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Evaluation Report 312

Claas Dominator 106 Self-Propelled Combine

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

CLAAS DOMINATOR 106 SELF-PROPELLED COMBINE

MANUFACTURER

Claas OHG
D-4834 Harswinkle, West Germany

DISTRIBUTOR

CLAAS of America Inc.
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Naicam, Saskatchewan
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RETAIL PRICE

$133,740.00 (April, 1983, f.o.b. Humboldt, with a 13 ft (3.9 m) header, 10 ft (3.2 m) Melroe 378 pickup, 28L x 26 R1 drive tires, 14.9 x 24 steering tires, straw chopper, header reverser, universal concave, slow speed cylinder drive, shaft speed monitors, grain loss monitor, and radio).

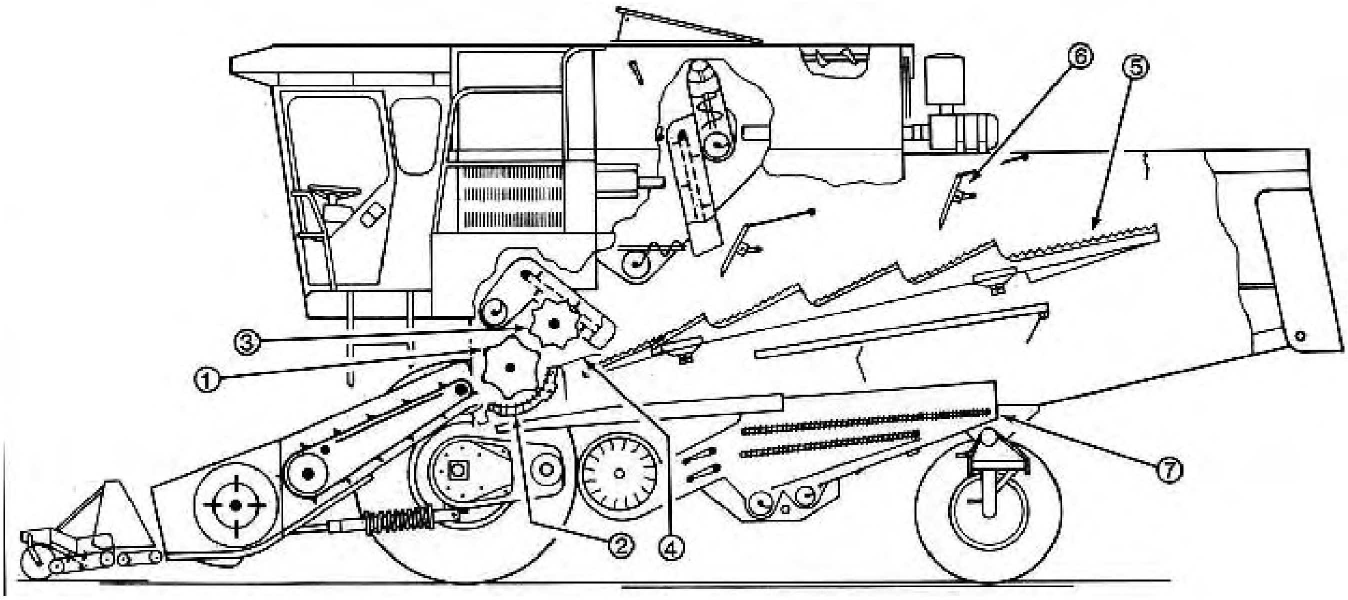

FIGURE 1. Claas Dominator 106: (1) Cylinder, (2) Concave, (3) Rear Beater, (4) Transition Grate, (5) Straw Walkers, (6) Straw Agitators, (7) Cleaning Shoe.

SUMMARY AND CONCLUSIONS

Functional Performance: Functional performance of the Claas Dominator 106 was very good in dry and tough cereal grain crops and rapeseed.

Capacity: The MOG Feedrate* at 3% total grain loss varied from 348 lb/min (9.5 t/h) in 37 bu/ac (2.5 t/ha) Neepawa wheat to 660 lb/min (18.0 t/h) in 50 bu/ac (3.4 t/ha) Neepawa wheat.

The capacity of the Claas Dominator 106 compared to that of the Machinery Institute reference combine at 3% total grain loss was about 2 times greater in barley and 1.5 to 2 times greater in wheat.

Grain loss limited combine capacity in all crops encountered. Grain loss due to incomplete threshing was low in most crops but became signi cant in very hard-to-thresh wheat crops. Grain loss over the straw walkers usually limited capacity in barley but was much lower in wheat crops. Shoe loss was usually low.

Ease of Operation: The Claas combine was convenient to operate. Forward and side visibility was good, but rear visibility was restricted to the use of rear view mirrors. The steering was smooth, easy, and responsive; however, cornering was inconvenient due to the excessive steering wheel rotation required. The wheel brakes were positive and aided in cornering. Combine maneuverability and handling were good in the eld and while transporting. Lighting for harvesting at night was good. Most instruments and controls were conveniently located, easy to use and responsive; however, many controls were not clearly marked. The cab was relatively dust free. The heater and air conditioner provided comfortable cab temperatures in all conditions. Operator station sound level was about 85 dBA. At medium to high feedrate, threshing noise was annoying.

The engine started easily and ran well. It had ample power for harvesting in all conditions encountered. The average fuel consumption for the test season was about 4.6 gal/h (21 L/h).

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

The pickup picked well in most crops and fed the crop under the table auger. The table auger plugged occasionally in bunchy windrows. The optional header reverser quickly and easily cleared slugs from the table auger. The feeder conveyor was aggressive and seldom plugged; however, the feeder conveyor chains frequently skipped out of time. The stone trap effectively stopped most stones and roots from entering the cylinder. Cleaning the stone trap was dirty. The cylinder was aggressive and seldom plugged. Unplugging the cylinder was fairly easy. Occasionally, straw speared in the cleaning shoe, but was easily removed.

The straw chopper cut and spread straw evenly over about 15 ft (4.6 m). The ease of disengaging the straw chopper to permit windrowing the straw was excellent. The unloading auger was easy to position for unloading. It had ample reach and clearance for all trucks and trailers, but the high discharge increased the dif culty of unloading on-the-go.

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

Ease of Adjustment: Ease of adjusting the components on the Claas Dominator 106 was very good. Cylinder speed, pickup speed, and concave clearance were adjusted from within the cab and could be varied on-the-go. Fan speed, wind board position, and shoe settings had to be made on the machine.

Ease of setting the machine to suit most crop conditions was fair. The return tailings could not be easily sampled and the grain sample was inconvenient to check. The shoe required considerable experimenting to become familiar with the affects of the numerous adjustments available.

Operator Safety: The Claas Dominator 106 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: Only a few minor mechanical problems occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Clearly identifying all controls.
2. Modifications to improve the ease of operating the unloading auger swing control and to increase the unloading auger swing-out speed.
3. Modifications to make the hydrostatic lever more comfortable to operate.
4. Modifications to improve grain tank and unloading auger lighting.
5. Modifications to reduce the amount of steering wheel rotation required for cornering.
6. Modifications to eliminate interference between the wing nuts and the tabs on the clean grain and tailing auger access panels.
7. Modifications to permit increased oil flow through the filler spouts on the hydraulic and hydrostatic reservoirs for easier filling.
8. Modifications to facilitate draining the hydraulic reservoir.
9. Supplying a safe convenient mechanism to permit sampling the return tailings while harvesting.
10. Improving the ease of removing and installing shields, which are presently bolted in place.
11. Supplying additional hand railing to improve the safety and ease of using the cab access ladder.
12. Modifications to reduce sprocket wear on the pickup hydraulic pump drive.
13. Changing the suggested lubrication interval of the shoe shaker arm bearings from 50 hours to 10 hours.
14. Modifications to prevent dirt and chaff build-up in the cylinder drive variable pitch sheave.
15. Modifications to prevent the feeder conveyor chain from skipping out of time.

Senior Engineer: G. E. Frehlich

Project Technologist: L. G. Hilt

THE MANUFACTURER STATES THAT:

With regard to recommendation number:

1. No action wilt be taken at this time to improve controls. Improvements will be made to any new designs.
2. The auger swing-out speed will be increased beginning with 1983 production. Improvement in operation is being evaluated.
3. Modifications to the hydrostatic lever to make it more comfortable to operate are being investigated.
4. New light kits are included to illuminate the unloading auger. A better grain tank light is being investigated.
5. Improvements to reduce the amount of steering wheel rotation for cornering will be available during 1983.
6. Methods to eliminate interference between the wing nuts and the tabs on the clean grain and tailings auger access panels are being investigated.
7. Currently, there are no plans to modify the hydraulic and hydrostatic reservoirs for improved filling.
8. There are no current plans to modify the hydraulic reservoir to facilitate draining. The operator manual recommends draining the system through the steering cylinder on the rear axle since this is the lowest point in the system.
9. There are no current plans to provide a mechanism for sampling the tailings.
10. No immediate changes are being planned. Removal of shields is very seldom requested.
11. Additional handrails for ease of using the cab access ladder are being investigated.
12. This recommendation has been referred to the pickup manufacturer for a solution.
13. Shoe shaker arm bearings for 1983 have been changed and seals improved so that 50 hour lubrication intervals should be adequate.
14. .Modifications have been made to prevent dirt and chaff build-up in the cylinder drive variable pitch sheave.
15. Changes have been made to prevent the feeder conveyor chain from skipping out of time.

GENERAL DESCRIPTION

The Claas Dominator 106 is a self-propelled combine with a transverse mounted, tangential threshing cylinder, concave, straw walkers, straw agitators, and cleaning shoe. Threshing and initial separation occur at the cylinder and concave, while the straw walkers complete final separation of grain from straw. The grain is cleaned at the shoe and the tailings returned to the cylinder.

The test machine was equipped with a 200 hp (150 kW) turbocharged, six cylinder Mercedes diesel engine, 13 ft (3.9 m) header, 10 ft (3.2 m) Melroe 378 pickup, straw chopper and other optional equipment listed on page 2.

The Claas Dominator 106 has a pressurized operator's cab, power steering, hydraulic wheel brakes, and a hydrostatic traction drive. The separator and header drives are hydraulically engaged while the unloading auger is manually engaged. Header height and unloading auger swing are hydraulically controlled. Cylinder and pickup speed, and concave clearance may be adjusted from within the cab. The fan speed and shoe settings are adjusted on the machine.

The return tailings cannot be easily sampled. Most component speeds and harvest functions are monitored in the cab. Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Claas Dominator 106 was operated for 137 hours while harvesting about 1447 ac (586 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 manual. Throughout the tests, comparisons were made to the Machinery Institute reference combine.

TABLE 1. Operating Conditions

		Average Yield		Swath Width			Field Area	
Crop	Variety	bu/ac	t/ha	ft	m	Hours	ac	ha
Barley	Bonanza	50	2.7	20, 24, 28, 50	6.1, 7.3, 8.5, 15.2	17.5	173	70
Barley	Elrose	35	1.9	18, 40, 50	5.5, 12.2, 15.2	12.5	158	63
Rapeseed	Regent	23	1.3	24, 28	7.3, 8.5	22.5	269	109
Rye	Puma	30	1.9	20, 24, 40	6.1, 7.3, 12.2	47.0	519	210
Wheat	Benito	37	2.5	50	15.2	3.0	35	14
Wheat	Neepawa	31	2.1	18, 20, 24, 40, 50	5.5, 6.1, 7.3, 12.2, 15.2	23.5	185	75
Wheat	Park	30	2.0	24	7.3	3.0	27	11
Wheat	Sinton	37	2.5	15, 28	4.8, 8.5	8.0	84	34
Total						137.0	1447	566

TABLE 2. Operation in Stony Fields

		Field Area (ha)	
Field Condition	**Hours**	**ac**	**ha**
Stone Free	70	694	281
Occasional Stones	47	528	214
Moderately Stony	20	225	91
Total	137	1447	586

RESULTS AND DISCUSSION

EASE OF OPERATION

Operator Location: The Claas Dominator 106 was equipped with an operator's cab positioned ahead of the engine compartment and centered on the combine body. Side visibility was very good, but long range forward visibility was restricted by the upper console. Rear visibility was restricted. The large curved rear view mirrors greatly improved rear visibility. View of the incoming windrow was good. The steering wheel and column partially blocked visibility of the table auger. Leaning forward and to the right provided a better view but was uncomfortable (FIGURES 2 and 3). The grain in the grain tank was not clearly visible from the cab.

The seat was comfortable and could be adjusted to suit most operators. Leg room was limited. The steering column was adjustable but awkward to lock. The steering wheel angle was uncomfortable for some operators. Incoming air was effectively filtered while the fans pressurized the cab to reduce dust leaks. The air conditioner and heater provided comfortable cab temperatures.

Operator station sound level was about 85 dBA. At medium to high feedrates, threshing noise became prevalent and was annoying.

Controls: The control arrangement is shown in FIGURES 4, 5, and 6. Most controls were conveniently located and easy to operate. Some were difficult to identify as they were not marked. It is recommended that the manufacturer consider clearly identifying all controls.

The separator and header levers, which hydraulically engaged the drives, took a while to become accustomed to, as there was no "feel" for the response.

FIGURE 2. Normal View of Incoming Windrow.

FIGURE 3. View of incoming Windrow when Leaning Forward and to the Right.

FIGURE 4. Controls to the Right of the Operator.

Swinging the unloading auger out was inconvenient. Twisting the small control knob (FIGURE 5) was difficult and the auger swung slowly.

It is recommended that the manufacturer consider modifications to improve the ease of operating the unloading auger swing control and to increase the unloading auger swing-out speed.

The header lift on the hydrostatic lever was convenient to use and header lift and drop rates were adequate for most conditions encountered. The hydrostatic lever was too short and located too far rearward for comfortable operation. It is recommended that the manufacturer consider modifications to make the hydrostatic lever more comfortable to operate.

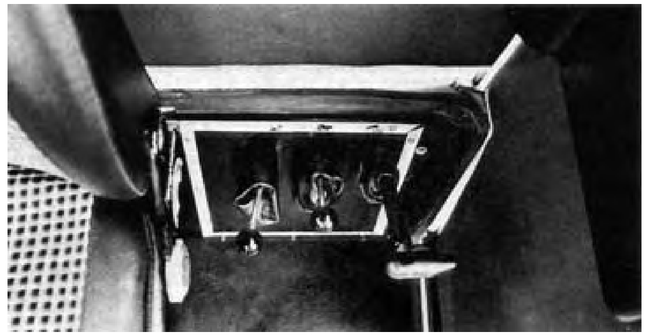

FIGURE 5. Controls to the Left of the Operator.

FIGURE 6. Central Control Column.

Instruments: The main instrument cluster was very conveniently located on the steering column (FIGURE 6). It contained a fuel gauge, engine temperature gauge, warning lights, and a tachometer which could be switched to display cylinder or transmission input shaft speed. The warning lights indicated four-way flasher operation, turn signal operation, low engine oil pressure, low battery charge, park brake engagement, grain tank nearly full and full, inadequate thresher engagement, and speed reduction of most major component drives. An audio alarm sounded in conjunction with lights for low engine oil pressure, restricted air cleaner, engaged park brake and a speed reduction of any of the monitored drives.

Loss Monitor: Full width board sensors were located behind the chaffer and straw walkers. The monitor displayed shoe loss with one row of lights and walker loss with another row. As the loss increased, the number of lights illuminated in each row increased. The lights were very bright and annoying at night. The monitor could not detect air borne losses but was effective in indicating changes in mechanical loss. The monitor reading was meaningful only if it was compared to actual losses observed behind the combine.

Lights: The combine was equipped with four front lights, an unloading auger light, a rear light, a grain tank light, tail light, and warning lights. The front and rear lights provided good lighting for harvesting at night. The grain tank light was too dim to provide adequate light. The unloading auger light was poorly located, as the unloading auger cast a shadow on the grain discharge. It is recommended that the manufacturer consider improving the grain tank lighting and relocating the unloading auger light.

The combination signal and warning lights, and the taillight were adequate for safe road travel. Instrument lighting was good. The interior light was very bright and shone in the operator's eyes.

Engine: The engine started easily and ran well. It had adequate power for operating in all conditions.

Average fuel consumption was about 4.6 gal/h (21 L/h). Oil consumption was insignificant. The fuel tank inlet was located 7.5 ft (2.3 m) above ground level and could usually be filled from average height gravity fuel tanks.

The radiator rotary inlet screen prevented radiator plugging. The engine air intake used an aspirated pre-cleaner and a single dry element filter. The filter element required periodic cleaning.

Maneuverability: The Claas Dominator 106 was quite maneuverable. The steering was smooth, easy, and responsive but the steering wheel had to be turned many revolutions to turn a corner. It is recommended that the manufacturer consider modifications to reduce the amount of steering wheel rotation required for cornering. The wheel brakes were positive and aided turning, but were not usually necessary for picking around most windrow corners. On difficult-to-pick corners, the hydrostatic drive made backing up quick and easy.

Stability: The combine was very stable in the field, even with a full grain tank. Normal caution was required when operating on hillsides and when travelling at transport speeds. The combine transported well, however, transport speed was relatively slow at 14.5 mph (23 km/h).

Grain Tank: The Claas Dominator 106 had a 180 bu (6.5 m³) enclosed grain tank. The tank filled completely in all crops. The grain entering the tank was difficult to observe as the windows between the cab, engine compartment, and grain tank quickly became dirty, reducing visibility. Also, the grain tank light was too dim to provide adequate lighting at night or when the lid was closed. Although the grain level in the tank was difficult to see, the two bin level sensors warned the operator of a nearly full and completely full grain tank.

The unloading auger had ample reach and clearance for unloading into most trucks and grain trailers (FIGURE 7), however, the high discharge made unloading on-the-go difficult. A flexible down spout would improve the ease of unloading on-the-go, as swinging the auger back, although reducing the discharge height, also reduced the reach, clearance, and visibility of the discharge. The unloading auger delivered a compact stream of grain, unloading a full tank of dry wheat in about 100 seconds.

FIGURE 7. Unloading.

Pickup: The Claas Dominator 106 was equipped with a 10.5 ft (3.2 m) hydraulically driven Melroe 378 windrow pickup. It is a two roller pickup with rubber drapers, steel teeth, an intermediate transfer draper, and a windguard. The picking height was set by the castor wheel adjustment. Picking angle was determined by the support chains and header height while pickup speed was adjusted from the cab.

The pickup performed well in most crops at speeds up to 5 mph (8 km/h). The sprocket on the hydrostatic pump had to be changed for faster ground speeds. In rapeseed the windguard had to be removed to prevent bunching and excessive shelling.

Stone Protection: A stone trap was located in front of the cylinder. It was effective in collecting most stones and roots, preventing them from entering the cylinder. The stone trap access was inconvenient and dirty to clean.

Straw Chopper: The straw chopper attachment performed well in all crops encountered. It spread straw uniformly over a width of about 15 ft (4.6 m). The straw chopper could be easily changed without removing it to permit windrowing the straw.

Plugging: The table auger and feeder were aggressive and seldom plugged. If plugged they were easily cleared using the header power reverser. The cylinder was aggressive and seldom plugged. Unplugging the cylinder was inconvenient but not difficult. The rear of the concave was easily lowered and in some conditions the slug could be powered through. In severe conditions, reversing the cylinder was inconvenient. The cylinder could be turned only a small amount before the bar had to be repositioned on the hub provided (FIGURE 8).

Machine Cleaning: Cleaning the Claas Dominator 106 completely for combining seed grain was laborious and time consuming. The grain tank was easy to clean and protected from the weather. Access to the grain tank was limited. The shoe grain delivery pan was difficult to clean. The chaffer and sieves were easy to remove. The clean grain and tailings cross augers had access panels but the wing nuts securing the panels interfered with the edge of the tabs (FIGURE 9) and were difficult to remove. It is recommended that the manufacturer consider modifications to prevent interference between the fasteners and tabs on the clean grain and tailing cross auger panels. The exterior of the combine was easy to clean.

FIGURE 8. Cylinder Reversing Hub.

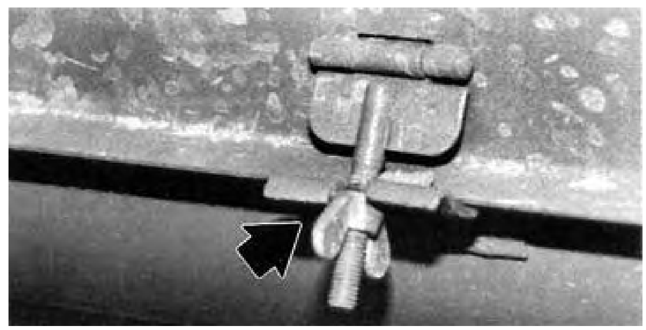

FIGURE 9. Interference Between Wing Nuts and the Tabs on the Clean Grain and Tailing Auger Access Panels.

Lubrication: The combine had 52 pressure grease fittings. Eight required greasing every 10 hours, twenty-one every 50 hours, fifteen every 100 hours, and eight once a season. Two other points required grease application every 10 hours and one every 50 hours. Most grease fittings were easily accessible. The engine, hydraulic, and hydrostatic oil levels required periodic checking. Adding oil to the hydraulic and hydrostatic reservoirs was inconvenient due to restricted oil flow through the filler spouts. It is recommended that the manufacturer consider modifications to the filler spouts on the hydraulic and hydrostatic reservoirs to improve the ease of filling. The hydraulic reservoir drain plug was inaccessible. It is recommended that the manufacturer consider modifications to facilitate draining the hydraulic reservoir.

EASE OF ADJUSTMENT

Field Adjustment: The Claas Dominator 106 was easy to adjust and could be set by one person. Concave clearance and cylinder speed were adjusted from within the cab. Fan speed, wind board position, and shoe settings were adjusted on the machine. The clean grain sample was difficult to see and the return tailings could not be inspected while harvesting. It is recommended that the manufacturer consider supplying a safe convenient mechanism to permit sampling the return tailings while harvesting.

Concave Adjustment: The single segment universal concave was levelled and proportioned with draw bolts at each corner of the concave. Large access panels provided easy access for checking concave clearance. Initial settings with the large concave adjusting lever in the third hole from the top and the small lever in the top hole (FIGURE 10) were 0.50 in (13 mm) at the front and 0.12 in (3 mm) at the rear. The concave adjusting levers could be set to provide clearances of 0.47 to 1.56 in (12 to 40 mm) at the front and 0.04 to 1.29 in (1 to 34 mm) at the rear. The main concave lever opened the front and rear equally, while the small lever adjusted the rear of the concave only. The concave was also equipped with two sets of "disawning plates" or filler bars which could be engaged, from the outside of the machine. They covered the first three or five spaces of the concave.

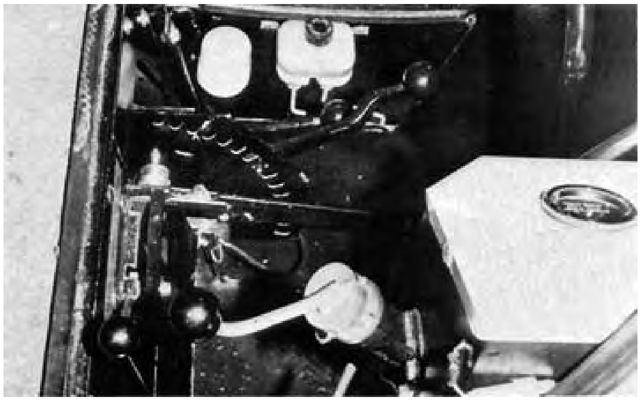

FIGURE 10. Concave Adjusting Levers.

Suitable concave clearances were 0.47 to 0.59 in (12 to 15 mm) at the front and 0.04 to 0.2 in (1 to 5 mm) at the rear in wheat, 0.47 to 0.79 in (12 to 20 mm) front and 0.04 to 0.40 in (1 to 10 mm) rear in barley, 0.60 to 1.0 in (15 to 25 mm) front and rear for rapeseed, and 0.60 to 0.70 in (15 to 18 mm) front and 0.40 in (10 mm) rear in fall rye. In some wheat and barley crops the first three disawning plates were engaged.

Cylinder Adjustment: The combine was equipped with the optional slow speed cylinder drive kit. The cylinder was chain driven while the cylinder speed was controlled through an intermediate variable pitch belt drive. The slow speed drive kit provided speed ranges from 570 to 1300 rpm and 290 to 660 rpm.

Suitable cylinder speeds for threshing were 1000 to 1300 rpm in wheat, 1000 to 1200 rpm in rye, 1000 to 1100 rpm in barley and 800 to 900 rpm in rapeseed.

Shoe Adjustment: The shoe was convenient to adjust. The chaffer and sieve were adjusted with levers at the rear of the machine. Fan blast was varied by a crank on the left side of the machine. The direction of the blast was controlled by two wind boards which were adjusted on the left side of the machine. Adjusting the shoe to suit crop conditions was often time consuming as there were many combinations of fan speed, wind board position, and chaffer and sieve openings. Once familiar with the shoe behavior suitable settings were easier to determine.

Header Adjustment: The Claas Dominator 106 was tested only with a windrow pickup header. The header table could be easily removed in about 10 minutes by one person. Complete header and feeder assembly removal took about 30 minutes and required appropriate header support jacks (not supplied).

Adjustments were provided for auger finger timing, feeder chain tension, front feeder drum position, levelling the header, and limiting table auger travel.

Slip Clutches: Individual slip clutches protected the table auger, feeder conveyor, and return elevator.

RATE OF WORK

Average Workrates: TABLE 3 presents average workrates for the Claas Dominator 106 in all crops harvested during the test. Average workrates are affected by crop conditions, windrow quality, field conditions and availability of grain handling equipment; therefore, they should not be used to compare combines tested in different years. Average workrates varied from 225 bu/h (5.1 t/h) in 19 bu/ac (1.1 t/ha) Regent rapeseed to 455 bu/h (12.4 t/h) in 37 bu/ac (2.5 t/ha) Benito wheat.

Maximum Feedrate: The workrates in TABLE 3 represent average workrates at acceptable loss levels. In most crops higher feedrates could be obtained when operating at the engine power limit. The maximum acceptable feedrate was limited by grain loss 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 specified total loss level. Many crop variables affect combine capacity. Crop type and variety, grain and straw yield and moisture contents, local climatic conditions and windrow quality cause capacity variations.

TABLE 3. 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	48	2.6	1.6 to 4.4	2.6 to 6.5	10.0	4.0	480	10.5
Barley	Elrose	33	1.8	2 to 5.7	3.2 to 9.1	12.0	4.9	417	9.1
Rapeseed	Regent	19	1.1	3.6 to 4.0	5.8 to 6.7	12.0	4.9	225	5.1
Rye	Puma	28	1.8	12.3 to 4.6	3.7 to 7.4	11.0	4.5	318	8.1
Wheat	Benito	37	2.5	2	3.2	12.0	4.9	455	12.4
Wheat	Neepawa	31	2.1	1.9 to 5.3	3.1 to 8.5	11.5	4.7	370	10.1
Wheat	Park	30	2.0	3	4.8	8.5	3.5	253	6.9
Wheat	Sinton	31	2.1	3 to 5.8	5.2 to 9.2	11.0	4.4	345	9.4

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

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

Grain losses from a combine are 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 percent of the total grain passing through the combine.

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

Capacity of the Claas Dominator 106: TABLE 4 presents capacity results for the Claas Dominator 106 in six different crops. MOG Feedrates at a 3% total grain loss varied from 348 lb/min (9.5 t/h) in 37 bu/ac (2.5 t/ha) Neepawa wheat to 660 lb/min (18 t/h) in 51 bu/ac (3.41 t/ha) Neepawa wheat.

GRAIN LOSS CHARACTERISTICS

The grain loss characteristics for the Claas Dominator 106 in the six crops described in TABLE 4 are presented in FIGURES 11 to 16.

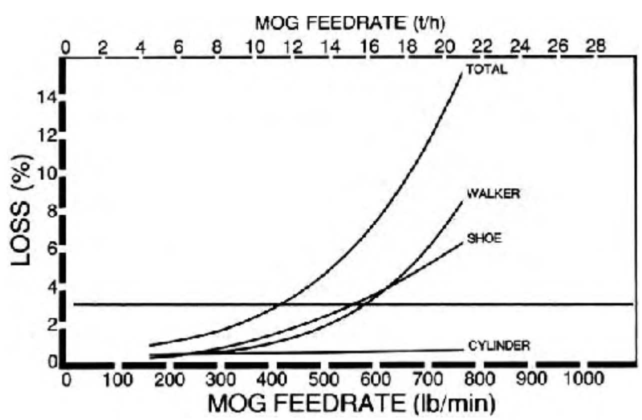

FIGURE 11. Grain Loss in Bonanza Barley (A).

Walker Loss: Grain loss over the straw walkers limited combine capacity in most barley crops. Walker loss did not limit capacity in wheat crops but would have been significant if cylinder loss had been reduced. In the wheat crops tested, the straw walkers had

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 (A)	Bonanza	28	8.5[1]	71	3.81	23.8	12.4	0.79	422	11.5	667	14.6	0.5	1.5	Fig. 11
Barley (B)	Bonanza	50	15.2[2]	60	3.23	10.9	13.1	0.59	473	12.9	1002	21.9	0.5	1.0	Fig. 12
Wheat (C)	Neepawa	40	12.2[2]	39	2.61	10.6	13.6	0.74	557	15.2	753	20.5	1.0	1.5	Fig. 13
Wheat (D)	Neepawa	40	12.2[2]	37	2.50	9.9	14.4	0.78	348	9.5	447	12.2	1.5	2.5	Fig. 14
Wheat (E)	Neepawa	50	15.2[2]	48	3.22	6.8	12.0	0.81	642	17.5	792	21.6	1.5	2.0	Fig. 15
Wheat (F)	Neepawa	25	7.6[1]	51	3.41	6.0	11.7	0.85	660	18.0	777	21.2	2.0	3.0	Fig. 16

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

similar loss characteristics in single, side-by-side double, and double overlapped windrows. The affects of the straw agitator on walker performance were not determined.

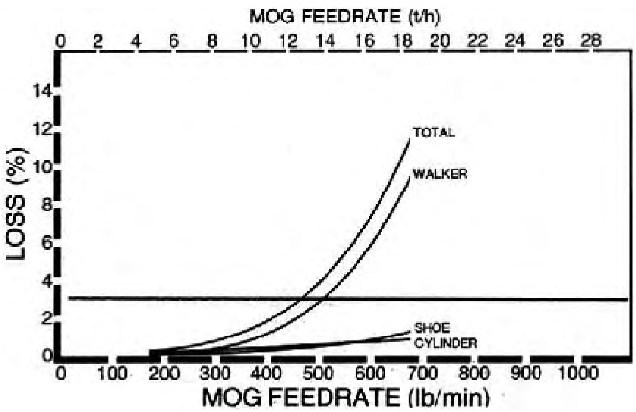

FIGURE 12. Grain Loss in Bonanza Barley (B).

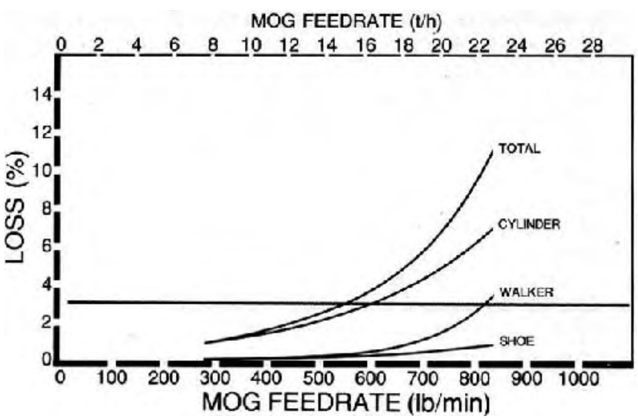

FIGURE 13. Grain Loss in Neepawa Wheat (C).

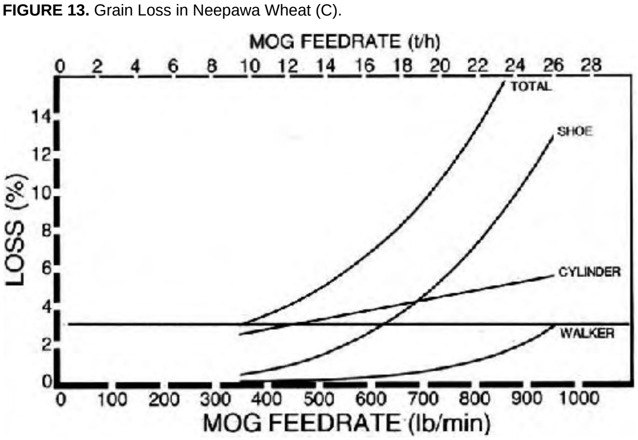

FIGURE 14. Grain Loss in Neepawa Wheat (D).

Shoe Loss: When the shoe was adjusted for optimum performance shoe loss did not limit combine capacity, but was occasionally signi cant.

The shoe performed well in most crops encountered. The grain sample was clean with average dockage of about 1.5 to 3% in most crops.

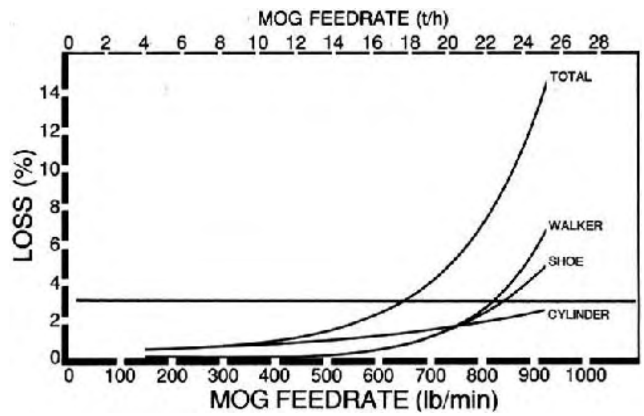

FIGURE 15. Grain Loss in Neepawa Wheat (E).

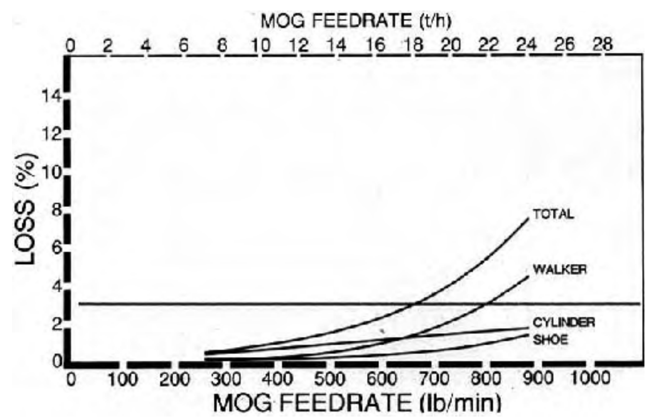

FIGURE 16. Grain Loss in Neepawa Wheat (F).

The shoe was subject to spearing especially on the left side (FIGURES 17 and 18). Spearing occurred most often in rapeseed, and if not cleaned periodically, shoe loss increased greatly. At the end of the test it was discovered that the left panel under the shoe was not properly engaged (FIGURE 19). This may have affected the air ow causing a greater amount of spearing on the left.

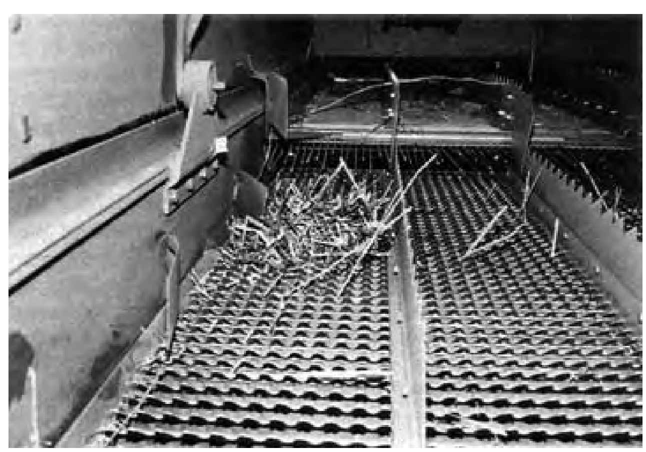
FIGURE 17. Straw Spearing in the Chaffer.

FIGURE 18. Straw Spearing on the Sieve.

FIGURE 19. Incorrectly Installed Panel (1).

Cylinder Loss and Grain Damage: Cylinder loss was low in easy-to-thresh crops, but was significant in hard-to-thresh crops and occasionally limited capacity. In hard-to-thresh wheat crops, grain cracks in the tank were only about 1 to 2%. 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 capacity while still keeping grain cracks to an acceptable level.

Body Loss: A small amount of grain leaked around the clean grain elevator door. The door was modified and no further leaking occurred.

Comparison to Reference Combine: Comparing combine capacities is complex because crop and growing conditions affect combine performance with the result that slightly different capacity characteristics can be expected every year. As an aid in determining relative combine capacities, the Machinery Institute uses a reference combine. This combine is operated alongside test combines whenever capacity measurements are made. This permits the comparison of loss characteristics of every test combine to those of the reference combine, independent of crop conditions. The reference combine used by the Machinery Institute is commonly accepted in the prairie provinces and is described in Evaluation Report No. 27. See APPENDIX II for the reference combine capacity results.

FIGURES 20 to 25 compare the total grain losses of the Claas Dominator 106 and the reference combine in the six crops described in TABLE 4. The shaded areas on the figures are 95% confidence belts. If the shaded areas overlap, the loss characteristics of the two combines are not significantly different, whereas if the shaded areas do not overlap, losses are significantly different.

The capacity of the Claas Dominator 106 was much greater than the reference combine capacity in wheat and barley. At 3% total loss, the capacity of the Claas was about 2 times that of the reference in barley and about 1.5 to 2 times greater in wheat.

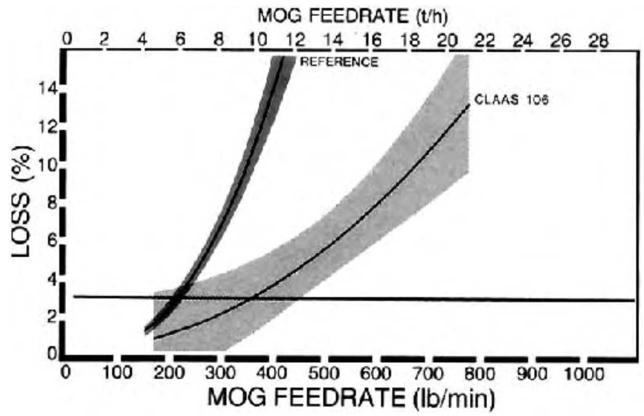

FIGURE 20. Total Grain Loss in Bonanza Barley (A).

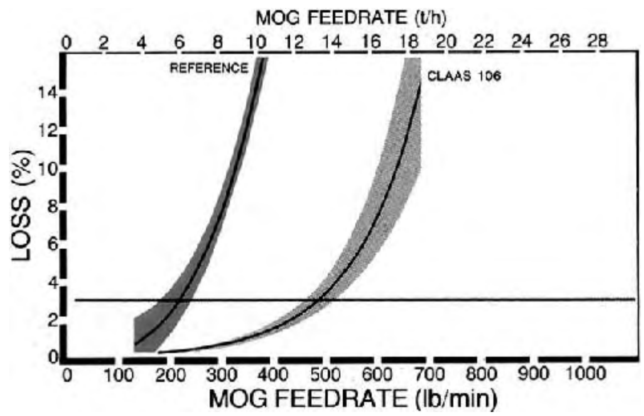

FIGURE 21. Total Grain Loss in Bonanza Barley (B).

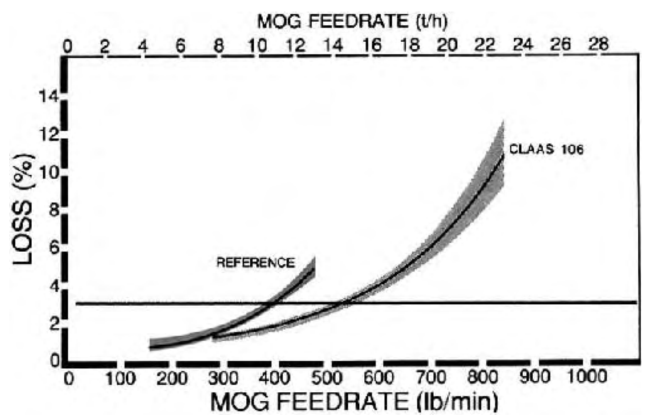

FIGURE 22. Total Grain Loss in Neepawa Wheat (C).

OPERATOR SAFETY

The operator manual briefly emphasized operator safety.

Moving parts were well shielded. Most shields were hinged and had locks to hold them open. Shields, which were bolted in place, such as the shield on the left side of the feeder, were inconvenient to remove and install. It is recommended that the manufacturer consider improving the ease of removing and installing shields, which are presently bolted in place.

The rear view mirror mounting was often used to assist the operator to climb the ladder to the cab. The mirror mounting easily moved and could have caused a serious fall. It is recommended that the manufacturer consider supplying additional hand railing to improve the safety and ease of climbing the ladder to the cab.

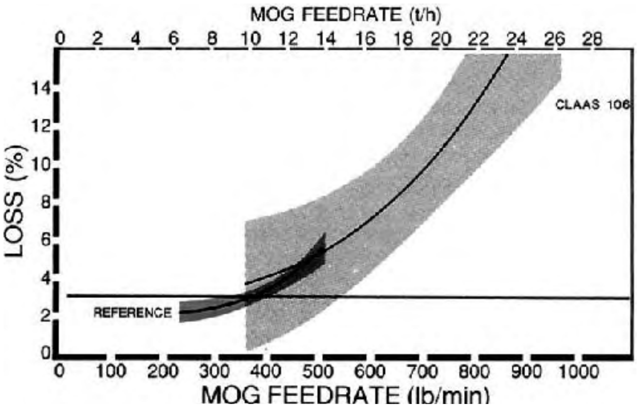

FIGURE 23. Total Grain Loss in Neepawa Wheat (D).

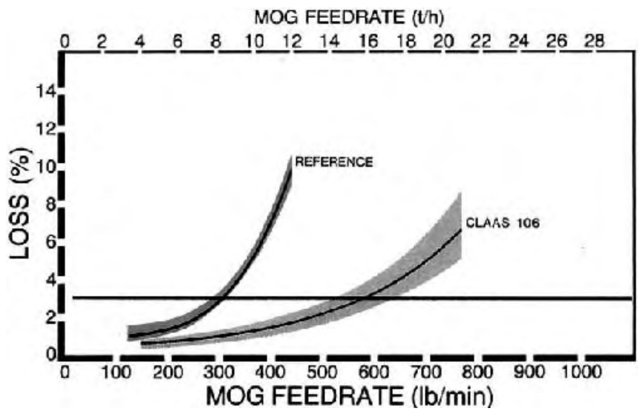

FIGURE 24. Total Grain Loss in Neepawa Wheat (E).

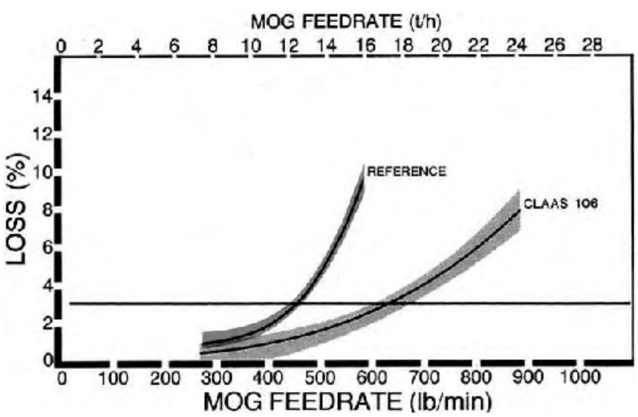

FIGURE 25. Total Grain Loss in Neepawa Wheat (F).

Caution was required when working on the rear hood of the combine. Stepping on the sloped section could easily cause the operator to fall.

A header lock was provided and should be used when working near the header or when leaving the combine unattended. This is especially important as the header can be lowered even when the engine is stopped.

Machine adjustments could be made safely, however, adjusting the fan speed and wind boards should not be attempted on-the-go. All clutches should be disengaged and the engine shut off before attempting to manually clear obstructions.

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

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

OPERATOR MANUAL

The operator manual was clearly written, well illustrated, and well organized. It contained much useful information on safe operation, controls, adjustment, crop settings, servicing, and machine specifications.

DURABILITY RESULTS

MECHANICAL HISTORY

TABLE 5 represents the mechanical history of the Claas Dominator 106 during the 137 hours of field operation while harvesting 1448 ac (586 ha). The intent of the test was functional performance. Extended durability testing was not conducted.

DISCUSSION OF MECHANICAL FAILURES

Thresher Drive Belt Replacement: Replacing the thresher drive belt was very inconvenient. Five sets of belts, a hydraulic line, and the belt guides had to be removed to install a new drive belt. Access to the belts was restricted and many drives did not have adequate adjustment for easy belt removal while others were very difficult to retension.

Pickup Hydraulic Pump Sprocket: The pickup hydraulic pump sprocket wore quickly, especially when the small sprocket was used for higher pickup speeds. It is recommended that the manufacturer consider modifications to reduce sprocket wear on the pickup hydraulic pump drive.

TABLE 5. Mechanical History

Item	Operating Hours	Field Area ac	(ha)
Drives:			
-The thresher drive belt broke and was replaced at	31	333	(135)
-A bearing on the shoe shaker arm failed and was replaced at	51	545	(220)
-The sprocket on the hydraulic pump for the pickup was worn and replaced at	81	849	(343)
-The worn cylinder drive chain was replaced at	122	1226	(495)
-The cylinder variable sheave housings clogged with grease and dirt and were cleaned at	130	1317	(532)
Electrical:			
-A bundle of electrical wires was rubbed through by a straw chopper belt and repaired at	91	904	(366)
Miscellaneous:			
-The feeder conveyor chains skipped out of time and had to be retimed at	48, 72, 115	525, 751, 1153	(212), (303), (466)
-The feeder conveyor slats came loose and lost bolts were replaced at	115	1153	(456)
-The feeder conveyor front drum shield broke loose at	115	1153	(466)
and was repaired at the		end of the test	

Shoe Shaker Bearings: The bearing failure on the left shoe shaker arm may have been caused by inadequate lubrication. It is recommended that the manufacturer consider changing the suggested lubrication interval of the shoe shaker arm bearings from 50 hours to 10 hours.

Cylinder Variable Sheave: Chaff and dirt mixed with grease and built up in the housings of the variable speed sheaves preventing the sheaves from completely opening and closing. It is recommended that the manufacturer consider modifications to prevent dirt and chaff build-up in the cylinder drive variable pitch sheaves.

Feeder Conveyor Chain: The sides of the feeder chain repeatedly skipped out of time even when the chain was properly tensioned. It is recommended that the manufacturer consider modifications to prevent the feeder conveyor chain from skipping out of time.

APPENDIX I
SPECIFICATIONS

MAKE:	Claas Self-Propelled Combine
MODEL:	Dominator 106
SERIAL NUMBER:	Body - 14300037 Series 143 Engine - 401-901-000-223692
MANUFACTURER:	Claas OHG Harswinkel, West Germany
WINDROW PICKUP:	
-- make	Melroe 378
-- type	roller and draper
-- pickup width	126 in (3215 mm)
-- number of belts	7
-- teeth per belt	40
-- type of teeth	steel
-- number of rollers	2 pickup, 2 transfer
-- height control	castor gauge wheels
-- speed control	variable - hydrostatic
-- speed range	0 to 295 ft/min (0 to 1.5 m/s)
HEADER:	
-- type	center feed
-- width	10.5 ft (3.2 m)
-- auger diameter	23 in (580 mm)
-- feed conveyor	4 roller chains, slatted conveyor
-- conveyor speed	570 ft/min (2.9 m/s)
-- range picking height	-16.5 in to 42.5 in (420 to 1080 mm)
-- number of lift cylinders	2
-- raising time	6 s
-- lowering time	53 s
-- options	header reverser, straight cut header, exible cutter bar, sun ower cutter bar, maize header, automatic steering, header height control
STONE PROTECTION:	
-- type	stone trap pocket
-- ejection	manually operated access door
CYLINDER:	
-- type	rasp bar
-- number of rasp bars	6
-- diameter	17.7 in (450 mm)
-- width	61.6 in (1565 mm)
-- number of spiders	7
-- drive	V-belt
-- speed control	hydraulically controlled variable pitch belt
-- speed range	650 to 1500 rpm
-- options	slow speed drive kit (290 to 680 rpm 570 to 1320 rpm), step pulley drive (750, 1000, 1200, and 1500 rpm)
CYLINDER BEATER:	
-- type	8 triangular bats on drum
-- diameter	14.8 in (375 mm)
-- width	60.2 in (1530 mm)
-- speed	1140 rpm
CONCAVE:	
-- type	bar and wire grate (universal)
-- number of bars	12
-- con guration	11 intervals with 0.24 in (6 mm) diameter wires and 0.45 in (11.5 mm) spaces
-- wrap	120°
-- total area	1156 in² (0.746 m²)
-- open area	815 in² (0.526 m²)
-- transition grate -total area	772 in² (0.498 m²)
-open area	93 in² (0.060 m²)
-- grain delivery to shoe	riddle grain pan
-- options	grain concave and maze concave
STRAW WALKERS:	
-- type	stepped
-- number	6
-- length	14.3 ft (4350 mm)
-- walker housing width	62.4 in (1585 mm)
-- separating area	10121 in² (6.53m²)
-- crank throw	2 in (50 mm)
-- speed	220 rpm
-- grain delivery to shoe	closed bottom walkers and at bottom grain pan
-- options	risers, step covers
SHOE:	
-- type	single action
-- speed	300 rpm
-- chaffer sleeve	adjustable lip, 4130 in² (2.660 m²)
-- chaffer sieve extension	adjustable tip, 1089 in² (0.699 m²)
-- cleaning grain sieve	adjustable lip, 2992 in² (1.930 m²) with 1.5 in (39 mm) throw
-- options	maize - cob mix chaffer
CLEANING FAN:	
-- type	triple turbine (32 blades each)
-- diameter	15.75 in (400 mm)
-- width	7.7 in (195 mm) earl-
-- drive	variable pitch belt
-- speed range	620 to 1340 rpm

ELEVATORS:	
-- type	roller chain with rubber ights
-- clean grain (bottom drive)	6.7 x 11.8 in (170 x 300 mm)
-- tailings (bottom drive)	4.7 x 9.1 in (120 x 230 mm)
GRAIN TANK:	
-- capacity	180 bu (65 m³)
-- unloading time	90 s
-- unloading auger diameter	11.8 in (300 mm)
STRAW CHOPPER:	
-- type	rotor with 60 freely swinging ails
-- speed	2930 rpm
-- options	straw spreader
ENGINE:	
-- make and model	Mercedes Benz OM-401-901
-- type	4 stroke turbocharged diesel
-- number of cylinders	V6 con guration
-- displacement	638 in³ (10.5 L)
-- governed speed (full throttle)	2390 rpm
-- manufacturer's rating	202 hp (151 kW) @ 2390 rpm
-- fuel tank capacity	93 gal (412 L)
CLUTCHES:	
-- header	hydraulic belt tightener
-- separator	hydraulic belt tightener
-- unloading auger	manual belt tightener
NUMBER OF CHAIN DRIVES:	9
NUMBER OF BELT DRIVES:	14
NUMBER OF GEAR BOXES:	3
NUMBER OF PRELUBRICATED BEARINGS:	92
LUBRICATION POINTS:	
-- 10h	13
-- 50h	20
-- 100h	17
-- 500 h	14
TIRES:	
-- front	28L x 26, R1, 12-ply
-- rear	14.9 x 24, 8-ply
TRACTION DRIVE:	
-- type	hydrostatic
-- speed ranges	
-1st gear	0 to 4.4 mph (0 to 7 km/h)
-2nd gear	0 to 6.3 mph (0 to 10 km/h)
-3rd gear	0 to 14.4 mph (0 to 23 km/h)
OVERALL DIMENSIONS:	
-- wheel tread (front)	9.1 ft (28 m)
-- wheel tread (rear)	8.7 ft (27 m) (adjustable)
-- wheel base	12.0 ft (37 m)
-- transport height	12.9 ft (39 m)
-- transport length	31.8 ft (9 7 m)
-- transport width	14.4 ft (44 m)
-- eld height	13.7 ft (42 m)
-- eld length	32.0 ft (98 m)
-- eld width	15.5 ft (47 m)
-- unloader discharge height	13.7 ft (42 m)
-- unloader clearance height	11.9 ft (36 m)
-- unloader reach	9.5 ft (29 m)
-- turning radius -left	24.4 ft (74 m)
-right	25.0 ft (76 m)
MASS: (empty grain tank)	
-- right front wheel	8778 lb (3990 kg)
-- left front wheel	8690 lb (3950 kg)
-- right rear wheel	3223 lb (1465 kg)
-- left rear wheel	3223 lb (1465 kg
TOTAL	23914 lb (10870 kg)

APPENDIX II
REGRESSION EQUATIONS FOR CAPACITY RESULTS

Regression equations for the capacity results shown in FIGURES 11 to 16 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 to the number of loss collections. Limits of the regressions may be obtained from FIGURES 11 to 16 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	11	$\ln C = -1.34 + 0.18 \ln F$ $\ln S = -5.19 + 2.30 \ln F$ $W = 0.33 + 4.10 \times 10^{-5} F^4$	0.31 0.89 0.99	0.54 19.17[2] 488.91[2]	7
Barley - Bonanza	12	$\ln C = -4.12 + 1.31 \ln F$ $\ln S = -3.53 + 0.20F$ $\ln W = -9.48 + 4.01 \ln F$	0.89 0.82 0.99	23.64[2] 11.89[1] 279.04[2]	8
Wheat - Neepawa	13	$\ln C = -1.06 + 0.13F$ $\ln S = -11.37 + 3.54F$ $\ln W = -5.98 + 0.31F$	0.99 0.90 0.97	237.80[2] 22.54[2] 194.30[2]	7
Wheat - Neepawa	14	$C = 0.83 + 0.18F$ $\ln S = -8.52 + 3.39 \ln F$ $\ln W = - 4.81 + 0.23F$	0.91 0.89 0.95	25.08[2] 18.89[2] 43.86[2]	7
Wheat - Neepawa	15	$\ln C = -1.13 + 0.08F$ $S = -0.04 + 5.0 \times 10^{-7} F^5$ $\ln W = -5.19 + 0.28F$	0.96 0.91 0.97	50.10[2] 19.69[2] 74.49[2]	6
Wheat - Neepawa	16	$C = -0.16 + 0.07F$ $\ln S = -4.61 + 0.120F$ $\ln W = -11.74 + 4.14 \ln F$	0.92 0.85 0.97	23.54[2] 10.34[1] 73.75[2]	6

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

APPENDIX III

MACHINERY INSTITUTE REFERENCE COMBINE CAPACITY RESULTS

TABLE 7 and FIGURES 26 and 27 present the capacity results for the Machinery Institute reference combine in wheat and barley crops harvested from 1978 to 1982.

FIGURE 26 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 27 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.

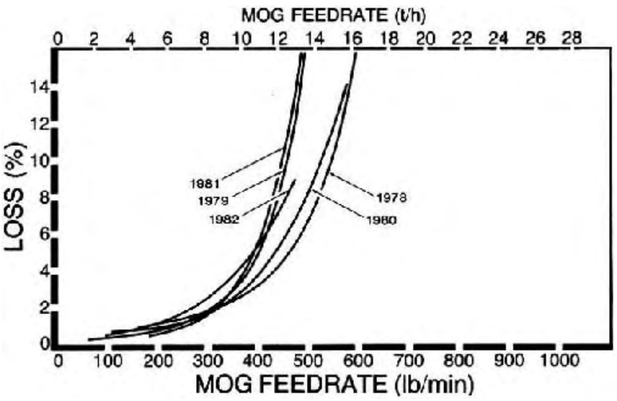

FIGURE 26. Total Grain Loss for the Reference Combine in Neepawa Wheat.

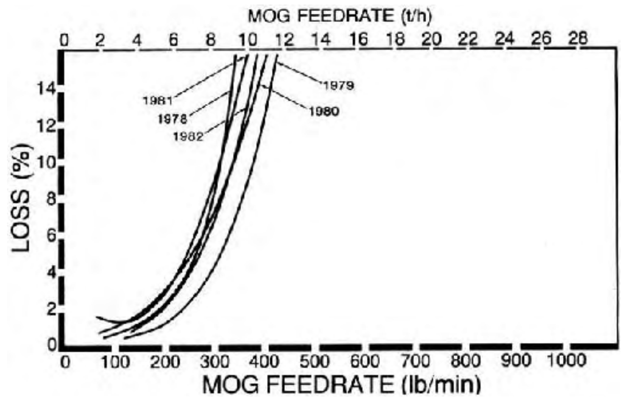

FIGURE 27. Total Grain Loss for the Reference Combine in Barley.

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 Evaluation 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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