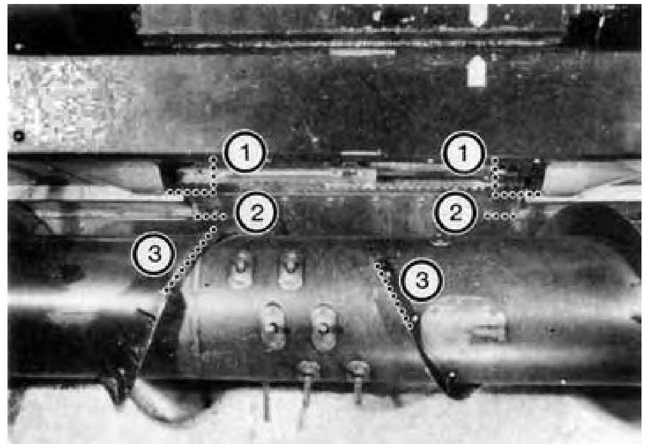

FIGURE 10. Feeder Modifications: (1) Extensions Removed, (2) Stripper Bars Cutback, (3) Flighting Extensions Added.

Stone Protection: Stones and other hard objects that contacted the rotor were forced out through a spring latched door. The latch could be adjusted to determine the force required to open the door. The system provided good protection and prevented damage to the rotor, concave, and cage.

After an object was ejected, the door had to be manually relatched with a crank. The object also had to be dumped from the screen below the fan.

Threshing: Threshing was accomplished by the open, rasp bar rotor, threshing concave, and cage (FIGURES 11 and 12).

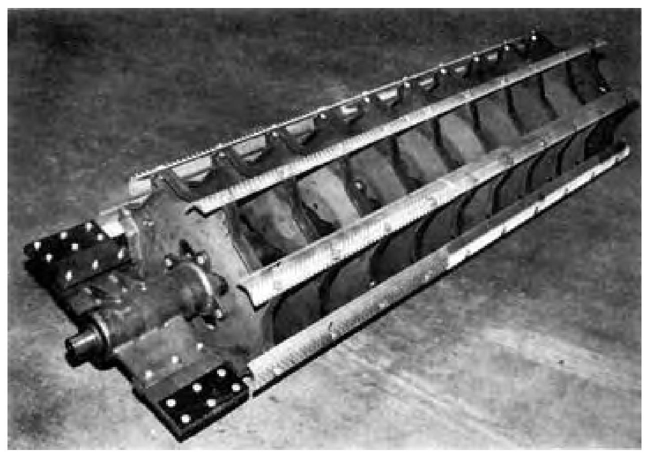

FIGURE 11. Rotor.

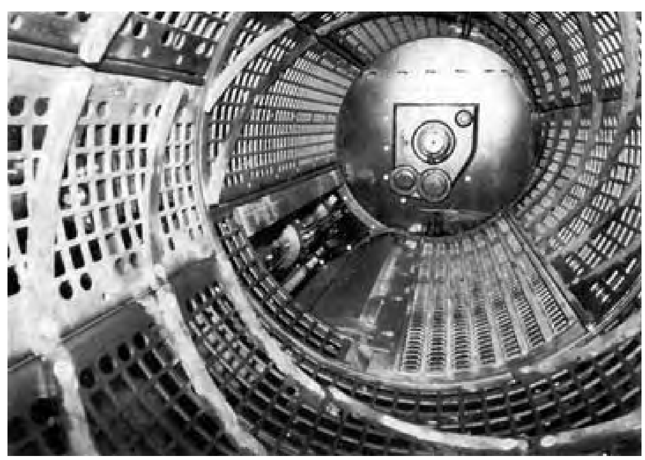

FIGURE 12. Adjustable Concave and Rotor Cage.

The rotor was powered through a two-speed gearbox and torque sensing variable speed belt drive. The drive was positive and provided a suitable speed range for all crops encountered. The concave had adequate adjustment. Suitable threshing in grain crops was obtained when using rotor speeds and concave clearance similar to the settings used on many conventional combines. In hard-to-thresh crops additional cage cover plates were installed. They provided more complete threshing and reduced the amount of unthreshed heads, which were returned. In rapeseed, slower rotor speeds and wider concave clearance were used. However, the rotor speeds were faster than necessary for threshing but were required to move the material through the cage without slugging. The range of rotor speeds and concave openings used for various crops are given in TABLE 5.

The Allis-Chalmers Gleaner N7 threshed aggressively and plugging was not a problem. Unthreshed losses appeared low in all crops. However, the straw chopper, which could not be disengaged, may have reduced unthreshed loss, which then appeared as rotor loss. Grain cracks were minimal. The aggressive threshing action caused severe straw break-up in all conditions. In tough conditions, unthreshed loss was still acceptable although the maximum feedrate attainable was greatly reduced due to increased power requirements.

TABLE 5. Crop Settings

	Cylinder	Concave Clearance		Chaffer Setting		Cleaning Ext. Setting		Fan Opening Position
Crop	rpm	in	mm	in	mm	in	mm	
Fall Rye	900-1000	¾ - 1½	19 - 38	⅜ - ½	10 - 13	⅛ - ¼	3 - 6	4 - 4½
Barley	800-950	½ - ¾	13 - 19	½ - ¾	13 - 19	¼ - ⅜	6 - 10	4 - 5
Rape-seed	650-850	½ - 1¼	13 - 32	½ - 1	13 - 25	⅛ - ¼	3 - 6	3¾ - 4¾
Wheat	1000-1050	⅛ - ½	3 - 13	½ - ¾	13 - 19	⅛	3	5 - 5½

Separating: Grain was separated from the straw at the concave and cage by gravity and centrifugal force.

Separation was mainly affected by rotor speed and concave clearance. In most conditions maximum separation was achieved using high rotor speeds and minimal concave clearance. The optional cage covers increased rotor loss in hard-to-separate crops such as barley and had to be removed. The optional cage fingers increased separation by breaking up the straw mat in dry barley crops. In easier-to-separate crops, the cage fingers were removed as the extra power required outweighed their benefit. Settings used for the various crops are given in TABLE 5.

An all crops encountered the Allis-Chalmers N7 had very good separation. Even in barley, a typically hard-to-separate crop, rotor loss was low over the entire operating range and did not limit capacity.

Cleaning: Chaff and debris were cleaned from the grain using a combination of air and sieving action. The tailings were returned to the rotor.

The adjustable inlet, transverse flow fan supplied a suitable air blast for most crops. Some of the air was ducted to provide a strong pre-cleaning blast to material being propelled from the accelerator rolls to the sieves. The rest of the air was directed through the sieves. The pre-cleaning blast removed much of the chaff and greatly reduced chaffer loading. This was especially beneficial at high feedrates and when operating on side slopes. In variable rapeseed crops the air blast could not be controlled adequately to provide acceptable performance. In these crops it would have been helpful to be able to control the pre-cleaning and sieve air independently. Although not tested, the optional small seeds kit (FIGURE 13) would likely have provided the control required.

The chaffer and cleaning sieves moved in unison but straw “spearing” was not a problem. They could be easily adjusted to suit nearly all crop conditions encountered. The shoe settings used for the various crops are included in TABLE 5.

In highly variable rapeseed crops, sieve settings could not compensate for the effects of uneven shoe loading and inadequate air control. This resulted in excessive grain loss and trash in the grain sample. In uniform rapeseed crops, the shoe could be set for acceptable performance, however, higher shoe capacity was attained using a larger chaffer opening and more air than suggested in the manual.

In grain crops the cleaning shoe had very good capacity and shoe losses were low over the entire operating range. The sample was clean although in hard-to-thresh wheat this required returning some clean grain with the tailings to get rid of “White caps”. Dockage in the sample was mainly due to undersized kernels.

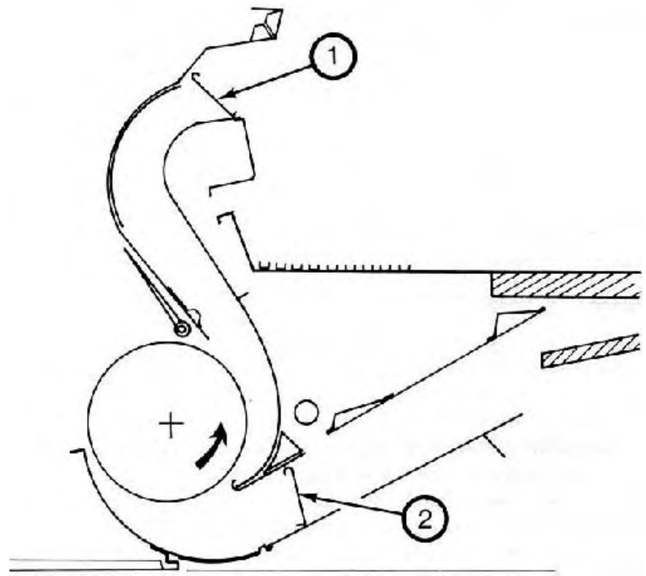

FIGURE 13. Small Seed Kit (Damper Placement 1 and 2).

The transfer auger on the optional return plugged continually in rapeseed. Pods wedged between the flighting and discharge paddles on the auger. After one paddle was removed and the other aligned with the end of the auger flighting, no further plugging occurred. It is recommended that the manufacturer consider modifications to prevent plugging of the upper tailing transfer auger.

The tailings were normally delivered near the discharge end of the rotor. This provided very little rethreshing in hard-to-thresh crops and heavily loaded the left side of the shoe. The trough under the overfeed auger at the front of the rotor was removed allowing the tailings to be delivered to the inlet side of the rotor. This greatly improved rethreshing and shoe loading. This modification was suggested by the manufacturer but not included in the operator manual. It is recommended that the manufacturer consider including in the operator manual a suggestion that in hard-to-thresh crops the tailings overfeed auger trough may be removed to provide more aggressive rethreshing and more uniform shoe loading.

The tailings could not be easily checked while harvesting.

Clean Grain Handling: The clean grain elevator had adequate capacity for all crops encountered. The open grain tank filled evenly and completely in all crops, the tank held about 300 bushels (10.9 m^3) of dry wheat. The unloading auger had adequate reach and clearance for unloading into trucks and grain trailers (FIGURE 14). The auger discharged grain in a compact even stream and could empty a tank of dry wheat in about 190 seconds. The tank did not empty completely, leaving about 1 bu (36 L) of grain trapped on various ledges.

Straw Spreading: The test machine was equipped with the optional straw chopper and straw spreader. The straw chopper replaced the discharge beater and could not be disengaged. The straw from the chopper was broken into very small lengths. The bat-type spreader spread straw up to 12 ft (3.6 m). This was narrow for this size of machine. Most of the straw was spread directly behind the combine (FIGURE 15). The straw spread was greatly affected by wind. The straw spreader was easily removed for checking losses or to permit windrowing, although the windrows were not suitable for baling.

EASE OF OPERATION AND ADJUSTMENT

Operator Comfort: The Allis-Chalmers Gleaner N7 was equipped with an operator’s cab positioned ahead of the grain tank and centered on the combine body. The feeder housing was offset slightly to the right. Entrance into the cab was difficult for some operators. Protruding steel steps for access to the grain tank and low cab door, often caused operator injury when entering or exiting the cab. It is recommended that the manufacturer consider modifications to improve the ease and safety for operator entry into the cab.

FIGURE 14. Unloading.

FIGURE 15. Straw Spreader Operation.

The cab was very quiet. Operator station sound level at full speed with no load was about 78 dBA.

Incoming air was effectively filtered while fans pressurized the cab to reduce dust leaks. The heater and air conditioner provided suitable cab temperatures.

The seat and steering column were adjustable, providing a reasonably comfortable combination. However, if the seat backrest could be reclined, operator comfort would be much better. The three brake pedals limited leg room on the right.

Visibility forward and to both sides was very good; rear visibility was restricted to the use of rear view mirrors. Four rear view mirrors were provided, which gave very good visibility to the rear. Caution was still needed when maneuvering in confined areas. View of the incoming windrow was very good (FIGURE 16). Grain level was visible through the rear window until the tank was nearly full.

FIGURE 16. View of Incoming Windrow.

Instruments: The instruments were located on two consoles, one to the right of the operator, the other above the windshield (FIGURES 17 and 18). The lower console had gauges for turbocharger boost pressure, battery voltage, coolant temperatures, engine oil pressure, and a grain loss monitor meter. The upper console had the grain loss monitor adjustments, engine and separator hour meters, an acre estimator, air conditioning and heater controls, and a digital readout that selectively displayed fuel level, cylinder speed, engine speed, and combine ground speed. As standard equipment, warning lights signalled an open stone trap door, engaged parking brake, excessive hydraulic oil temperature, engine air filter restrictions, low coolant level, fuel filter restriction, transmission lubrication pressure, and reduced speeds of the major combine drives. No shaft speed monitor was supplied to warn of rotor speed reduction.

Optional instruments on the test machine included warning lights for low engine oil pressure, low hydraulic oil level, low battery voltage, excessive coolant temperature, full grain tank, and unloading auger in unloading position.

FIGURE 17. Controls and Lower Instrument Console.

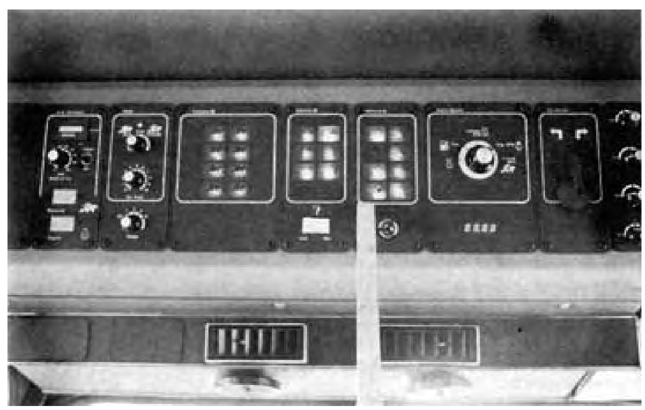

FIGURE 18. Upper Instrument Console.

Most of the standard and optional warning lights were accompanied by a four second audio alarm. The audio alarm was very helpful but also very loud and annoying. It is recommended that the manufacturer consider reducing the audio alarm volume or providing an adjustable volume control. The instruments on the upper console were inconvenient to observe while harvesting. The acre estimator gave inaccurate results, which may have been due to improper calibration before shipping.

Controls: The controls for the Allis-Chalmers Gleaner N7 (FIGURE 17) were conveniently located and easy to operate. Most functions were activated electrically with rocker switches. They were easily operated but sometimes difficult to identify quickly in an emergency. The light switches and header reverse switch were in conveniently located. The throttle lever was often difficult to release from its locked high idle position. The hydrostatic lever and header height control switch were vary conveniently located. Header height adjustment was very abrupt without the optional header hydraulic accumulator. With the hydraulic accumulator properly adjusted, control was smooth and responsive. The fan adjustment was stiff to operate.

The operator had to be careful not to retract the unloading auger from its unloading position while it was still turning.

Loss Monitor: Grain loss sensor pads were located behind the shoe and at the discharge end of the rotor. The operator could select a readout for shoe loss, rotor loss or both. The monitor detected mechanical shoe loss but not airborne shoe loss. Shoe loss readings were meaningful only if compared to actual losses observed behind the combine. Rotor loss was impossible to compare to the meter readings since the affect of the straw chopper could not be determined. The meter was conveniently located and easy to read.

Lighting: The combine was equipped with six field lights, two transport lights, a grain tank light, unloading auger light, tail lights, warning lights, and an interior light. The exterior lights provided very good lighting for night time harvesting and transporting. Interior lighting was poor. Without the interior light on, many instruments and controls on the upper and lower consoles were not visible. It is recommended that the manufacturer consider improving upper and lower console lighting.

Handling: The Allis-Chalmers Gleaner N7 was very maneuverable. Steering was smooth and responsive. The wheel brakes were positive and aided turning but were not required for picking around most windrow corners. The brake pedals were close together and inconvenient to operate.

The transmission was easy to shift. The hydrostatic drive was responsive and made changing speed and reversing quick and easy.

The combine was very stable in the field even with a full grain tank however, normal caution was required when operating on hillsides. The combine transported at speeds up to 23 mph (37 km/h). Above 18 mph (29 km/h) over-steering could easily cause loss of control. Extreme caution must be taken when operating at maximum transport speed.

Adjustment: Pickup speed, rotor speed, and fan inlet opening were controlled from within the cab. The fan adjustment was difficult to operate as the fan choke would bind against the frame. Tension in the linkage eventually caused the inlet gate or indicator to move, making accurate adjustment difficult. It is recommended that the manufacturer consider modifications to improve the ease and accuracy of fan choke adjustment.

Table auger, concave, and sieve adjustments were made on the machine. Table auger finger timing, auger clearance, and auger stripper adjustment were easily made and seldom had to be readjusted. The concave adjusting ratchet was easy to operate. The concave indicator conveniently showed concave clearance. The chaffer sieve adjustment was easily accessible at the rear of the shoe. The cleaning sieve was accessible through an access door below the chaffer sieve.

Field Setting: The Allis-Chalmers Gleaner N7 was easy to set for coarse grains but difficult to set for uneven rapeseed crops.

Removing the straw spreader provided easy access for checking rotor loss. However, it was impossible to accurately determine unthreshed loss since the straw passed through the straw chopper. Fan and sieve settings were critical. The fan, if misadjusted, could easily cause high shoe loss. Once set for optimum performance it was essential that the shoe be kept loaded. There was no way to easily check the return tailings. It is recommended that the manufacturer consider supplying a safe convenient method for sampling the return tailings.

Unplugging: The optional power header reverser made unplugging the table auger and feeder quick and easy.

Unplugging the rotor could be accomplished by lowering the concave, shifting the rotor drive gearbox to low and powering the slug through.

Unplugging the tailings upper transfer auger was very difficult. There was limited access to the auger through panels in the grain tank. The material had to be removed by hand. However, after the auger discharge paddles were modified, plugging did not occur.

Machine Cleaning: Cleaning the Allis-Chalmers Gleaner N7 for harvesting seed grain was laborious and time-consuming. The grain tank was easy to clean. Cleaning around the rotor cage and distribution augers was inconvenient and time-consuming because of the many ledges that retained material. The grain pan under the accelerator rolls was difficult to access and clean. The sieves were easy to remove, and once removed provided access to the clean grain cross auger but not the tailings cross auger. The exterior of the combine was easily cleaned.

Lubrication: The fuel tank inlet was located 8.8 ft (2.7 m) above the ground, which made it difficult to fuel from some gravity fuel tanks.

The combine had 49 pressure grease fittings. Eight required greasing every 10 hours, an additional thirty-three every 50 hours, and eight more once a season. Engine and hydraulic oil levels required regular checking. Most lubrication points were easily accessible except for those on the cylinder shaft drive coupler, the unloading auger U-joint, and the lower Uu-joint on the straw spreader drive. Care had to be taken not to over grease shafts, which had jaw slip clutches. Any grease on the jaw faces greatly reduced their effectiveness.

Maintenance: Routine maintenance was easy to perform. The radiator had to be cleaned periodically. The rotary screen swung out allowing easy access to the front of the radiator, but access from the engine side was limited.

The outer dry element engine air filter had to be cleaned regularly. It was easily accessible.

Tension on most chains and belts was easy to check and adjust, but the tailings return chain adjustment was difficult to reach. Jaw clutches protected the lower feeder conveyor, return tailings, and cage sweep drives. They had very limited adjustment. The table auger had a friction slip clutch, which was easily adjusted.

The header table was easy to remove and install.

The rotor was inconvenient to remove and install. Several shields and the mounting plate at the discharge end of the rotor had to be removed. The rotor was heavy and could not be manually handled. When installing, aligning the rotor drive shaft and gearbox was difficult.

The threshing concave was fairly easy to level and set to initial clearance. J-bolts adjusted the rear of the concave while an adjustable cam set the front.

ENGINE AND FUEL CONSUMPTION

The Allis-Chalmers 6851 diesel engine started easily in temperatures above +10°C, but started poorly at lower temperatures. It ran well and had adequate power for dry conditions but was slightly underpowered for very tough conditions.

Average fuel consumption based on separator hours, was about 8.9 gal/h (40.4 L/h). Oil consumption was insignificant.

OPERATOR SAFETY

The operator manual emphasized operator safety.

The Gleaner N7 had adequate warning decals to warn of dangerous areas, and shields to provide protection from moving parts. Most shields were hinged to allow easy access.

The access ladder to the cab had narrow rungs with no backing to prevent the operator's foot from slipping through.

When entering or exiting the cab, operators often struck their head on the top of the door opening and/or bumped into the grain tank steps.

Most machine adjustments could be made safely. However, when adjusting the shoe, the over-center catches fastening the sieve access door snapped open with considerable force, often striking the operator a painful blow.

A header lock was provided and should be used when working under the header or when the combine is left unattended.

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. Extreme caution was required at maximum transport speed as slight over-steering could cause loss of control.

A fire 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 setting, servicing, troubleshooting, and machine specifications.

The operator manual did not clearly indicate that the hydraulic accumulator control valve could be set in any position to provide the desired header reaction. It is recommended that the manufacturer consider clarifying the instructions for adjustment of the hydraulic accumulator.

The straw chopper speed setting in the operator manual for cereal grain was incorrect. It is recommended that the manufacturer consider correcting the straw chopper speeds listed in the operator manual.

The manual does not indicate a grease fitting on the spring-loaded idler hub for the upper straw chopper drive belt. It is recommended that this be included in the lubrication section of the operator manual.

Fan settings suggested in the operator manual for wheat, barley, and rapeseed caused excessive grain loss over the shoe. It is recommended that the manufacturer consider revising the suggested fan settings for wheat, barley, and rapeseed.

DURABILITY RESULTS

MECHANICAL HISTORY

TABLE 6 outlines the mechanical history of the Allis-Chalmers Gleaner N7 during the 138 hours of field operation while harvesting about 1635 ac (663 ha). The intent of the test was functional performance evaluation. Extended durability testing was not conducted.

TABLE 6. Mechanical History.

Item	Operating Hours	Field Area ac	Field Area (ha)
Drives:			
-The pickup hydraulic pump failed to provide oil flow at	6	60	(24)
The separator clutch slipped causing it to overheat and be damaged at	6	60	(24)
-The rotor drive belt broke at	7, 9	60, 73	(24, 29)
-The rotor torque sensing hub was repacked with grease at	9	73	(29)
-The oil seal on the drive shaft of the pickup hydraulic pump started leaking and was replaced at	15	140	(57)
-The new seal started leaking again at	62	663	(268)
-The inner half of the cylinder drive sheave broke loose from the hub at	18	170	(69)
-The straw chopper lower drive belt broke at	74	826	(334)
-The straw chopper idler pulley was damaged at	74	826	(334)
-The engine main drive belt broke at	74	826	(334)
-The chain and sprockets on the pickup hydraulic pump were completely worn at	116	1290	(522)
Miscellaneous:			
-The straw chopper would not disengage properly at	Start of Season		
-The engine water pump started leaking at	18	170	(69)
-The windshield wipers quit working at	46	516	(209)
-The grain tank leveling auger shield bent due to overfilling at	46	516	(209)
-The boost pressure gauge tube was damaged at	56	663	(268)
-The chaffer adjusting lever locking nut shook loose preventing the chaffer from maintaining its set position at	62	780	(316)
-The alternator failed at	74	826	(334)
-The rotating union and connector for the hydraulic line to the separator clutch were damaged at	74	826	(334)
-The cab heater supply and return hoses were interchanged at	90	975	(395)
-The unloading auger position indicator light malfunctioned	Throughout the Season		

DISCUSSION OF MECHANICAL FAILURES

Pickup Hydraulic Pump: A sleeve that seats the oil flow control plunger slid down into the pressure line, blocked the oil flow and prevented the pickup from turning.
After repairing the pump, the main seal started to leak. It was replaced but started leaking again for no apparent reason.

Rotor Torque Sensing Hub: The torque sensing hub did not keep adequate tension on the rotor drive belt, allowing it to slip. The cams were lacking grease, which may have caused it to react sluggishly. The hub was repacked and no further problems occurred.

Separator Clutch: The separator clutch overheated during rotor plugging. Later inspection showed the clutch had been severely damaged, and it was replaced.

Cylinder Drive Sheave: The inner half of the cylinder drive sheave broke loose from the splined tube and hub. No reason for the failure was apparent.

Straw Chopper Belt Tensioner: The idler sheave on the spring-loaded tensioner for the lower straw chopper belt had been installed in the wrong hole on its support arm. Also, the support arm had not been properly aligned. As a result, under load, the idler sheave moved down until it contacted the engine main drive belt. This prevented the idler from maintaining adequate tension and allowed the lower straw chopper belt to slip. This may have been a contributing factor in causing rotor plugging in rye crops. Eventually the sheave damaged the engine main drive belt causing it to break. The main drive belt in turn damaged the rotating union and connector on the separator clutch hydraulic line.

Once the idler sheave was properly positioned and the idler arm aligned, no further problems occurred. It is recommended that the manufacturer consider modifications to assure proper positioning and alignment of the lower straw chopper belt tensioner.

Cab Heater: From the beginning of the test the heater would not shut off completely even though the control was closed. The problem was overcome by interchanging the heater supply and return hoses.

Boost Pressure Line: When the engine was installed at the factory, the boost pressure line was pinched under one of the motor mounts which eventually wore a hole through the line. It was repaired and relocated, and no further problems occurred.

APPENDIX I
SPECIFICATIONS

MAKE:	Allis-Chalmers Self-Propelled Combine
MODEL:	Gleaner N7
SERIAL NUMBER:	Header - N-PI1087F-83-83 Body - N7GO3595HB3 Engine - 85-04487
MANUFACTURER:	Allis-Chalmers Corporation Combine Division Independence, Missouri
WINDROW PICKUP:	
-- make	Victory
-- type	rubber draper and transfer belts
-- pickup width	10 ft (3.0 m)
-- number of belts	7
-- teeth per belt	54
-- type of teeth	nylon
-- number of rollers	2 pickup, 2 transfer
-- height control	castor gauge wheels
-- speed control	variable speed hydraulic drive
-- speed range	0-452 ft/min (0-23 m/s)
HEADER:	
-- type	center feed
-- width	13 ft (3.9 m)
-- auger diameter	20 in (508 mm)
-- feed conveyor	2 stage, 9 roller chains, under-shot slatted conveyor
-- conveyor speed	
- upper conveyor	585 ft/min (3.0 m/s)
- lower conveyor	558 ft/min (2.8 m/s)
-- range of picking height	-6 to 50 in (-152 to 1270 mm)
-- number of lift cylinders	2
-- raising time	adjustable
-- lowering time	adjustable
-- options	table auger flight extensions, feeder reverser, corn and straight cut headers, hydraulic accumulator, feeder house extensions
STONE PROTECTION:	
-- type	spring loaded latch on door in front of concave
-- ejection	automatic with manual reset
ROTOR:	
-- crop flow	axial
-- number of rotors	1
-- diameter	25 in (630 mm)
-- length	
- feeding and threshing	6.6 ft (2.0 m)
- discharge	9.8 in (250 mm)
- total	7.4 ft (22 m)
-- drive	two speed gearbox with variable pitch belt
-- speeds	
- low range	225 to 515 rpm
- high range	480 to 1080 rpm
-- options	helical bars, chrome rasp bars
CONCAVE (THRESHING):	
-- number	1
-- type	bars separated by formed metal
-- number of bars	8
-- configuration	7 intervals with 1/4 in (6.5 mm) spacers and 5/8 in × 1 in (18 mm x 254 mm) openings
-- area total	601 in² (0.388 m²)
-- area open	201 in² (0.129 m²)
-- wrap	59 degrees
-- grain delivery to shoe	distribution augers and accelerator rolls filler bars, concave extension
CONCAVE (SEPARATING):	
-- number	1
-- type	perforated formed metal
-- area total	5835 in² (3.76 m²)

-- area open	2190 in² (1.41 m²)
-- wrap	380 degrees
-- grain delivery to shoe	distribution augers and accelerator rolls
-- options	cover plates, cage fingers
THRESHING AND SEPARATING CHAMBER:	
-- number of spirals	12
-- pitch of spirals	8 at 49 degrees and 4 at 22 degrees
STRAW CHOPPER:	
-- type	rotor with 12 freely swinging flails
-- width	10.75 in (273 mm)
-- speed	2235 rpm
SHOE:	
-- type	single action
-- speed	300 rpm
-- chaffer sieve	adjustable lip, 2360 in² (1.52 m² (with 1.3 in (32 mm) throw
-- chaffer extension sieve	adjustable lip, 400 in² (0.26 m²)
-- clean grain sieve	adjustable lip, 2305 in (1.49 m²) with 1.3 in (32 mm) throw
ACCELERATOR ROLLS:	
-- number	2
-- type	timed, rubber cogged rollers
-- width	81 in (1550 mm)
-- speed	1150 rpm
CLEANING FAN:	
-- type	transverse flow
-- diameter	11 in (280 mm)
-- width	82.5 in (1590 mm)
-- control	variable inlet
-- options	small seed kit
ELEVATORS:	
-- type	roller chain with rubber flights, top delivery
-- clean grain (top drip)	9 x 10.1 in (230 x 257 mm)
-- railings (top drive)	53 x 85 in (135 x 216 mm)
GRAIN TANK:	
-- capacity	300 bu (10.9 m³)
-- unloading time	190 sec
-- unloading auger diameter	12.3 in (312 mm)
-- options	perforated unloader tube, long unloader tube and down spout
STRAW SPREADER:	
-- number of spreaders	1
-- type	steel hub with 4 rubber pats
-- speed	270 rpm
ENGINE:	
-- make and model	Allis-Chalmers 8851
-- type	4 stroke, turbocharged and intercooled diesel
-- number of cylinders	8
-- displacement	516 m³ (8.46 L)
-- governed speed (full throttle)	2380 rpm
-- manufacturer's rating	270 hp (201 kW) @ 2200 rpm
-- fuel tank capacity	145 gal (659 L)
-- options	block heater
CLUTCHES:	
-- header	electro-magnetic
-- separator	electro-hydraulic
-- unloading auger	electro-hydraulic V-belt tightener
NUMBER OF CHAIN DRIVES:	8
NUMBER OF BELT DRIVES:	22
NUMBER OF GEARBOXES:	1
NUMBER OF PRELUBRICATED BEARINGS:	75
LUBRICATION POINTS:	
-- 10 hours	8
-- 50 hours	33
-- seasonal	8
TIRES:	
--front	30.5 x 32 R1, 12-ply
--rear	12.4 x 24, R1, 8-ply
TRACTION DRIVE:	
-- type	hydrostatic
-- speed ranges	
-1st gear	0 to 3.1 mph (0 to 5 km/h)
-2nd gear	0 to 6.4 mph (0 to 10.3 km/h)
-3rd gear	0 to 12.7 mph (0 to 20.4 km/h)
-4th gear	0 to 23.0 mph (0 to 37 km/h)

OVERALL DIMENSIONS:	
-- wheel tread (front)	10.0 to 3.1 m)
-- wheel tread (rear)	9.7 ft (2.9 m)
-- wheel base	11.4 ft (3.5 m)
-- transport height	11.1 ft (3.4 m)
-- transport length	28. I ft (8.5 m)
-- transport width	14.1 ft (4.3 m)
-- field height	12.6 ft (3.8 m)
-- field length	27.5 ft (8.3 m)
-- field width	14.1 ft (4.3 m)
-- unloader discharge height	11.0 ft (3.3 m)
-- unloader clearance height	10.6 ft (3.2 m)
-- unloader reach	11.2 ft (3.4 m)
-- turning radius	
- left	21.7 ft (6.6 m)
- right	21.7 ft (6.6 m)
MASS (EMPTY GRAIN TANK):	
-- right front wheel	9000 lb (4090 kg)
-- left front wheel	8850 lb (4020 kg)
-- right rear wheel	3700 lb (1680 kg)
-- left rear wheel	3700 lb (1680 kg)
TOTAL	25250 lb (11470 kg)

APPENDIX II
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 1979 to 1983.

FIGURE 19 shows capacity differences in Neepawa wheat for the five years. The 1983 Neepawa wheat crop shown in TABLE 7 had about average straw yield, below average grain yield, and below average grain and straw moisture content.

FIGURE 20 shows capacity differences in six-row Bonanza barley for 1981, 1982 and 1983, two-row Fergus barley for 1979 and two-row Hector barley for 1980. The 1983 Bonanza barley crops shown in TABLE 7 had above average straw yield, grain yield, grain moisture, and straw moisture. 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% Yield

	Crop Conditions									Capacity Results						
			Width of Cut		Crop Yield		Grain Moisture		MOG/G	MOG Feedrate		Grain Feedrate		Ground Speed		
	Crop	Variety	ft	m	bu/ac	t/ha	Straw %	Grain %	Ratio	lb/min	t/h	bu/h	t/h	mph	km/h	Loss Curve
1983	Barley	Bonanza	28	8.5	71.9	3.3	11.7	13.2	0.86	226	6.2	263	7.2	1.6	2.6	
	Barley	Bonanza	24	7.4	72.5	3.6	6.7	10.7	0.85	313	8.5	368	10.0	2.4	3.8	Fig. 20
	Wheat	Neepawa	27	8.2	40.3	2.9	5.1	10.0	1.01	340	9.3	337	9.2	2.6	4.2	Fig. 19
	Wheat	Columbus	41	12.5	36.7	2.7	7.9	11.3	1.36	425	11.6	313	8.5	1.6	2.6	
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. 20
	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. 19
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. 20
	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. 19
	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. 20
	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. 19
	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. 19
	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. 20

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

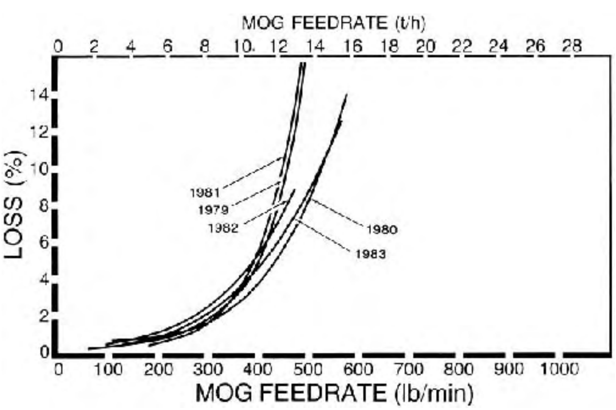

FIGURE 19. Total Gram Loss for the Reference Combine in Neepawa Wheat

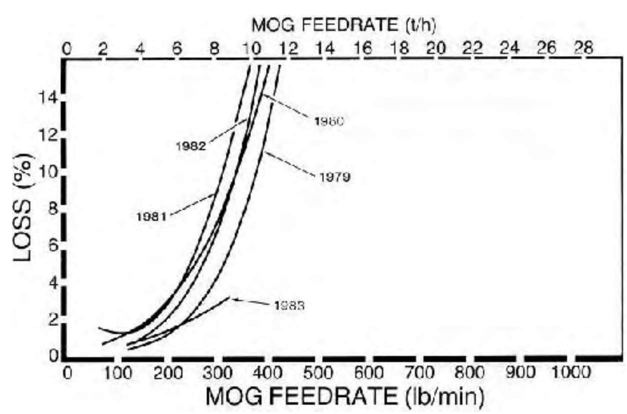

FIGURE 20. Total Grain Loss for the Reference Combine in Bonanza Barley

APPENDIX III
REGRESSION EQUATIONS FOR CAPACITY RESULTS

Regression equations for the capacity results shown in FIGURES 2 to 5 are presented in TABLE 8. In the regressions, U = unthreshed loss in percent of yield, S = shoe loss in percent of yield, R = rotor loss in percent of yield, F = the MOG feedrate in lb/min, while ln is the natural logarithm. Sample size refers to the number of loss collections. Limits of the regressions may be obtained from FIGURES 2 to 5 while crop conditions are presented in TABLE 3.

TABLE 8. Regression Equations

Crop - Variety	Figure Number	Regression Equations	Simple Correlation Coefficient	Variance Ratio	Sample Size
Barley - Bonanza	2	$U = 0.19 + 1.07 \times 10^{-3}F$ $S = 0.73 - 2.9 \times 10^{-3}F + 3.2 \times 10^{-6}F^2$ $\ln R = -2.55 + 5.63 \times 10^{-3}F$	0.89 0.89 0.99	22.15[2] 19.12[1] 305.38[2]	7
Barley - Bonanza	3	$U = 0.03 + 6.41 \times 10^{-2}F^2$ $S = 1.34 - 3.83 \times 10^{-3} + 5.93 \times 10^{-9}F^3$ $\ln R = -10.05 + 1.64/nF$	0.88 0.78 0.98	17.12[2] 3.14 113.33[2]	6
Wheat - Columbus	4	$U = 0.07 + 8.34 \times 10^{-2}F^2$ $S = 0.45 - 3.64 \times 10^{-4}F$ $\ln R = -2.44 + 3.73 \times 10^{-3}F$	0.84 0.72 0.95	14.67[2] 6.56[1] 55.42[2]	8
Wheat - Neepawa	5	$U = 0.07 + 6.10 \times 10^{-4}F$ $S = 1.33 - 1.56 \times 10^{-6}F^2$ $R = -1.16 + 4.93 \times 10^{-3}F$	0.92 0.92 0.96	28.18[2] 28.81[2] 62.83[2]	7

[1]Significant at $P < 0.05$
[2]Significant at $P < 0.01$

APPENDIX IV
Machine Ratings

The following rating scale is used in Machinery Institute Reports:

- excellent
- very good
- good
- fair
- poor
- unsatisfactory

APPENDIX V
CONVERSION TABLE

IMPERIAL UNITS	MULTIPLY BY	SI UNITS
Inches (in)	25.4	Millimetres (mm)
Mile/Hour (mph)	1.61	Kilometres/Hour (km/h)
Pound (lb)	0.454	Kilogram (kg)
Gallons (gal)	4 54	Litres (L)
Acres (ac)	0.405	Hectare (ha)
Horsepower (hp)	0.746	Kilowatt (kW)
Bushels (bu)		
-- Volume	0.0364	Cubic Metres (m^3)
-- Weight	0.0272	Tonnes (t) wheat
	0.0218	Tonnes (t) barley
	0.0227	Tonnes (t) rapeseed
	0.0254	Tonnes (t) rye

SUMMARY CHART

ALLIS-CHALMERS GLEANER N7 SELF-PROPELLED COMBINE

Retail Price - $165,898.00 (May, 1984, f.o.b. Humboldt, Sask.)

	EVALUATION	COMMENTS
CAPACITY		
Compared to Reference		
Combine -wheat	2 x reference	-at 3% total loss
-barley	2.5 x reference	-at 3% total loss
MOG Feedrates		
-wheat	-Columbus 850 lb/min (23.2 t/h)	-at 3% total loss
	-Neepawa 630 lb/min (17.2 t/h)	-at 3% total loss
-barley	-Bonanza 620 lb/min (16.9 t/h)	-at 3% total loss
	-Bonanza 680 lb/min (18.5 t/h)	-at 3% total loss
QUALITY OF WORK		
Picking	**Good**	-0 to 6 mph (0 to 9.6 km/h)
Feeding	**Fair**	-some hesitation at feeder inlet
Stone Protection	**Good**	-no damage to rotor or concaves
Threshing	**Very Good**	-cage covers required in wheat
Separating	**Very Good**	-cage fingers help separation in barley
Cleaning	**Good**	-should use small seed kit in small seed crops
Grain Handling	**Very Good**	-large capacity tank
Straw Spreading	**Fair**	-narrow spread for size of machine
EASE OF OPERATION AND ADJUSTMENT		
Comfort	**Very Good**	-good visibility, and quiet
Instruments	**Very Good**	-easy to read, alarm is too loud
Controls	**Very Good**	-push-button, convenient
Loss Monitor	**Fair**	-mainly for shoe loss
Lighting	**Good**	-good exterior lighting, poor cab lighting
Handling	**Very Good**	-brakes responsive, steering smooth, handles poorly at high transport speed
Adjustment	**Good**	-easily accessible
Setting	**Good**	-many combinations of settings and attachments to experiment with
Unplugging	**Very Good**	-auto header reverser, power unplugging for rotor
Cleaning	**Fair**	-difficult to clean around rotor
Lubrication	**Good**	-most points easily accessible
Maintenance	**Good**	-easy to work on
ENGINE AND FUEL CONSUMPTION		
Engine	**Good**	-adequate power -started poor in cold weather
Fuel Consumption	8.9 gal/h (40.4 L/h)	-average for season
OPERATOR SAFETY	**Very Good**	-well shielded but accessible
OPERATOR MANUAL	**Good**	well written

CAUTION:

This summary chart is not intended to present the final conclusions of the evaluation reports. The relevance of the ratings is secondary to the information provided in the full text of the report. It is not recommended that a purchase decision be based only on the summary chart.

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