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Evaluation Report 676

New Holland TX36

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

NEW HOLLAND TX36 SELF-PROPELLED COMBINE

MANUFACTURER:

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DISTRIBUTORS:

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RETAIL PRICE:

$184,402.00 [April, 1992, f.o.b. Humboldt Sask., with a 13 ft (4.0 m) header, 11.2 ft (3.4 m) Rake-Up pickup, hydraulic feeder reverser, straw chopper, chaff spreader, Petersen chaffer, 30.5L x 32 R1 drive tires, 16.0/70-20 steering tires, grain loss monitor, starting fluid injector kit, AM-FM radio, heater, air conditioner, and portable service light.]

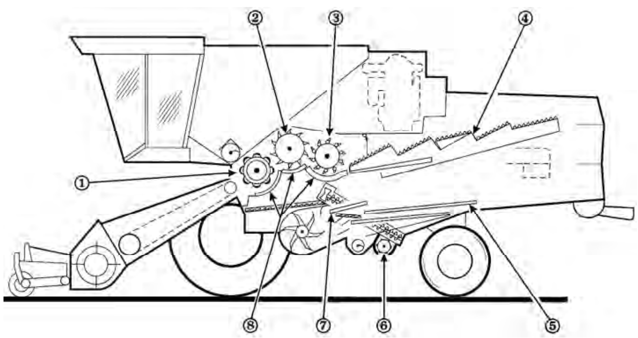

FIGURE 1. New Holland TX36: (1) Cylinder, (2) Beater, (3) Rotary Separator, (4) Straw Walkers, (5) Self Levelling Cleaning Shoe, (6) Rethresher (Roto-Thresher), (7) Pre-Blower Sieve, (8) Concaves.

SUMMARY AND CONCLUSIONS

Capacity: In the capacity tests, the MOG feedrate* at 3% total grain loss in Bonanza and Harrington barley was 690 lb/min (18.8 t/h) and 670 lb/min (18.2 t/h) respectively. Combine capacity was 1065 lb/min (29.0 t/h) in Katepwa wheat and 755 lb/min (20.5 t/h) in Laura wheat.

In the Bonanza and Harrington barley the New Holland TX36 capacity was respectively 2.2 and 1.9 times the capacity of the PAMI Reference II combine when compared at 3% total grain loss. In the wheat tests, the capacity of the New Holland TX36 was about 2.0 times that of the Reference II in Katepwa and 1.9 times in Laura.

Quality of Work: Picking performance was very good. The Rake-Up pickup picked cleanly in all reasonably well supported windrows and no plugging occurred. The windrow was shifted to the left as it was picked.

Feeding was excellent. Windrows even as wide as the pickup were smoothly conveyed up the feeder and into the cylinder. The stone trap provided good stone protection. Objects up to 4 in (100 mm) in diameter were collected in the trap. No major raspbar or concave damage occurred.

Threshing was good. Unthreshed losses were generally low in all crops. Blanking provided extra threshing aggressiveness but increased cracks.

Separating was very good. Material flowed smoothly under the cylinder, beater and rotary separator and onto the walkers. The rotary separator effectively separated grain from MOG. Loss from the straw walkers increased gradually in most crops, limiting combine capacity in most cereal crops.

Cleaning shoe performance was very good. Shoe loss was low in all crops. The self levelling mechanism worked well and kept the shoe operating efficiently on side slopes up to 9.5° (17%).

Clean grain handling was good. The 230 bu (8.3 m³) grain tank filled evenly in all crops. The unloading auger had adequate reach but with the unloading auger fully extended clearance was excessive for all trucks and trailers encountered. The auger discharged the grain in a compact stream and unloaded a full tank of dry wheat in about 115 seconds. The wind caused some scatter loss when unloading using the standard discharge spout. Straw spreading was good and chaff spreading was very good. Straw was spread evenly up to a maximum of 25 ft (7.6 m) while chaff was spread up to 20 ft (6 m).

Ease of Operation and Adjustment: Operator comfort was good. The cab was clean, quiet and was well suited for one person. The air conditioner and heater provided comfortable cab temperatures. The seat and steering column could be adjusted to suit most operators. The operator had a clear view forward and to the sides and large convex mirrors provided suitable rear visibility. The incoming swath was partially blocked by the steering wheel. Instrumentation was good. Most important machine and engine components were monitored with a combination of gauges, a digital display, warning lights and audio alarm. Engine rpm was not displayed. The horizontal console, to the right of the operator, contained most of the instrumentation. Viewing this console required the operator to look away from the windrow. The controls were very good. Most of the controls were located to the right of the operator with only a few to the left, on the floor, in the steering console and above the operator. The more frequently used controls were located conveniently close to the operator. Mechanical controls engaged the combine functions while electrical controls activated the hydraulics and component speed adjustments.

The loss monitor was very good in cereals but poor in flax and canola. The time base monitor gave suitable indications for both straw walker and shoe loss in cereals only.

Lighting was good. Short, medium and long range lighting provided effective illumination when using the pickup header and could be adjusted to suit wider headers. However, with the header fully raised, long range light was restricted. Grain tank lighting was inadequate. The portable service light was very handy for night servicing or checks,

Handling was excellent. Quick steering response and short turning radius allowed the New Holland TX36 to pick around sharp windrow corners without the aid of wheel brakes. The hydrostatic drive was smooth and responsive, and the gear ratios were appropriate for suitable harvest speeds. The combine was stable in the field and while transporting,

Ease of adjustment was good. Most components were very easy to adjust from the cab. Ease of setting the components to suit crop conditions was very good. Once familiar with the combine's performance, setting was quick and little fine-tuning was required. Checking material from the straw walkers was easy as the flow could be redirected from the chopper into a windrow by moving a lever. With the chaff spreader in its operating position, access to the shoe was restricted.

Ease of unplugging was very good. The header reverser backed material from the header and also enabled feeding material slowly back into the combine. The cylinder plugged only once during the season, when a heavy wad of green canola entered the cylinder.

It was easily removed. When closed to 0.13 in (3.2 mm) or less in cereal crops, the cleaning sieve plugged with awns and white caps.

Ease of cleaning the combine was very good. The open and unrestricted grain tank allowed easy cleaning. Large access doors in the grain tank, a removable stone trap, and access doors the full length of the clean grain and return augers made cleaning interior components easy.

Ease of lubrication was good. Daily lubrication was quick and easy. Ease of performing routine maintenance was good although changing the hydrostatic filter was difficult. Most belts had spring loaded idlers and the chain drives had bolts tighteners for simplified maintenance. The left front concave adjusting nut was difficult to access when the feeder was attached.

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

Engine and Fuel Consumption: The engine started quickly and ran well. The engine had adequate power to reach feedrates that limited combine capacity. Average fuel consumption was 7.5 gal/h (34.2 L/h) and oil consumption was insignificant.

Operator Safety: No safety hazards were apparent. However, normal safety precautions were required and warnings had to be heeded. The operator's manual emphasized safety.

Operator's Manual: The operator's manual was very good.

The manual was clearly written. The table of contents and index made finding information easy. A separate engine manual and 971 header operator's manual were supplied.

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

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying a safety mechanism in the unloading system to prevent unloader system damage should a restriction occur.
2. Modifications to the cab ladder to permit easier cab access.
3. Modifications to display engine rpm and to provide clear visibility of the digital speed display in all light conditions.
4. Providing better grain tank lighting.
5. Modifications to improve forward lighting when the header is fully raised.
6. Modifications to permit easier pre-blower sieve adjustment.
7. Modifications to the chaff spreader to improve the ease of positioning and to allow easy access to the shoe.
8. Providing a safe and convenient method for sampling the return tailings.
9. Modifications to prevent chaff from collecting on the inside lips of the large access panels.
10. Modifications to prevent the concave from falling during heavy feedrate conditions.
11. Modifications to reduce concave bending.

Senior Engineer: J.D. Wassermann

Harvesting Manager: L.G. Hill

Project Engineer: S.J. Grywacheski

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A shear bolt for the unloading system will be included in future design changes.
2. This recommendation is included in future design changes.
3. This recommendation is included in future design changes.
4. There are no plans for change in this area.
5. There are no plans for change in the area, since it is recommended that the header not be fully raised during transporting.
6. An access door in the right side panel will be included in future design changes.
7. A chaff spreader, which pivots near the shoe and swings down at the rear to give access to the sieves is under consideration for future design changes.
8. Presently, sampling the return tailings can be done by kill stalling the engine and opening the rethresher (Roto-thresher) cover. Tests are being performed to design a convenient return indicator.
9. This recommendation is under consideration for future design changes.
10. This was caused by incorrect installation of a washer in the concave lever. This has been corrected on current models.
11. The concaves on the current models have reinforced bars and spring steel wires.

GENERAL DESCRIPTION

The Ford New Holland TX36 is a self-propelled combine. It has a transverse mounted, tangential threshing cylinder, concave, beater, transverse mounted rotary separator, straw walkers, rethresher (rotothresher) and a self levelling cleaning shoe. The open cylinder has eight rasp bars with the ribs on alternate bars having opposite angle. The concaves under the cylinder, beater and rotary separator are bar and wire construction. Two externally engageable blanking plates which cover the first four concave spaces are mounted under the front of the cylinder concave. The rotary separator is an open, spike type cylinder, which has 10 rows of teeth. The teeth alternate 8 and 9 teeth per row. The 6 multi-step straw walkers have closed bottoms. The cleaning fan is a six-blade paddle fan. The grain pan, pre-blower sieve and chaffer move in opposed motion to the cleaning sieve. The combine tailings return is equipped with an independent rethresher.

The crop is fed up the feeder to the cylinder. Threshing begins as the crop first contacts the rasp bars, and continues as the crop is pulled between the cylinder and concave. Grain separation occurs through the cylinder, beater and rotary separator concaves and straw walkers. A reciprocating grain pan conveys material from under the concaves to the pre-blower sieve. Material separated by the straw walkers is also dropped onto the pre-blower sieve. The grain is cleaned by a combination of pneumatic and mechanical sieving action. The grain pan and cleaning shoe automatically level on side slopes of up to 9.5° (17%). Return tailings are fed to the spike-tooth rethresher and then returned onto the grain pan.

The test machine was equipped with a 240 hp (179 kW) Ford inline, six cylinder, turbocharged diesel engine; a 12.5 ft (3.8 m) header; an 11.2 ft (3.4 m) Rake-Up pickup; and other optional equipment listed on page 2. The New Holland TX36 has a pressurized operator's cab, power steering, hydraulic wheel brakes, four speed transmission and a hydrostatic traction drive.

The separator, header and unloading auger drives are manually engaged. The straw chopper is engaged by an electro-magnetic clutch. Header height and tilt along with unloading auger swing are hydraulically controlled. Cylinder pickup and cleaning fan speeds, feeder reverser and cylinder concave clearance are adjusted from within the cab. Rotary separator concave clearance and speed are adjusted outside the cab. Cleaning shoe adjustments are performed at the rear of the machine. There are no provisions to safely and conveniently inspect the return tailings while operating. Important component speeds and alarms are displayed by an electronic monitor in the cab.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The machine evaluated by PAMI was configured as described in the General Description, FIGURE 1, and Specifications section of this report. The manufacturer may have built different configurations of this machine before or after PAMI tests. Therefore, when using this report, check that the machine under consideration is the same as the one reported here. If differences exist, assistance can be obtained from PAMI or the manufacturer to determine changes in performance.

The main purpose of the test was to determine the functional performance of the New Holland TX36. Measurements and observations were made to evaluate the New Holland TX36 for rate of work, quality of work, ease of operation and adjustment, operator safety, and the suitability of the operator's manual. Although extended durability testing was not conducted, the mechanical failures were recorded.

The New Holland TX36 was operated for 115 hours while harvesting approximately 1190 ac (482 ha) of various crops. The crops and conditions are shown in TABLES 1 and 2. Capacity tests were conducted in two barley crops and two wheat crops. A side slope test was performed at 5° (8.8%) to determine non-level shoe performance. As well, a comparison was made between the Petersen and standard chaffers in wheat.

RESULTS AND DISCUSSION

TERMINOLOGY

MOG, MOG Feedrate, Grain Feedrate, MOG/G Ratio and Total Feedrate: 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 the "MOG Feedrate". Similarly, the amount of grain being 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, the combine has to handle 50 lbs (22.7 kg) of straw for every 100 lbs (45.4 kg) of grain harvested. 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 (68.1 kg) of straw - 3 times as much. Therefore, the higher the MOG/G ratio, the more difficult it is to separate the grain.

Total feedrate is the sum of MOG and grain feedrates. This gives an indication of the total amount of material being processed. This total feedrate is often useful to confirm the effects of extreme MOG/G ratios on combine performance.

TABLE 1. Operating Conditions

Crop	Variety	Yield Range		Cut Width		Sep.	Field Area		Crop Harvested	
		bu/ac	t/ha	ft	m	hrs	ac	ha	bu	t
Barley	Bonanza	63-101	3.4-5.4	25, 42	7.6, 12.8	18.0	145	59	13275	289
	Harrington	65-100	3.5-5.4	42	12.8	4.5	35	14	2745	60
Canola	Bounty	19	1.1	24	7.3	5.0	50	20	930	21
	Legend	29	1.7	30, 42	9.1, 12.8	8.0	85	34	2465	56
	Parkland	20-34	1.3-1.9	30, 42	9.1, 12.8	9.0	105	42	2725	62
Flax	Vimy	18-24	1.1-1.4	30, 50	9.1, 15.2	13.0	205	83	3880	99
Rye	Cougar	39-52	2.0-3.3	26	7.9	20.0	210	85	9595	244
Spring Wheat	Columbus	53	3.6	42	12.8	6.5	45	18	2400	65
	Conway	32	2.2	42	12.8	3.5	50	20	1620	44
	Laura	43-53	2.9-3.6	42	12.8	21.5	200	81	9195	250
	Katepwa	41	2.9	42	12.8	6.0	60	24	2485	68
Total						115.0	1190	482	51315	1258

TABLE 2. Operation in Stony Conditions

Field Conditions	Hours	Field Area	
		ac	ha
Stone Free	63	565	229
Occasional Stones	28	315	127
Moderately Stony	22	310	126
Total	115	1190	482

Grain Loss, Grain Damage, Dockage and Foreign Material: 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 Loss 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 the actual damaged kernels to the entire weight of a sample taken from the grain tank.

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

Foreign material consists of the large undesirable particles in the sample, which will not pass through the dockage screens.

Capacity: Combine capacity is the maximum rate at which a combine, adjusted for optimum performance, can process crop at a certain total loss level. PAMI 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. For this reason, PAMI is now including a comparison at 1.5% total loss, which may reflect a more realistic operating loss as machines and crops have been improved.

Reference Combine: It is well recognized that a combine's capacity may vary greatly due to differences in crop and weather conditions. These differences make it impossible to directly compare combines not tested in the same conditions. For this reason, PAMI uses a reference combine. The reference combine is simply one combine that is tested along with each combine being evaluated. Since the test conditions are similar, each test combine can be compared directly to the reference combine to determine a relative capacity or "capacity ratio". This capacity ratio can be used to indirectly compare combines tested in different years and under different conditions. As well, the reference combine is useful for showing how crop conditions affect capacity. For example, if the reference combine's capacity is higher than usual, then the capacity of the combine being evaluated will also be higher than normally expected.

For 10 years PAMI had used the same reference combine. However, capacity differences between the reference combine and some of the combines tested became so great that it was difficult to test the reference combine in conditions suitable for the evaluation combines. PAMI changed its reference combine to better handle these conditions. The new reference combine is a John Deere 7720 Titan II that was tested in 1984 (see PAMI report #426). To distinguish between the reference combines, the new reference will be referred to as Reference II and the old reference as Reference I. Combines appearing in reports printed in 1986 or earlier have been compared to Reference I (Old Reference) and combines appearing in reports printed in 1987 or later are compared to Reference II.

RATE OF WORK

Capacity Test Results: The capacity test results for the New Holland TX36 are summarized in TABLE 3.

TABLE 3. Capacity of TX36 at a Total Loss of 3% and 1.5% of Yield

CROP CONDITIONS

Crop	Variety	Cut Width		Crop Yield		Moisture Content		MOG/G Ratio	Figure Number
		ft	m	bu/ac	t/ha	Straw %	Grain %		
Barley	Bonanza	25	7.6	84	4.5	8.9	11.7	0.80	2
Barley	Harrington	42	12.6	68	3.7	9.1	11.9	0.90	3
Wheat	Katepwa	42	12.8	43	2.3	6.1	12.7	1.22	4
Wheat	Laura	42	12.8	42	2.3	6.1	13.2	1.22	5

CAPACITY AT 3%

Crop	Variety	Feedrates						Grain Cracks	Dock-age	Foreign Material
		MOG		Grain		Total				
		lb/min	t/h	bu/h	t/h	lb/min	t/h	%	%	
Barley	Bonanza	690	18.8	1075	23.4	1550	42.2	1.1	0.7	0
Barley	Harrington	670	18.2	930	20.2	1410	38.4	3.0	0.7	0
Wheat	Katepwa	1065	29.0	875	23.8	1940	52.8	3.3	2.7	1.3
Wheat	Laura	755	20.5	620	16.9	1375	37.4	2.1	4.0	1.3

CAPACITY AT 1.5%

Crop	Variety	Feedrates						Grain Cracks	Dock-age	Foreign Material
		MOG		Grain		Total				
		lb/min	t/h	bu/h	t/h	lb/min	t/h	%	%	
Barley	Bonanza	585	15.9	910	19.8	1310	35.7	1.2	0.7	0
Barley	Harrington	550	15.0	765	16.7	1165	31.7	2.9	0.7	0
Wheat	Katepwa	915	24.9	750	20.4	1665	45.3	4.9	2.7	1.3
Wheat	Laura	625	17.0	515	14.0	1140	31.0	2.1	4.0	1.3

The performance curves for the capacity tests are presented in FIGURES 2 to 5. The performance curves are plots of walker, shoe, unthreshed and total grain loss for a range of MOG feedrates. From the graphs, combine capacity can be determined at various loss levels. The rate at which loss changes with respect to feedrate shows where the combine can be operated effectively. Portions of the curves which are "flat" or slope gradually indicates stable performance. Where the curves hook up sharply, small increases in feedrate cause loss to increase greatly. It would be difficult to operate in this range of feedrates without having widely varying loss.

The Bonanza barley crop chosen for the test came from a uniform stand. The crop was cut two weeks before the test. Wind and rain damage had caused minor lodging and some broken straw. The windrow was the same width as the feeder. Crop yield and MOG/G ratio were typical. Straw and grain moisture contents were on average for windrowed barley crops. During this capacity test, the concave blanks were not engaged and the louvre chaffer was installed.

The MOG feedrate at 3% total loss was 690 lb/min (18.8 t/h) and 585 lb/min (15.9 t/h) at 1.5% total loss. Walker and shoe losses were low and stable at MOG feedrates up to 550 lb/min (15.0 t/h). Both losses increased significantly at higher feedrates and collectively limited capacity. Unthreshed loss was low over the entire range of feedrates in the test. In this crop, higher cylinder rpm and tighter concave clearance would have increased separations but would also have resulted in unacceptable shoe performance and a lower overall capacity.

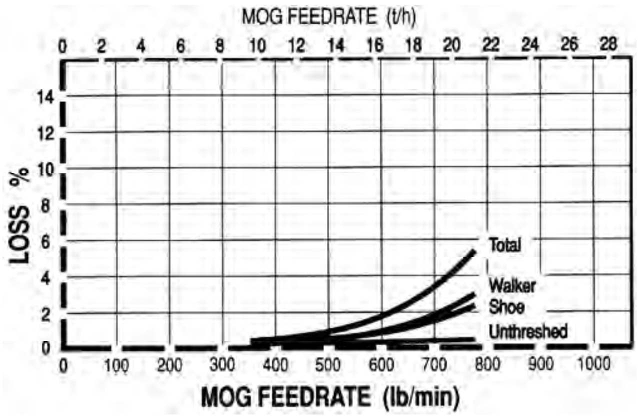

FIGURE 2. Grain Loss in Bonanza Barley.

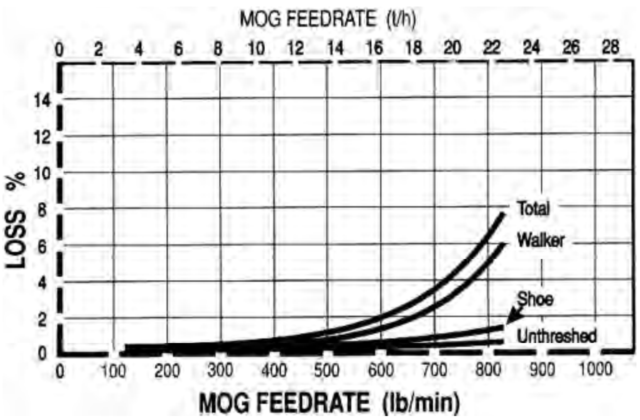

FIGURE 3. Grain Loss in Harrington Barley.

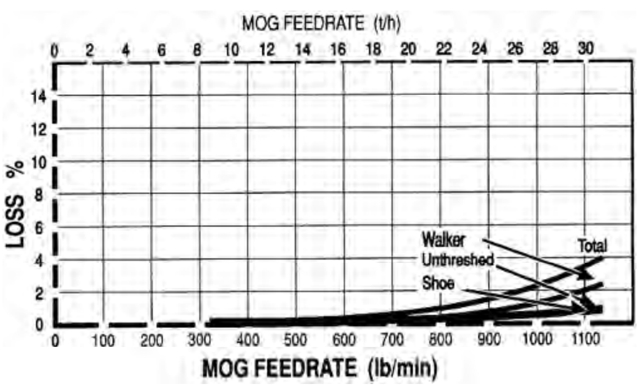

FIGURE 4. Grain Loss in Katepwa Wheat.

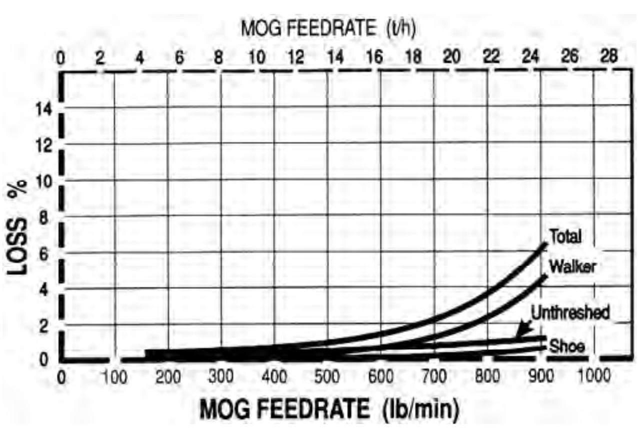

FIGURE 5. Grain Loss in Laura Wheat.

The Harrington barley crop used for the test came from a uniform stand with slight wind damage. The crop was cut ten days before the test. The windrow was uniform and exceeded the width of the feeder. The bottom of the windrow touched the ground and having been rained on after windrowing, some under growth was present. This resulted in some pickup loss and hard to thresh heads. Both the straw and grain were at average moisture. Grain yield was slightly below average but the MOG/G ratio was typical. The 42 ft (12.8 m) width of cut enabled harvesting at high MOG feedrates without travelling at fast ground speeds. For this capacity test the concave blanks were not engaged and the louvre chaffer was installed.

MOG feedrate at 3% total loss was 670 lb/min (18.2 t/h) and 550 lb/min (15.0 t/h) at 1.5% total loss. The higher feedrates were easily reached without experiencing power or feeding limits. However, loss levels became unacceptable. Walker loss was the main part of total loss at MOG feedrates higher than 400 lb/min (10.9 t/h), increasing sharply as feedrate increased. Shoe loss was stable and remained acceptable over the entire range of MOG feedrates in the test. Unthreshed loss was insignificant staying below 0.5% throughout the feedrate range.

The Katepwa wheat was from a mature, average stand. The crop was cut the same day as the test. The windrow width greatly exceeded that of the feeder. Crop yield and the MOG/G ratio were average. Straw and grain moisture were also typical. Straw break-up and threshing difficulty were normal. For this capacity test concave blanks were not engaged and the louvre chaffer was installed.

MOG feedrate at 3% total loss was 1065 lb/min (29.0 t/h) and 915 lb/min (24.9 t/h) at 1.5% loss. Walker loss was low and stable up to a feedrate of 800 lb/min (21.8 t/h) but limited capacity beyond this rate. Shoe and unthreshed losses were also low up to the 800 lb/min (21.8 t/h) feedrate. Both rose slightly as feedrate increased, contributing equally to total loss. The Petersen sieve was installed and tested in the same Katepwa wheat crop. These results are presented in the cleaning section.

The Laura wheat tested was from a uniform stand. The crop received some wind and rain damage while standing. The crop was cut a week before the test and had received some rain. The crop was cut low to the ground and the windrow was somewhat bunchy. The windrow greatly exceeded the width of the feeder. Grain yield and MOG/G ratio were average. Straw and grain moisture contents were average. Straw break up and threshing difficulty were typical. Concave blanks were not engaged and the louvre chaffer was installed.

MOG feedrate at 3% total loss was 755 lb/min (20.5 t/h) and 625 lb/min (17.0 t/h) at 1.5% total loss. Straw walker loss remained low and stable up to a MOG feedrate of 600 lb/min (16.3 t/h). However, at higher feedrates, walker loss limited combine capacity. Unthreshed loss was below 0.5% up to 500 lb/min (13.6 t/h) MOG, and increased gradually with feedrate. Shoe loss was insignificant over the entire range of feedrates in the test.

A second test was performed in this crop to show the effects on shoe performance with the shoe tilted at 5° (8.8%). Details are given in the cleaning section.

Average Workrates: TABLE 4 shows the range of average workrates achieved during day-to-day operation in the various crops encountered. The table is intended to give a reasonable indication of the average rates most operators could expect to obtain, while acknowledging the effects of crop and field variables. For any given crop, the average work rate may vary considerably. Although a few common variables such as yield and width of cut are included in TABLE 4, they are by no means the only or most important factors. There are many other crop and field conditions, which affect workrates. As well, operating at different loss levels, availability of grain handling equipment, and differences in operating habits can have an important effect.

The effect of the variables as indicated in TABLE 4, explains why even the maximum average workrates may be considerably lower than the capacity results, which are instantaneous workrates.

Note that TABLE 4 should not be used to compare performance of combines. The factors affecting average workrates are simply too numerous and too variable to be duplicated for each combine tested.

Comparing Combine Capacities: The capacity of combines tested in different years or in different crop conditions should be compared only by using the PAMI reference combines. Capacity ratios comparing the test combine to the reference combine are given in the following section. For older reports where the ratio is not given, a ratio can be calculated by dividing the MOG feedrate listed in the capacity table by the corresponding MOG feedrate of the Reference combine listed in APPENDIX II for that particular crop.

TABLE 4. Field Workrates

Crop	Average Workrate	Grain Feedrate		Area Rate		Associated Conditions				
						Width of Cut		Yield		Variety
		bu/h	t/h	ac/h	ha/h	ft	m	bu/ac	t/ha	
Barley	High	860	18.7	13.7	5.5	42	12.8	63	3.6	Bonanza
	Low	590	12.8	6.4	2.6	25	7.6	92	5.3	Bonanza
	Season	720	15.7	8.8	3.6			82	4.7	
Canola	High	365	8.3	12.6	5.1	42	12.8	29	1.7	Legend
	Low	195	4.4	10.3	4.2	24	7.3	19	1.1	Bounty
	Season	285	6.5	11.0	4.5			26	1.6	
Flax	High	340	8.6	14.2	5.7	50	15.2	24	1.5	Vimy
	Low	205	5.2	11.4	4.6	30	9.1	18	1.1	Vimy
	Season	300	7.6	15.8	6.4			19	1.2	
Rye	High	530	13.5	13.6	5.5	26	7.9	39	2.4	Cougar
	Low	475	12.1	9.1	3.7	26	7.9	52	3.2	Cougar
	Season	490	12.4	10.7	4.3			46	2.8	
Wheat	High	515	14.0	9.7	3.9	42	12.8	53	3.5	Laura
	Low	365	9.9	8.3	3.4	42	12.8	44	2.9	Laura
	Season	420	11.4	9.5	3.8			44	2.9	

Once capacity ratios for different evaluation combines have been determined for comparable crops, they can be used to approximate capacity difference. For example, if one combine has a capacity ratio of 1.2 times the Reference combine and another combine has a capacity ratio of 2.0 times the Reference combine, then the second combine is about 67% larger [(2.0 - 1.2) ÷ 1.2 x 100 = 67%]. An evaluation combine can also be compared to the Reference combine at losses other than 3%. The total loss curves for the evaluation and Reference combine are shown in the graphs in the following section. The shaded bands around the curves represent 95% confidence belts. Where the bands overlap, very little difference in capacity exists, where the band do not overlap a significant difference can be noticed.

PAMI recognizes that the change to the Reference II combine may make it difficult to compare test machines, which were compared to Reference I. To determine a relative size it is necessary to use a ratio of the two reference combines. Tests indicated that Reference II had about 1.5 to 1.6 times the capacity of Reference I in wheat and about 1.4 to 1.5 times Reference I's capacity in barley.

Capacity Compared to Reference Combine: The capacity of the New Holland TX36 was significantly greater than the PAMI Reference II combine in the wheat and barley crops. The New Holland TX36 had 2.2 and 1.9 times the capacity of the Reference II combine respectively in Bonanza and Harrington barley at 3% total loss. For the Katepwa and Laura wheat crops the respective capacity of the New Holland TX36 was 2.0 and 1.9 times that of the Reference II at 3% total loss.

Compared at 1.5% total loss, the capacity of the New Holland TX36 was 2.2 and 1.9 times that of the Reference II in the Bonanza and Harrington barley tests. The New Holland TX36 had 2.0 times the capacity the Reference II in both Katepwa and Laura wheat.

FIGURES 6 to 9 compare the total losses of both combines over the range of feedrates tested. The graphs show that at total losses greater than 1% the New Holland TX36 usually had significantly higher capacity than the Reference II combine. This difference in capacity would usually be easily noticed when harvesting. At losses less than 1%, the confidence belts in the graphs overlap, indicating that the difference in capacity may not be statistically significant. However, even when operating at low losses the difference in capacity would usually be quite noticeable.

QUALITY OF WORK

Picking: Picking performance was very good.

The header was adjusted so the pickup wheels just touched the ground, which resulted in the header table floor being approximately 14.5 in (368 mm) from the ground. The gauge wheels were adjusted so the teeth cleared the ground by about a 0.5 in (13 mm). The pickup speed was normally adjusted slightly slower than ground speed.

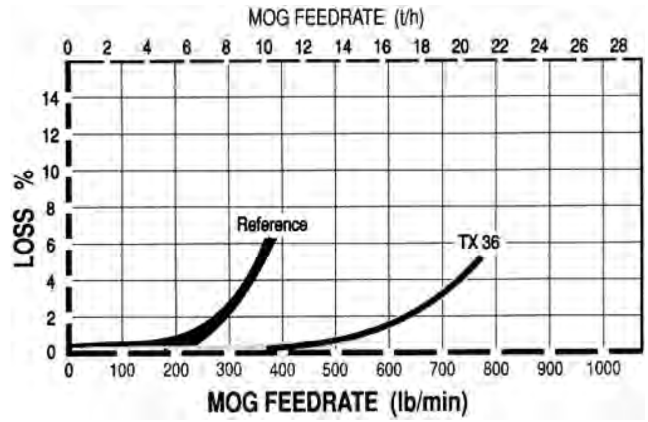

FIGURE 6. Total Grain Loss in Bonanza Barley.

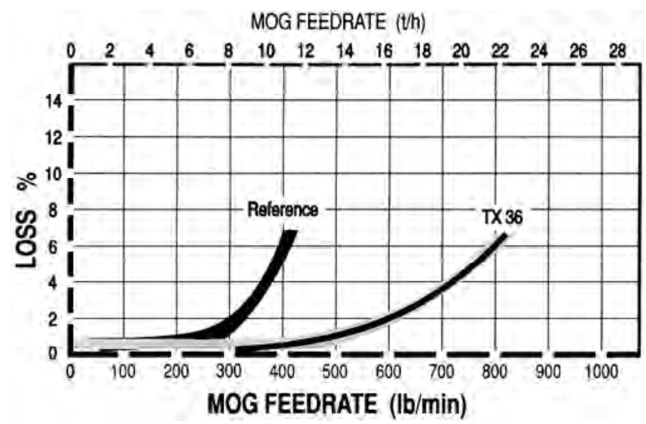

FIGURE 7. Total Grain Loss in Harrington Barley.

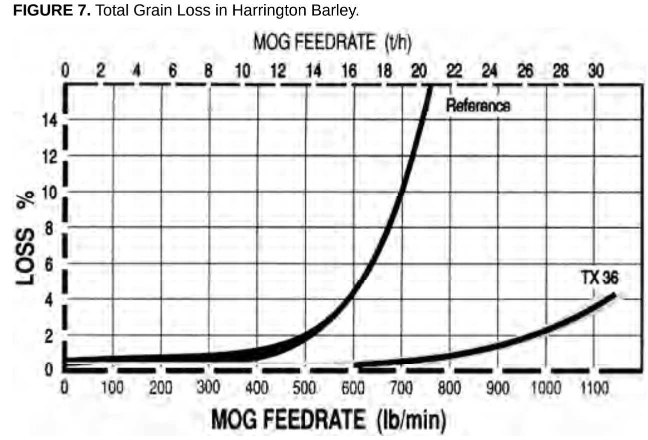

FIGURE 8. Total Grain Loss in Katepwa Wheat.

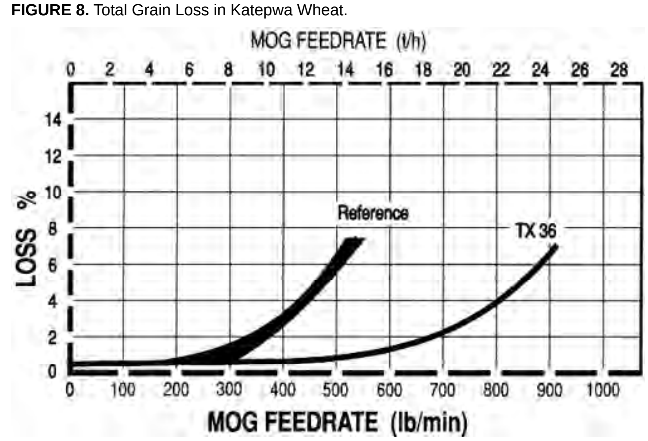

FIGURE 9. Total Grain Loss in Laura Wheat.

To centre feed a windrow, the operator had to pick the windrow slightly right of centre. The unique action of the Rake-Up pickup moved the windrow to the left as it was transferred to the header.

The pickup picked well supported windrows cleanly at speeds up to 8.5 mph (13.5 km/h) and did not plug. To cleanly pick windrows, which had settled on the ground. The pickup was lowered so the teeth just touched the ground. Even with the pickup teeth touching the ground, using a slow picking speed prevented picking up most stones, dirt and other objects. All windrows during the test were large, so the spring wires were not required to prevent the crop from rolling in front of the pickup. Thus, they were adjusted to the same level as the windguard. In windy conditions, the windguard assisted in guiding material into the table. In canola windrows, the spring wire tube was removed and the windguard had to be raised to prevent shatter loss. The windguard was easily raised, in about one minute with the aid of hand tools.

The pickup was wide enough to pick around most windrow corners.

Feeding: Feeding was excellent.

During the season, large windrows, as wide as the pickup were encountered. The table auger easily conveyed these large windrows to the centre and fed the crop smoothly into the feeder opening. The table auger plugged only in bunchy wet windrows. The feeder chain did not plug during the test. Crop transfer from the feeder chain to the cylinder was smooth.

As with all conventional combines, to fully utilize the threshing and separating capability of the cylinder and concave, it was necessary to feed windrows at least as wide as the cylinder, with the heads evenly distributed across the width. In narrower windrows and windrows with the heads concentrated in one area, it was best to centre the heads on the feeder opening.

Stone Protection: Stone protection was good.

The cylinder deflected hard objects into the stone trap sump, which is located in front of the cylinder. Hard objects up to 4 in (100 mm) in diameter were effectively trapped. Dirt, straw and grain filled the trap. It had to be cleaned daily, or more frequently in severe conditions, to maintain effectiveness. Occasionally smaller objects were heard passing between the cylinder and concave. On final inspection, nicks on the cylinder and concave along with bent wires were found.

Threshing: Threshing was good.

Crop fed smoothly between the cylinder and concave. Backfeeding was not noticed and the cylinder plugged only once during the season. This occurred when a wad of green canola wedged between the concave and the cylinder. It was easily removed.

The manufacturer's recommended cylinder speeds and concave clearances produced adequate threshing in most crops. The cylinder speeds were common to most conventional combines with comparable cylinder diameters. Concave clearances were also typical for conventional combines. In harder to thresh conditions, unthreshed was minimized by increasing cylinder speed and decreasing concave clearance. In some wheat crops, concave blanks were occasionally used to further increase threshing aggressiveness. Often however, the increased grain damage exceeded the benefits of the lower unthreshed loss. In flax, the first blank was engaged to reduce unthreshed bolls in the grain tank. In easier threshing crops like canola and barley, cylinder speed was decreased, the concave was opened and the blanks were not used.

TABLE 5 shows typical settings PAMI found to be suitable for the different crops harvested.

Separation: Separation was very good.

In all crops, material flowed smoothly over the concaves and straw walkers. Material easily made the transition into the beater and rotary separator. No plugging or bridging occurred.

In barley and wheat, straw walker loss limited capacity. Typically straw walker loss was insignificant at low feedrates, increasing gradually with increased feedrate. Once the separating components reached their effective capacity, walker loss increased much more rapidly although not as quickly as some conventional combines. The rotary separator effectively separated grain from MOG before it reached the straw walkers. This resulted in flatter walker curves (FIGURES 2 to 5).

In flax and canola, straw walker loss was low and had little effect on capacity. In canola, the rotary separator, which normally operated at 780 rpm was slowed to 410 rpm to reduce straw break up.

The settings used by PAMI are shown in TABLE 5.

Cleaning: Cleaning shoe performance was very good.

Shoe loading was even except when harvesting narrow windrows if feeding off centre. Some cleaning sieve plugging occurred.

The wind boards and vanes were not changed from the factory settings. The front-to-rear angle of the chaffer and cleaning sieve did not noticeably affect shoe performance. The rear of the chaffer and cleaning sieve were typically operated in the lowest position.

The tailings passed through the rethresher at the end of the tailings return auger. There was usually little material in the return and the rethresher did not plug during the season. The distribution of the material returned to the shoe was adjusted by a deflector plate.

The right side of the shoe had a slightly stronger air blast, resulting in higher grain loss on the right side. Conversely the left side of the cleaning sieved occasionally plugged with barley awns, rye awns and wheat white caps (FIGURE 10). Opening the cleaning sieve more than 0.13 in (3.2 mm) and increasing fan speed slightly prevented this plugging.

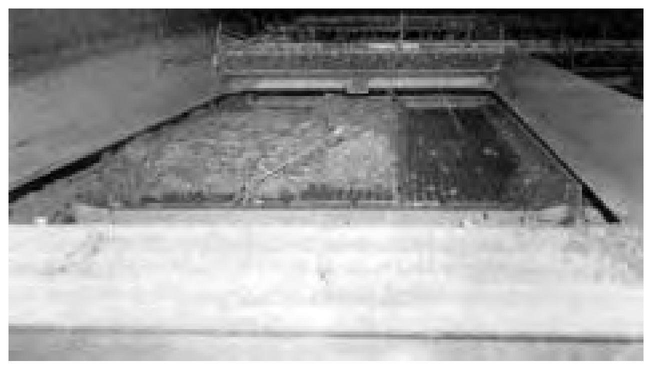

FIGURE 10. Plugging of the Left Cleaning Sieve.

In most crops, the pre-blower sieve was set at its most open adjustment. In flax, however, the pre-blower sieve was positioned at its smallest opening to reduce the amount of tailing returned.

In barley, wheat and rye, shoe loss was low. However, in extremely dry barley, threshing aggressiveness had to be decreased to prevent overloading the shoe with MOG, which caused unstable shoe performance.

In flax and canola, the chaffer and tailing sieve openings had to be set to balance loss, sample quality and return tailings volume. In these crops, cleaning shoe loss usually limited the harvesting rate.

The self-levelling system performed very well. The shoe levelling system compensated for slopes up to 9.5° (17%). Although this covered most conditions, slopes of 15° (27%) are not untypical in Western Canada. FIGURE 11 compares the shoe performance in Laura wheat with the shoe titled 5° to its performance with the shoe level. During this test, combine setting remained the same. The self-levelling feature greatly reduced cleaning losses and consequently improved capacity significantly on side slopes.

The New Holland TX36 came equipped with a louvre chaffer, which was used for most of the season. An optional Petersen airfoil chaffer was also supplied. It was installed and tested on the same

TABLE 5. Crop Settings

Crop	Cylinder Speed rpm	Rotor Separator rpm	Concave Setting Position #	Sieve Opening								Fan Speed
				Pre-Cleaning		Chaffer		Tailings		Cleaning		
				in	mm	in	mm	in	mm	in	mm	rpm
Barley	850 - 1000	780	1 - 3	1/2	12	5/8 - 7/8	14 - 22	3/4 - 7/8	19 - 22	5/16 - 1/2	8 - 13	700 - 800
Canola	550 - 580	410	4 - 5	1/2	12	1/2 - 5/8	13 - 16	1/8 - 1/2	3 - 13	1/8	3	520 - 600
Flax	1050	780	1*	1/4	6	7/16	8	1/4	6	1/16 - 1/8	2 - 3	510
Rye	730 - 840	780	4	1/4 - 5/16	6 - 8	5/8 - 3/4	16 - 19	5/8 - 3/4	16 - 19	3/16	5	820 - 840
Wheat	950 - 1150	780	1 - 2	1/2	12	5/8 - 3/4	16 - 19	3/4 - 1	19 - 25	3/16 - 1/4	5 - 6	780 - 880

**First Blank Engaged*

day as the test in Katepwa wheat. During this test, combine settings remained the same with the exception of fan speed and chaffer settings. The results showed similar loss characteristics for both it and the louvre chaffer at typical operating feedrates. At lower and higher feedrates than would be normally used for harvesting the Petersen airfoil chaffer had higher losses. These higher losses resulted from increased unthreshed load over the shoe. The Petersen chaffer was also used in barley, canola and flax and gave similar loss characteristics as the louvre chaffer.

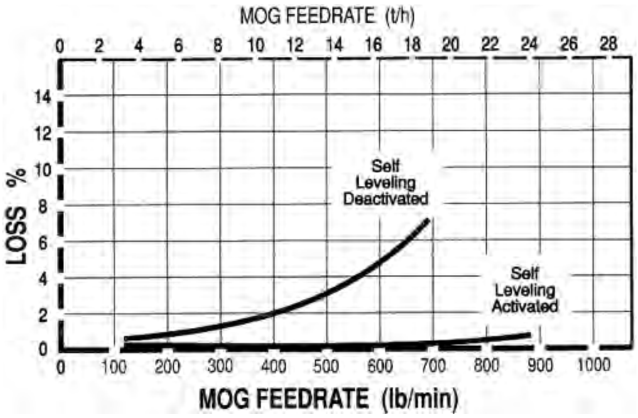

FIGURE 11. Effect of Self-Levelling Shoe at a 50 Slope.

Clean Grain Handling: Clean grain handling was good.

The open grain tank filled evenly and completely in all crops. It held approximately 230 Imp bu (8.4 m³) of dry wheat. The full bin sensor could be adjusted to signal when the bin was between 70 to 95% full. The horn sounded until the operator depressed a deactivating button. The warning light remained on while the sensor was covered. Windows between the cab and grain tank allowed the operator to watch the grain entering the tank.

Fully extended, the unloading auger had ample reach for unloading into most farm trucks. However, clearance was too high for convenient unloading into most trucks and was susceptible to loss in windy conditions (FIGURE 12). To prevent loss when unloading in windy conditions, the auger had to be swung rearward to reduce clearance. This also reduced the reach and made it difficult for the operator to view the auger. A 4 ft (1.2 m) flexible spout, (not the New Holland Option), was installed by PAMI. This allowed unloading with the auger in the forward position with minimal loss due to wind.

FIGURE 12. Unloading.

No shear bolt or safety device was used on the unloading drive so extreme care was required to prevent plugging this auger spout. It is recommended that the manufacturer consider supplying a safety mechanism in the unloading system to prevent unloader system damage should a restriction occur. The unloading auger was hydraulically positioned for unloading to the left and would unload in any position. The grain stream was compact and uniform, and a full tank unloaded in about 115 seconds.

If the unloading auger was stopped while full and then retracted to the transport position about 0.25 bu (9 L) of grain trickled from the end of auger.

Straw and Chaff Spreading: Straw and chaff spreading was very good.

The width of straw spread was set by adjusting the tail plate and fin angle. The length of cut was varied by the retractable knife. Under ideal conditions, straw was evenly spread over widths up to 25 ft (7.6 m).

The chaff spreaders maximum spread width was 20 ft (6.1 m) (FIGURE 13). The chaff spread pattern was greatly affected by wind.

FIGURE 13. Chaff Spreading.

EASE OF OPERATION AND ADJUSTMENT

Operator Comfort: Operator comfort was good.

The New Holland TX36 was equipped with an operator's cab positioned ahead of the grain tank and centred on the combine body. Cab access was safe but the narrow ladder made climbing awkward for some operators. It is recommended that the manufacturer consider modifications to the cab ladder to permit easier cab access. The latches on both the inside and outside of the cab door were inconvenient to use. Cab space was suitable for the operator, but was very limited for a passenger. The cab was quiet and pressurized with well filtered air. Air flow could be directed to suit the operator and the heater and air conditioner provided comfortable cab temperatures. The seat and steering wheel could be adjusted to suit most operators.

The operator had a clear view forward and to the side. Rear visibility was provided by five convex mirrors. These mirrors gave a wide field view but typical of convex mirrors made it difficult to judge the distances of objects appearing in the mirror.

Most operators had a clear view of the windrow coming into the pickup. However, when the header was close to the ground the operator had to lean forward to see the table auger. In a normal seated position, view of the table auger was obstructed by the steering wheel (FIGURE 14). Grain entering the tank was easily viewed through windows between the cab and grain tank.

FIGURE 14. View of Incoming Windrow.

Instruments: Instrumentation was good.

Most of the instruments were located to the right of the operator in a horizontal console while the shaft speed monitor was mounted in the overhead console.

Instruments were grouped in three modules on the horizontal console. One module contained lights, the other a speed display and the other gauges. The light module was located in the forward right corner. The speed display module and gauges module were located in the centre of the horizontal console and were sloped towards the operator (FIGURE 15). The lights module contained lights to indicate high beam, combine and trailer turn signal, cleaning shoe levelling and limit, obstructed air cleaner and unloading auger out.

The light module also contained warning lights for low engine oil, low hydrostatic charge pressure, high hydrostatic oil temperature and engaged park brake. An audible alarm sounded when a warning light was activated. The speed display module selectively showed shoe fan rpm, cylinder rpm and ground speed. The gauge module contained gauges for voltage, fuel level, engine hours and engine coolant temperature. An audible alarm also helps signal excessive coolant temperatures. Slow down of the return auger, cleaning shoe, clean grain cross auger and elevator, straw walkers, rotary separator, straw chopper and beater were monitored by the module in the overhead console. The activation point for each component could be individually set. The manufacturer suggested setting the alarm for 80% of full speed. When activated a warning light triggered and an audible alarm sounded.

FIGURE 15. Instrument and Controls Console.

Header tilt position was monitored by a series of lights. This made detecting header level easy and convenient since the tilt switch was easily bumped and without the lights the operator might not be aware of the tilted header.

Although most instruments were easy to identify, the operator had to look away from the header momentarily when viewing the instruments. This was inconvenient at times. Engine rpm, which is often desirable to monitor was not displayed. As well, during the day the top of the digital speed display was shaded which made if difficult to read. It is recommended that the manufacturer consider modifications to display engine rpm and to provide clear visibility of the digital speed display in all light conditions.

Controls: The New Holland TX36 controls were very good.

Some of the machine function controls were located right of the operator (FIGURE 15), some to the left beside the seat (FIGURE 16) and some on the cab floor. Accessory controls were located in the overhead panel and horizontal console. The controls were conveniently placed and easy to identify and use.

FIGURE 16. Lower Left Controls.

A neutral safety switch prevented the engine from cranking unless the hydrostatic control lever was in neutral. Fuel shut off was mechanically controlled. The mechanical throttle lever control was located to the right of the operator and had three detents for idle, half and full engine speed. The gearshift was also located to the right of the operator. Gearshift action was smooth and easy.

The mechanical park brake was located on the floor and to the left of the seat. The hydrostatic control was located to the right of the operator. This location allowed the operator's arm to comfortably rest on the armrest of the seat while controlling forward speed.

The mechanical engagement of the separator, feeder and unloading auger provided feedback to the operator, which aided in smooth engagement. The levers were convenient to use and required average force to operate [separator 60 lb (270 N), feeder 50 lb (230 N), and unloading auger 25 lb (110 N)]. The feeder could be engaged separately or with the separator. The header reverser was controlled with a foot pedal and an electric switch on the console. The foot pedal allowed the operator to back out a slug or to slowly feed material in without engaging the header drive. Header height and tilt were electro hydraulically controlled by switches located on the hydrostatic handle. Reel height and unloading auger position were controlled with hydraulic levers.

A minimum header height could be set using a dial control on the right console. This was convenient for dropping the header when entering crop. The system was activated by a switch located on the horizontal console. When on, the set point could be over ridden by depressing both the header height switch and override located on the front of the hydrostatic handle.

Pickup speed was controlled manually with a dial on the right console. Pickup speed did not vary automatically with ground speed changes. When in widely varying crop conditions adjusting pickup speed became tiresome. Fan and rotor speed were controlled electronically with switches located on the horizontal console, and could be adjusted while harvesting.

The Terrain Tracer option provided header lateral tilt. On the pickup table this was not beneficial but may be on wider straight cut headers. The tilt switch for the header was located on the hydrostatic lever. An indicator was provided to show when the table was level. This greatly assisted the operator since is was difficult to tell if the header had a slight tilt.

Loss Monitor: The loss monitor was very good for cereals but poor for small seed crops.

Both the straw walker and shoe were monitored by full width sensors. Loss level was indicated by two rows of coloured lights in the right horizontal console along with the monitor adjustments. One row indicated walker loss while the other indicated shoe loss. Green lights indicated low loss, yellow indicated average loss and red, high loss. The lights were easy to see at a glance. The loss monitor operated in time base mode.

Once set, the grain loss monitor provided a very useful and reliable indication of grain loss in wheat and barley. However, in canola and flax, the monitor did not provide a suitable indication of loss. In these crops the monitor could not be adjusted to show suitable output compared to observed loss.

As with all loss monitors, meter readings had to be regularly compared to actual loss observed behind the combine for appropriate calibration.

Lighting: Lighting was good.

Lighting for nighttime harvesting was provided by eight forward lights; one rear light, an unloading auger light, and a grain tank light. The forward lights illuminated the header well and provided suitable short, medium and long range lighting. The lights were adjusted to suit the pickup header but could be adjusted for wide straight cut headers as well. The unloading auger light was mounted on the grain tank in line with the unloading auger. This made unloading difficult since the stream of grain was in the shadow of the unloading auger. The unloading light was remounted at the rear of the grain tank, this illuminated the stream of grain and the truck box. The grain tank light was dim and became covered when the tank was about 90% full. This made topping off the grain tank at night difficult. It is recommended that the manufacturer consider providing better grain tank lighting.

The rear light also served as a portable service light. The light had a 20 ft (6.1 m) cord that plugged into either the horizontal console in the cab or near the rear access ladder. When plugged into the rear socket, the light could be slid into a bracket for normal use. A switch near the rear access ladder turned the light on and off. With these locations and available cord length all areas of the combine could be reached. This was convenient for night service.

The controls and instrumentation panel were lit only by the reflection of the forward lights, which made finding the switches at the rear of the horizontal console difficult. The gauge back lighting provided easy night viewing. One ceiling mounted interior light brightened the cab, making it easy for the operator to see all areas.

Two tail lights, two parking lights and six flashing warning lights aided in safe road transport. The driving lights shone into the header when the header was fully raised. This reduced forward lighting. It is recommended that the manufacturer consider modifications to improve forward lighting when the header is fully raised.

Handling: Handling was excellent.

The New Holland TX36 was easy to drive and very maneuverable. The steering and hydrostatic ground drive were smooth and responsive. The quick steering and short turning radius allowed the New Holland TX36 to pick around sharp windrow corners. The wheel brakes assisted in cornering but were rarely needed. The hydrostatic ground drive was very convenient for matching ground speed to crop conditions and made backing up quick and easy on hard to pick corners. The speed ranges in the various gears were appropriate with most harvesting being done in second or third gear.

The combine was very stable in the field even with a full grain tank. Normal caution was needed when operating on hillsides and when travelling at transport speeds. The combine transported well. Maximum speed was 20.1 mph (32.4 km/h).

Adjustment: Ease of adjustment was good.

Pickup, feeder, fan, cylinder speeds and concave clearance were adjusted from in the cab. Sieve openings, rotary separator speed, and wind board position were adjusted on the machine.

Table auger clearance, table auger finger timing, table auger stripper position, front feeder drum height, wind board position, rotary separator concave, rethresher concave, returns distribution plate and sieve angle were easily adjusted with the aid of hand tools. Although there were a lot of adjustments, once adjusted for suitable performance, they seldom had to be readjusted.

Initial proportioning of the concave to the cylinder was inconvenient if the header was attached. The feeder drive pulley made access to the front left concave adjusting nut difficult. Gauging clearances was easily done through the access holes. Removing concave wires was easy once the stone trap was removed. Concave blanks were easily engaged from the side of the machine. The concave was adjusted with a lever inside the cab.

Care was required when adjusting the height of the beater wings to prevent contact with the rotary separator. This adjustment was best done by releasing belt tension on the rotary separator and rotating the beater and rotary separator independently of each other to find the position with the least clearance. PAMI adjusted the beater wings to their most inward position.

The cylinder speed and fan speed were convenient to adjust. The indexed adjustment levers on the sieves made it easy to position the adjustment precisely. Adjusting the pre-blower sieve was time consuming and required a wrench. It is recommended that the manufacturer consider modifications to permit easier pre-blower sieve adjustment. Switching the rotary separator speed was easily done by repositioning a belt on pulleys. No hand tools were required.

To provide a uniform layer of material on the grain pan the deflector plate was adjusted by observing the chaff load on the grain pan after a “kill stall”.

Positioning the chaff spreader was difficult and time consuming for one person due to its size and weight. Also, with the spreader in its optimum position for spreading, access to the shoe was restricted. It is recommended that the manufacturer consider modifications to the chaff spreader to improve the ease of positioning and to allow easy access to the shoe.

Field Settings: Ease of setting components to suit crop conditions was very good. Once familiar with the combine’s performance, setting was usually quick and little fine tuning was required.

Threshing was easy to set for in all crops. Simply moving a lever, redirected material from the chopper on to the ground, which provided an easy means to check processed straw. Maximum cylinder rpm and minimum concave clearance provided the most aggressive threshing. These aggressive settings were often used in hard to thresh crops such as Katepwa wheat. In flax, and occasionally in wheat, the awning plates were engaged to assist threshing. In easier to thresh crops, a lower cylinder speed and increased concave clearance were used.

Separation was also easy to set for, since the setting, which provided suitable threshing usually also provided acceptable separation. Maximum separation was obtained with the rotary separator at the high speed and its concave at minimum clearance. To minimize straw break up and shoe loading in easier threshing crops like canola, the rotary separator speed was decreased to 410 rpm. To further reduce break up the front separator concave clearance could be increased.

The shoe was easily set once the material was uniformly distributed to the shoe. In wheat and barley, both the standard and Petersen chaffers were usually set wide open and then the fan speed adjusted accordingly. However, in flax and canola the pre-blower, chaffer, and tailing sieve openings had to be decreased to reduce the amount of MOG passing to the cleaning sieve and into the return. No provision was made to easily check tailing returns, which would have been useful. It is recommended that the manufacturer consider providing a safe and convenient method for sampling the return tailings.

The wind boards did not require adjustments from factory settings. The clean grain sample was easy to see in the tank and a sample could be easily taken through the tank access door near the cab ladder. Sample cleanliness was usually easily controlled by adjusting the clean grain sieve. However, it could also be controlled by pre-blower sieve adjustment. Although the pre-blower sieve had only three positions two more could be obtained without modifications. These two were closed and wide open and were adjusted to these positions by moving the lever past the bottom and top hole, then inserting and tightening the bolt. These two positions did not affect shoe performance greatly. Although with the pre-blower sieve closed, the clean grain had less white caps. Fan speed was used to minimize loss.

Unplugging: Ease of unplugging was very good. The header, cylinder and cleaning sieve were the only components that plugged during the test.

The table auger plugged occasionally when dense wads of crop wedged under the table auger. The header reverser easily backed out these obstructions. The slow speed setting of the reverser made it very convenient for clearing and re-feeding an obstruction.

The cylinder plugged once in heavy green canola. It was easily unplugged by dropping the concave, reversing the header and engaging the separator. Removal of the stone trap, which was quite easy would allow easy access to the cylinder if severe plugging occurred.

The cleaning sieve plugged in barley, rye and wheat when too tight a sieve setting was used. The cleaning sieve could be unplugged by opening completely and running the separator. Although on some occasions the chaffer had to be removed and material freed manually.

Machine Cleaning: Ease of cleaning the New Holland TX36 completely was very good.

Cleaning the grain tank was easy. The tank was open and accessible. Only about 0.3 bu (0.01 m3) of grain remained in the tank. The majority of this grain was left in the unloading auger and loading auger sumps. The sumps were easily cleaned when the sump doors were removed.

With the feeder assembly raised and the stone trap removed, the grain pan could be completely cleaned. Access doors running the full length of the clean grain and returns auger allowed the augers to be cleaned without removing the sieves. The sieves could be easily removed for further cleaning.

Chaff and straw were easily cleaned from internal machine components with the aid of a blower. Large doors to the beater and rotary separator provided access to these components.

The small amount of chaff on the exterior of the machine was easily removed with the aid of a blower. Lips on the inside of the large access doors filled with chaff. When opened the chaff dumped onto the operator. It is recommended that the manufacturer consider modifications to prevent chaff from collecting on the inside lips of the large access panels.

Chaff collected on the rotary separator access door near the engine. This chaff did not cause any problems but was near the engine and should be cleaned regularly.

Lubrication: Ease of lubrication was good.

Daily lubrication was easy, requiring only 15 to 20 minutes. Of the 70 pressure grease fittings, thirty-four required service at 10 hours, thirty at 50 hours, and six at 100 hours. Grease banks were provided for the unloading auger pivot and thrust washers on the cylinder drive. Some fittings were difficult to reach but after a couple of service intervals, most operators developed a technique for getting to the hard to reach fittings. Grease banks would have reduced lubrication time and would improve the ease of servicing. The manufacturer also suggested lubricating five roller chains at 10 hour intervals. The 50 and 100 hours of service took slightly longer than daily service.

Engine, hydraulic and gearbox oil levels required regular checking. Changing engine oil was easy, however, changing the hydrostatic filter was inconvenient.

The fuel inlet was approximately 8 ft (2.4 m) above the ground and was difficult to fill from some gravity fuel tanks.

Service interval decals were placed on the combine and service schematics were provided in the operator's manual, this reduced time to lubricate. The lubrication points in the service decals included all options available. If the fine print was not read, the operator could spend time looking for pressure fittings that were not on their combine.

Maintenance: Ease of performing routine maintenance was good.

Most shields or panels were hinged or easily removed to provide access to the drives for lubrication and adjustment. Most belts had spring loaded idlers and the chain drives had bolt tighteners for simplified maintenance.

The spring tensioned feeder chain reduced the frequency of adjustment. Slip clutches protected the table auger, feeder, tailings, and clean grain drives.

The engine compartment was accessible from the back, the top and through a large door in the grain tank. Although the radiator did not need to be cleaned during the test, the large radiator screen was inconvenient to remove, as tools were required. Cab and engine air filters were easily removed for servicing.

The cylinder and concave were easily accessed when the stone trap was removed and the beater and rotary separator were accessed through large doors in the grain tank.

The table and feeder assembly could be removed quickly with the aid of only a few hand tools.

ENGINE AND FUEL CONSUMPTION

The Ford 474 diesel engine started quickly and ran well. The engine had adequate power to achieve feedrates that limited combine capacity in all conditions. It also had sufficient torque reserve to recover from over loading.

Average fuel consumption was 7.5 gal/h (34.2 L/h) for the separator hours of operation and 5.7 gal/h (26.0 L/h) based on engine hours. Oil consumption was insignificant.

OPERATOR SAFETY

No safety hazards on the New Holland TX36 were apparent. However, normal safety precautions were required and warnings had to be heeded.

The operator's manual emphasized safety. The New Holland TX36 had warning decals to indicate dangerous areas. All moving parts were well shielded and the shields were easily removed and replaced.

The neutral safety switch was incorporated into the hydrostatic lever ensuring the combine would not move when started. The combine came equipped with a horn to provide the operator with a means to warn individuals outside the machine. The New Holland TX36 would start when the separator unloading auger and feeder were engaged. This made it vitally important that the operator disengage all drives and shut off the engine before making adjustments or working on the combine. A header safety stop was provided and should be used when working near the header or when the combine is left unattended.

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

While these safety features were effective, PAMI still emphasizes the importance of conscientious maintenance and operating practices to prevent accidents or injury.

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

OPERATOR'S MANUAL

The operator's manual was very good.

The operator's manual was well organized and well written, although incorrect referencing occurred in a few locations and some of the terminology was unfamiliar. However, the unfamiliar terminology became clear after some time. A table of contents and index made finding specific information quick and easy. An operator's manual supplement was also provided for North America. This contained information about the header, radio, feeder reverser, reel speed adjustment, unloading auger chute, straw spreader, straw chopper and cold start kit.

The manual contained sections on safety, general information, operation, lubrication, maintenance, trouble shooting, standard and optional equipment and specifications. Although some engine information was supplied in the Combine Operator's Manual, the separate and more comprehensive Engine Operator's Manual was more useful. A separate manual provided information on the 971 header.

MECHANICAL HISTORY

The intent of the test was evaluation of functional performance. Extended durability testing was not conducted. However, TABLE 6 outlines the mechanical history of the New Holland TX36 for the 115 hours of operation during which about 1190 acres (482 ha) of crop were harvested.

TABLE 6. Mechanical History

Item	Operating Hours	Equivalent Field Area ac	(ha)
-Pickup teeth broke. The teeth 12 at beginning of test were replaced. 3 at various times		throughout test	
-Straw walker sensor retaining bolt loosened. Bolt was replaced	10	100	(40)
-Feeder chain jumped sprocket. Half links removed	30	310	(126)
-Concave indexing mechanism would not hold concave in position when slugs taken in	90	880	356
loading cross auger drive shaft sheared. Shaft welded at	100	1000	405
-Broken and bent concave wires. Ten wires replaced and 30 wires straightened at		End of test	

Broken Pickup Teeth: On initial start up, 12 teeth failed and during the test 3 more failed. The teeth were replaced with redesigned teeth. The new teeth did not fail during the test.

Retaining Bolt for Straw Walker Sensor: A retaining bolt loosened and was lost causing the sensor to trigger the horn alarm. The bolt was replaced.

Feeder Chain: After 25 hours of operation the feeder chain stretched and the adjustment mechanism did not tension the chain. Hence, the chain jumped on the sprocket. Half links were removed and the chain retensioned.

Concave Indexing Spring Retainer: The retainer holding the concave indexing spring failed. The indexing pin slipped from the slot causing the concave to fall. The retainer was repaired. The concave still continued to fall when slugs were taken in. As material passed between the concave and cylinder, the indexing mechanism and lever vibrated causing the holding pin to work out of the slot. A different slot angle would prevent concave falling. It is recommended that the manufacturer consider modifications to prevent the concave from falling during heavy feedrate conditions.

Unloading Cross Auger Shaft: The unloading cross-auger shaft failed. Grain in the truck box blocked the unloading auger down spout. As a result, the weld on the unloading cross auger stub shaft sheared and the sheet metal shrouding expanded. The stub shaft was temporarily welded. A new cross auger was installed after the test. The sheet metal was worked to it original shape.

Damaged Concave: On initial set up, PAMI found that cylinder-to-concave clearance was slightly greater in the middle of the first and second concave than by the edges. After harvest the difference in clearance had increased to about 0.1 in (2.5 mm). It was found that the first two bars had bent. It is recommended that the manufacturer consider modifications to reduce concave bending.

Also numerous concave wires were damaged between the first and second concave bars (FIGURE 17). One wire was broken and 45 were bent. Ten wires were replaced and 30 more were straightened while the remaining five did not warrant straightening.

FIGURE 17. Damaged Concave Wires.

APPENDIX I
SPECIFICATIONS

MAKE:	New Holland
MODEL:	TX36
SERIAL NUMBER:	Header-549111 Body-8602039 Engine-VZ093254
MANUFACTURER:	Ford New Holland 500 Dillar Avenue New Holland, Pennsylvania 17557
WINDROW PICKUP:	
-- make	Rake-Up
-- model	12S-SP
-- type	reciprocating reel bars with transfer drapers
-- pickup width	11.2 ft (3.4 m)
-- number of reel bars	6
-- number of transfer belts	7
-- type of teeth	plastic
-- number of rollers - transfer	2
-- height control	non-castoring gauge wheels
-- speed control	electro-hydraulic
-- speed range	0 to 314 ft/min (0 to 1.6 m/s)
HEADER:	
-- model	New Holland 971
-- type	centre feed
-- width -table	12.5 ft (3.8 m)
-feeder house	61.5 in (1565 mm)
-- auger diameter	23.7 in (603 mm)
-- feeder conveyor	3 roller chain with staggered L slatted conveyor
-- conveyor speed	523 ft/min (2.66 m/s)
-- pickup height range	-37.6 to 51.4 in (-0.9 to 1.3 m)
-- number of lift cylinder	2
-- raising time	adjustable (3.9 s minimum)
-- lowering time	adjustable (3.5 s minimum)
-- option	terrain tracer
STONE PROTECTION:	
-- type	removable sump
-- cleaning	manual access door
CYLINDER:	
-- type	high inertia transverse mounted hardened and chromed rasp bars
-- number of rasp bars	8
-- diameter	23.7 in (603 mm)
-- width	61.2 in (1555 mm)
-- drive	electro-mechanical controlled variable pitch belt
-- speed	380 to 1150 rpm
-- option	speed reducer
CONCAVE: (THRESHING)	
-- type	bar & wire
-- number of bars	13
-- configuration	8 interval with 0.14 in (3.5 mm) wire and 0.41 in (11 mm) opening with quick release awning plates
-- width	61.8 in (1569 mm)
-- radial length	23.9 in (606 mm)
-- wrap	123 degrees (max)
-- total area	1474 in^2 (0.951 m^2)
-- open area	928 in^2 (0.599 m^2), 63%
-- grain delivery to shoe	grain pan
BEATER:	
-- type	10 wing drum
-- diameter	23.9 in (607 mm)
-- speed	66.7% of cylinder speed

BEATER CONCAVE:	
-- type	bar and wire
-- number of bars	8
-- configuration	12 interval with 0.24 in (6 mm) diameter wires and 0.93 in (24 mm) spaces
-- width	61.8 in (1570 mm)
-- radial length	16.9 in (430 mm)
-- wrap	78 degrees
-- area total	1046 in^2 (0.675 m^2)
-- area open	632 in^2 (0.408 m^2), 60%
-- grain delivery to shoe	grain pan
ROTARY SEPARATOR:	
-- type	transverse mounted with angled spike teeth
-- configuration	open face 10 bar altering and staggering 8 & 9 teeth per bar
-- diameter	23.5 in (588 mm)
-- width	61.2 in (1555 mm)
-- tooth	
-width	2.2 in (56 mm)
-height	2.4 in (60 mm)
-- speed	410 and 780 rpm
ROTARY SEPARATOR CONCAVE:	
-- type	bar and wire
-- number of bars	12
-- configuration	12 interval with 0.24 in (6 mm) diameter wires and 0.93 in (24 mm) spaces Wires and radial bars extend out from rear of concave
-- width	61.8 in (1570 mm)
-- radial length	
-concave	19.7 in (500 mm)
-extension	5.3 in (135 mm)
-- wrap	
-concave	81 degrees
-extension	18 degrees
-- area	
-concave	1217 in^2 (0.785 m^2)
-extension	328 in^2 (0.212 m^2)
-- area open	
-concave	807 in^2 (0.520 m^2), 66%
-extension	268 in^2 (0.173 m^2), 81%
-- grain delivery to shoe	grain pan
STRAW WALKERS:	
-- type	5 step for meal metal spread steel rectangle opening
-- number	6
-- length	10.6 ft (3.23 m)
-- walker housing width	62.4 in (1586 mm)
-- separating area	55.1 ft^2 (5.12 m^2)
-- crank throw (radius)	1.9 in (47.5 m)
-- speed	230 rpm
-- grain delivery to shoe	closed bottom walker drops on pre-blower sieve
-- straw curtain	adjustable height
SHOE:	
-- type	opposed motion
-- speed	320 cpm
-- chaffer sieve	
-type	regular tooth - adjustable
-tooth depth	0.9 in (22 mm)
-louvre spacing	1.3 in (29 mm)
-total area	3007 in^2 (1.94 m^2)
-effective area	2553 in^2 (1.65 m^2)
-travel	0.9 in (22 mm) vertical 1.6 in (40 mm) horizontal
-option	Petersen
-- Pre-blower sieve	
-type	regular tooth - adjustable
-tooth depth	0.4 in (10 mm)
-louvre spacing	1.3 in (29 mm)
-total area	1834 in^2 (1.18 m^2)
-effective area	2837 in^2 (1.86 m^2)
-travel	0.9 in (22 mm) vertical 1.6 in (40 mm) horizontal
-extension	wire rake
-- tailings sieve	
-type	regular tooth - adjustable
-tooth depth	0.9 in (22 mm)
-louvre spacing	1.3 in (29 mm)
-total area	517 in^2 (0.33 m^2)
-effective area	393 in^2 (0.25 m^2)
-extension	wire rake
-- cleaning sieve	
-type	regular tooth - adjustable
-tooth depth	0.4 in (10 mm)
-louvre spacing	0.8 in (21 mm)
-total area 3	521 in^2 (2.27 m^2)
-effective area	2932 in^2 (1.89 m^2)
-travel	0.4 in (9 mm) vertical 1.4 in (36 mm) horizontal

CLEANING FAN:

-- type	6 blade forward curve
-- diameter	19.8 in (504 mm)
-- width	60.6 in (1538 mm)
-- drive	electric over mechanical variable pitch belt
-- speed range	500 - 960 rpm
-- wind boards	2 (adjustable)

RETHRESHER: (ROTO THRESHER)

-- type	rotating drum with 6 sets of staggered radial teeth intermeshing with concave teeth
-- drum	
-number of teeth	12
-diameter	11.1 in (282 mm)
-width	4.6 in (117 mm)
-speed	800 rpm
-- concave	
-number of teeth	11
-width	4.6 in (117 mm)
-radial length	11.6 in (295 mm)
-option	toothless concave

ELEVATORS:

-- type	
-clean grain	roller chain with rubber paddles
-tailings	auger with flipper paddles
-- clean grain (top drive)	6.7 x 10.6 in (169 x 270 mm)
-- returns (bottom drive)	6.7 in (172 mm) diameter

GRAIN TANK:

-- capacity	230 imp bu (8.3m³)
-- unloading time	115 seconds
-- unloading auger diameter	11.8 in (300 mm)
-- unloading auger length	13.6 ft (4.2 m)
-- options	flexible auger down spout

CHAFF SPREADERS:

-- number of spreaders	2
-- type	vertical disc with blade - side discharge
-- speed	350 rpm

STRAW CHOPPER:

-- type	rotating hammer and stationary knife
-- width	64.0 in (1625 mm)
-- speed	3540 rpm

ENGINE:

-- make	Ford
-- model	474
-- type	Diesel
-- number of cylinders	6 (inline)
-- displacement	474 in³ (7.8 L)
-- governed speed (full throttle)	2500 rpm
-- manufacturer's rating	240 hp (179 kW)
-- fuel tank capacity 1	07 gal (485 L)

CLUTCHES:

-- header	mechanical (belt tightener)
-- separator	mechanical (belt tightener)
-- unloading auger	mechanical (belt tightener)
-- straw chopper	electro-magnetic clutch

NUMBER OF CHAINS: 5

NUMBER OF BELT DRIVES: 15

NUMBER OF GEAR BOXES: 10

LUBRICATION POINTS:

-- 10 h	34
-- 50 h	30
-- 100 h	6

TIRES:

-- front	30.5L - 32 R1
-- rear	16/70 - 20

TRACTION DRIVE:

-- type	hydrostatic, 4 speed transmission
-- speed range	
-1st gear	0 to 2.4 mph (0 to 3.8 km/h)
-2nd gear	0 to 5.2 mph (0 to 8.4 km/h)
-3rd gear	0 to 9.3 mph (0 to 15.0 km/h)
-4th gear	0 to 20.1 mph (0 to 32.4 km/h)

OVERALL DIMENSIONS:

-- wheel tread (front)	10.7 ft (3.27 m)
-- wheel tread (rear)	9.6 ft (2.92 m)
-- wheel base	11.3 ft (3.45 m)
-- transport height	13.2 ft (4.03 m)
-- transport length	35.6 ft (10.85 m)
-- transport width	16.1 ft (4.90 m)
-- field height	13.2 ft (4.03 m)
-- unloader discharge height	13.2 ft (4.03 m)
-- unloader reach	7.9 ft (2.4 m)
-- unloader clearance	11.2 ft (3.41 m)
-- turning radius	
-left	22.3 ft (6.81 m)
-right	22.0 ft (6.71 m)

WEIGHT (GRAIN TANK EMPTY):

-- right front wheel	9420 lb (4270 kg)
-- left front wheel	10260 lb (4650 kg)
-- right rear wheel	3730 lb (1690 kg)
-- left rear wheel	3730 lb (1690 kg)
TOTAL	27120 lb (12300 kg)

APPENDIX II

PAMI REFERENCE II COMBINE CAPACITY RESULTS

The tables below and FIGURES 18 and 19 present the capacity results for the PAMI Reference II Combine in barley and wheat crops for 1988 to 1991.

FIGURE 18 shows capacity differences in barley crops for the different years. The Harrington barley crop shown in FIGURE 18 had slightly below average grain and straw yields and average straw and grain moisture. Capacity was slightly below average in this barley crop.

FIGURE 19 shows the capacity differences in wheat crops. In 1991 the Katepwa wheat crop selected had average grain and straw yield with average grain moisture and below average straw moisture. Wheat capacity in 1991 was about average for the Reference II combine.

The average capacity of the Reference II combine in the 1991 season indicates that combines tested along side the Reference II would also likely have had a similar average capacity. Results show that the Reference II combine is important in determining the effect of crop variable and in comparing capacity results of combines evaluated in different years.

Reference Combine Capacity Results for 1991

CROP CONDITIONS

Crop	Variety	Cut Width ft	Cut Width m	Crop Yield bu/ac	Crop Yield t/ha	Moisture Content Straw %	Moisture Content Grain %	MOG/G Ratio
Barley	Bonanza	25	7.6	93	5.0	11.4	11.5	0.77
Barley	Harrington	42	12.8	71	3.8	9.9	11.0	0.75
Wheat	Laura	42	12.8	42	2.8	6.3	13.1	1.40
Wheat	Katepwa	42	12.8	46	3.1	7.7	12.4	1.08

CAPACITY AT 3%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material
Barley	Bonanza	315	8.6	510	11.1	725	19.7	1.2	0.5	0
Barley	Harrington	350	9.5	580	12.6	815	22.2	2.1	0.7	0
Wheat	Laura	400	10.9	285	7.8	685	18.6	2.6	3.2	0.4
Wheat	Katepwa	555	15.1	515	14.0	1070	29.1	2.8	2.3	1.1

CAPACITY AT 1.5%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material %
Barley	Bonanza	260	7.1	422	9.2	600	16.3	1.2	0.5	0
Barley	Harrington	290	7.9	480	10.5	675	18.4	2.2	0.7	0
Wheat	Laura	320	8.7	230	6.3	550	15.0	2.8	3.2	0.4
Wheat	Katepwa	470	12.8	435	11.8	905	24.6	3.0	2.3	1.1

Reference Combine Capacity Results for 1990

CROP CONDITIONS

Crop	Variety	Cut Width ft	Cut Width m	Crop Yield bu/ac	Crop Yield t/ha	Moisture Content Straw %	Moisture Content Grain %	MOG/G Ratio
Barley	Harrington	30	9.2	56	3.0	5.9	11.2	0.71
Barley	Heartland	25	7.7	92	4.9	8.2	12.4	0.63
Barley	Virden	24	7.4	89	0.0	13.0	9.6	0.78
Wheat	Biggar	24	7.4	91	4.9	9.4	15.1	0.78
Wheat	Katepwa	24	7.4	45	2.4	4.2	12.7	0.99

CAPACITY AT 3%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material
Barley	Harrington	315	8.6	555	12.1	760	20.7	2.5	0.8	0.4
Barley	Heartland	355	9.7	700	15.2	920	25.0	1.6	4.0	3.6
Barley	Virden	405	0.0	650	0.0	925	0.0	1.2	1.8	0.8
Wheat	Biggar	575	15.6	735	20.0	1310	35.7	3.0	3.7	0.5
Wheat	Katepwa	550	15.0	555	15.1	1105	30.1	2.8	4.0	0.5

CAPACITY AT 1.5%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material %
Barley	Harrington	270	7.3	475	12.1	650	17.7	2.5	0.8	0.4
Barley	Heartland	300	8.2	600	15.2	755	21.1	1.6	4.0	3.6
Barley	Virden	325	0.0	520	0.0	730	0.0	1.2	1.8	0.8
Wheat	Biggar	485	13.2	620	16.9	1105	30.1	4.6	4.0	0.5
Wheat	Katepwa	475	12.9	480	15.1	955	26.0	2.8	4.0	0.5

Reference Combine Capacity Results for 1989

CROP CONDITIONS

Crop	Variety	Cut Width ft	Cut Width m	Crop Yield bu/ac	Crop Yield t/ha	Moisture Content Straw %	Moisture Content Grain %	MOG/G Ratio
Barley	Harrington	30	9.1	64	3.4	10.8	10.5	0.60
Barley	Heartland	30	9.1	70	3.8	10.0	13.4	0.64
Wheat	Katepwa A	20	6.1	55	3.7	8.8	16.2	1.00
Wheat	Katepwa B	30	9.1	57	3.9	11.5	15.4	1.10
Wheat	Katepwa C	30	9.1	66	4.4	14.8	15.8	1.13

CAPACITY AT 3%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material
Barley	Harrington	330	9.0	690	15.0	880	24.0	0.8	0.7	0.4
Barley	Heartland	320	8.7	625	13.6	820	22.3	1.7	0.1	0.1
Wheat	Katepwa A	490	13.4	490	13.4	980	26.8	3.1	0.7	0.4
Wheat	Katepwa B	405	11.0	370	10.1	775	21.1	2.8	0.5	0.3
Wheat	Katepwa C	470	12.8	415	11.3	885	24.1	3.1	0.5	0.3

CAPACITY AT 1.5%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material %
Barley	Harrington	285	8.8	595	24.7	760	19.5	0.8	0.6	0.4
Barley	Heartland	255	7.5	500	9.3	655	16.7	1.9	0.2	0.1
Wheat	Katepwa A	420	12.5	420	15.5	840	31.8	3.1	0.9	0.7
Wheat	Katepwa B	335	13.2	305	16.5	640	33.7	3.5	0.5	0.4
Wheat	Katepwa C	375	14.3	330	10.7	705	27.6	3.0	0.6	0.5

Reference Combine Capacity Results for 1988

CROP CONDITIONS

Crop	Variety	Cut Width ft	Cut Width m	Crop Yield bu/ac	Crop Yield t/ha	Moisture Content Straw %	Moisture Content Grain %	MOG/G Ratio
Barley	Ellice	30	9.1	68	3.7	12.9	11.4	0.75
Wheat	Katepwa A	30	9.1	35	2.4	4.7	12.4	0.93
Wheat	Katepwa B	30	9.1	43	2.9	9.5	13.7	1.20

CAPACITY AT 3%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material
Barley	Ellice	400	10.9	665	14.5	930	25.4	1.3	0.6	0.1
Wheat	Katepwa A	540	14.7	580	15.8	1120	30.5	1.7	2.0	0.3
Wheat	Katepwa B	570	15.5	475	12.9	1045	28.4	2.3	3.3	1.3

CAPACITY AT 1.5%

Crop	Variety	Feedrates MOG lb/min	MOG t/h	Grain bu/h	Grain t/h	Total lb/min	Total t/h	Grain Cracks %	Dockage %	Foreign Material %
Barley	Ellice	325	8.8	541	24.7	760	19.5	1.0	0.5	0.1
Wheat	Katepwa A	465	7.5	500	9.3	965	16.7	2.1	2.0	0.2
Wheat	Katepwa B	485	12.5	400	8.6	890	23.3	2.2	3.1	1.5

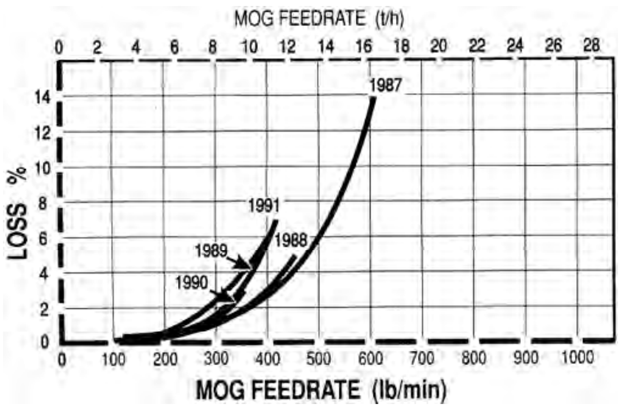

FIGURE 18. Total Grain Loss for the PAMI Reference II Combine in Barley.

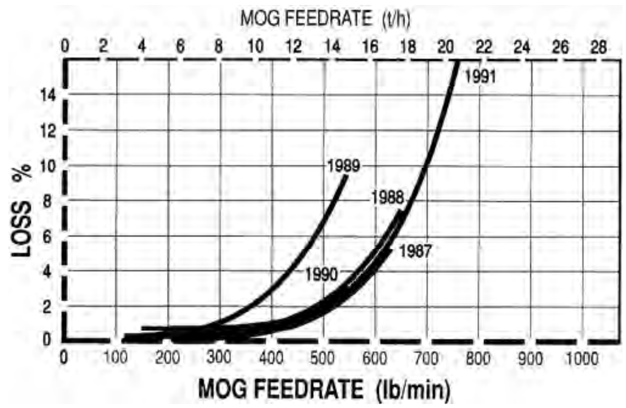

FIGURE 19. Total Grain Loss for the PAMI Reference II Combine in Wheat

APPENDIX III
REGRESSION EQUATIONS FOR NEW HOLLAND TR96 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 percentage of yield, S = shoe loss in percentage of yield, R = rotor loss in percentage of yield, F = the MOG feedrate in lb/min, while ln is the natural logarithm. Sample size refers to the number of toss 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	$U = -0.021 + 0.42 \times 10^{-6} \times F^2$ $S = 0.13 + 0.72 \times 10^{-14} \times F^5$ $W = -0.02 + 0.10 \times 10^{-13} \times F^5$	0.82 0.84 0.97	23^2 26^2 186^2	7
Barley Herrington	3	$ln\,U = -4.16 + 0.40 \times 10^{-2} \times F$ $S = 0.14 + 0.23 \times 10^{-11} \times F^4$ $ln\,W = -4.04 + 0.70 \times 10^{-2} \times F$	0.72 0.77 0.99	10^1 13^1 464^2	6
Wheat Katepwa	4	$U = 0.18 + 3.82 \times 10^{-16} \times F^5$ $S = -0.02 + 5.04 \times 10^{-10} \times F^3$ $W = -0.03 + 1.26 \times 10^{-15} \times F^5$	0.93 0.63 0.94	77^2 10^1 86^2	8
Wheat Laura	4	$ln\,U = -1.69 + 2.05 \times 10^{-3} \times F$ $S = 0.11 + 0.12 \times 10^{-23} \times F^8$ $ln\,W = -4.08 + 6.16 \times 10^{-3} \times MF$	0.89 0.97 0.99	63^2 275^2 9162	10

APPENDIX IV
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

SUMMARY CHART
NEW HOLLAND TX36 COMBINE

RETAIL PRICE	$184,402.00 (April, 1992, f.o.b. Humboldt)
CAPACITY	
Compared to Reference II	
-barley	1.9 and 2.2 x Reference II
-wheat	1.9 and 2.0 x Reference II
MOG Feedrates	
-barley - Bonanza	690 lb/min (18.8 t/h) at 3% total loss, FIGURE 2
-barley - Harrington	670 lb/min (18.2 t/h) at 3% total loss, FIGURE 3
-wheat - Katepwa	1065 lb/min (29.0 t/h) at 3% total loss, FIGURE 4
-wheat - Laura	755 lb/min (20.5 t/h) at 3% total loss, FIGURE 5
QUALITY OF WORK	
Picking	**Very Good;** picked well in all crops
Feeding	**Excellent;** aggressive table auger, smoothly fed large windrows
Stone Protection	**Good;** trapped most stones
Threshing	**Good;** aggressive threshing, concave blanking required in flax
Separating	**Very Good;** rotary separator aided separation of grain from MOG before walkers
Cleaning	**Very Good;** low shoe loss in all crops and on side slopes, some plugging
Clean Grain Handling	**Good;** filled evenly, difficult unloading in windy conditions
Straw and Chaff Spreading	**Good** straw spreading; spread evenly up to 25 ft (7.6 m) **Very Good** chaff spreading; spread evenly up to 20 ft (6 m)
EASE OF OPERATION AND ADJUSTMENT	
Operator Comfort	**Good;** quiet cab, cab access inconvenient
Instruments	**Good;** most functions monitored, instruments easy to observe
Controls	**Very Good;** well placed, easy to use
Loss Monitor	**Very Good** in Cereals; indicated loss well **Poor** in small seed crops; indication not useful
Lighting	**Good;** forward area well lit, poor grain tank light
Handling	**Excellent;** smooth responsive drive, small turning radius
Adjustment	**Good;** chaff spreader restricted access to shoe
Field Setting	**Very Good;** little fine tuning required
Unplugging	**Very Good;** feeder reverser worked well, feeder did not plug
Machine Cleaning	**Very Good;** all areas accessible
Lubrication	**Good;** decals in manual or machine
Maintenance	**Good;** most areas easily accessed
ENGINE AND FUEL CONSUMPTION	
Engine	Started quickly ran well, good torque reserve, power limit was not reached
Fuel Consumption	7.5 gal/h (34.2 L/h)
OPERATOR SAFETY	Well shielded and many safety features
OPERATOR'S MANUAL	**Very Good;** well organized and easy to find information
MECHANICAL HISTORY	A few mechanical problems occurred

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