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Group 4c

Evaluation Report 600

Case IH 1682 Pull-Type Combine

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

CASE IH 1682 PULL-TYPE COMBINE

MANUFACTURER:
J.I. Case Company
700 State Street
Racine, Wisconsin 53404
U.S.A.
Telephone: (414) 636-7530

DISTRIBUTOR:
J.I. Case Company
P.O. Box 5051240 Henderson Drive
Regina, Saskatchewan
S4P 3M3
Telephone: (306) 924-1600

RETAIL PRICE:
$89,943.00 [March, 1989, f.o.b. Humboldt, Sask., with a 13 ft (4.0 m) header, 13 ft (4.0 m) pickup, auxiliary header lift cylinder with hydraulic accumulator, powered rock beater with rock trap, wide and narrow spaced concaves, grain scan monitor, 17.3 ft (5.3 m) unloading auger, and straw chopper].

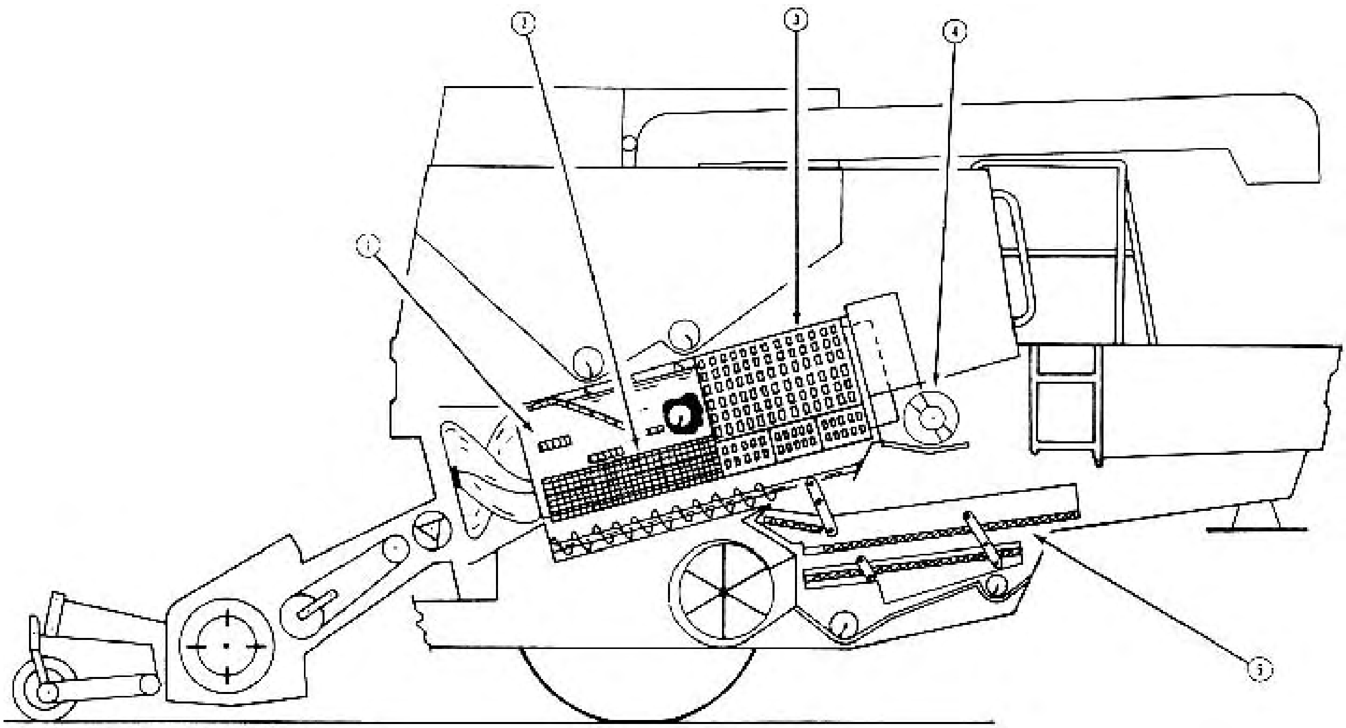

FIGURE 1. Case IH 1682: (1) Rotor, (2) Threshing Concaves, (3) Separating Concaves, (4) Discharge Chopper, (5) Cleaning Shoe.

SUMMARY AND CONCLUSIONS

Capacity: In the capacity tests, the MOG feedrate* at 3% total grain loss in Ellice barley was 710 lb/min (19.4 t/h). In wheat, capacity ranged from 700 lb/min (19.1 t/h) at just under 2% total grain loss in the Katepwa"A" crop to 850 lb/min (23.2 t/h) at 3% total grain loss in the Katepwa "B" crop.

In the barley test, the Case IH 1682 had approximately 1.8 times the capacity of the PAMI Reference II combine when compared at 3% total grain loss. In the wheat tests, the capacity of the Case IH 1682 was 1.5 and 1.3 times the capacity of the PAMI Reference II combine.

Quality of Work: Pickup performance was good. In well-supported windrows, crops were picked cleanly. However, in short barley crops, plugging frequently occurred between the drapers and the pickup stripper. Feeding was very good in most crops and conditions. The table auger and feeder were aggressive and seldom plugged.

The stone trap provided good stone protection. Objects up to 4 in (101 mm) in diameter were emptied from the trap. Some hard objects went through the rotor, but didn't cause any noticeable concave or rotor damage.

Threshing was good. Unthreshed loss and grain damage were low in most crops, but in hard-to-thresh crops, rotor drive slippage limited the maximum attainable feedrate. Using less aggressive settings reduced the slippage, but resulted in increased unthreshed loss. Separation of grain from straw was very good. In all crops, rotor loss was low over the normal operating range.

Cleaning shoe performance was fair. Shoe loss was acceptable in wheat and oil seeds, but in barley where wider chaffer settings were used, airflow problems caused chaffer plugging and grain loss.

Grain handling was good. The 245 bu (8.7 m³) grain tank filled evenly in all crops. Unloading a full tank of dry wheat took about 135 seconds. The optional longer unloading auger provided ample clearance for unloading into all trucks and trailers encountered. However, in windy conditions, the extra height of the discharge when the unloader was fully extended resulted in some scattering and loss.

Straw spreading was fair. The straw was spread only over 15 to 20 ft (4.6 to 6.1 m) and was concentrated more on the right side.

Ease of Operation and Adjustment: Ease of hitching was good. Initial hook-up took one person about one day. Some tractors may require a "zero" pressure return for the hydraulic pickup drive motor. Operator comfort and visibility depended on the tractor used.

Instrumentation was good. All important functions were monitored but only one could be displayed at a time. The controls were good. The controls utilized three of the tractor's remote hydraulics and the tractor's PTO clutch. The other combine controls were located in the cab mounted control console. The

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

touch sensitive keypads on the control console were convenient to operate and provided a clear "beep" each time they were activated.

The loss monitor was good. Shoe loss, rotor loss or both could be monitored. The loss reading was useful only if compared to actual loss.

Lighting supplied by the combine for nighttime harvesting was good. Most functional areas were adequately lit, but additional tractor lights were required for proper lighting of the windrow and header.

Handling was good. Changing between field and transport position took about 5 min. The combine was very stable in the field, even with a full grain tank.

Ease of adjusting the combine components was good. All components were easy to adjust, but response of the fan speed and rotor speed adjustments was slow, and changing concaves was inconvenient. Ease of setting the components to suit crop conditions was good. Once familiar with the rotor and shoe behavior, optimum settings could usually be determined quickly.

Ease of unplugging was good. The electric feeder reverser worked well, and was easy to use for unplugging the table auger and feeder. A plugged rotor could usually be cleared by lowering the concave and powering the slug through. Ease of complete cleaning was fair. Cleaning the grain tank sump and rotor cage was time consuming and laborious.

Ease of lubrication was very good. Daily lubrication was quick and easy. Performing general maintenance was very good as most belts and chains were easily accessed.

Power Requirements: The manufacturer recommended an optimum tractor size of 160 to 220 PTO hp (119 to 164 kW). Power take off input power alone was 150 hp (112 kW) when operating at capacity in Katepwa wheat. Additional power would be required for harder threshing conditions and for pulling a loaded combine in hills. PAMI suggests that a tractor with at least 180 hp (134 kW) is required for most harvesting conditions.

Operator Safety: No safety hazards were apparent on the Case IH 1682. However, normal safety precautions were required and warnings had to be heeded. The operator's manual emphasized operator safety.

Operator's Manual: The operator's manual was good. It was clearly written but sometimes incomplete. It contained useful information on safety, controls, trouble shooting, and machine specifications.

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

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to eliminate rotor drive slippage.
2. Modifications to provide positive airflow through the chaffer over the full range of chaffer settings.
3. Providing full bin warning sensors for the grain tank.
4. Modifications to improve straw spreading.
5. Modifications to improve response of the rotor speed and fan speed adjustments.
6. Modifications to permit safe, convenient sampling of the return tailings while harvesting.
7. Modifications to make sump cleaning easier and more convenient.
8. Revising the operator's manual to provide correct and detailed information on header adjustment and lubrication.
9. Revising the operator's manual to strongly emphasize the importance of not exceeding chaffer settings of 0.6 in (16 mm).
10. Modifications to provide proper and reliable operation of the automatic pickup speed control.
11. Modifications to provide smooth, positive operation of the rotor speed adjusting mechanism.
12. Modifications to reduce wear in the rotor intake cone.

Senior Engineer: J.D. Wassermann
Project Manager: L.G. Hill
Project Engineer: C.A. Hanson

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Modifications to eliminate rotor drive slippage are under investigation.
2. Modifications to provide positive airflow through the chaffer over the full range of settings will be investigated.
3. Providing full bin warning sensors for the grain tank will be considered.
4. Modifications to improve straw spreading will be considered.
5. Modifications to improve response of the rotor and fan speed adjustments will be considered.
6. Modifications to permit safe, convenient sampling of the return tailings while harvesting will be considered.
7. Modifications to make sump cleaning easier and more convenient will be considered.
8. The operator's manual for the 1682 combine will be revised to provide corrected and updated information. A separate operator's manual for the 1015 windrow pickup header is available but was inadvertently not delivered to PAMI with the header.
9. Revisions will be incorporated in the next printing of the operator's manual advising not to exceed a 0.6 inch chaffer setting except in special circumstances.
10. Modifications to provide proper and reliable operation of the automatic pickup speed control are under investigation.
11. Modifications to provide smooth positive operation of the rotor speed adjusting mechanism will be investigated.
12. Modifications to increase wear life of the rotor intake cone are under consideration.

GENERAL DESCRIPTION

The Case IH 1682 is a power take-off driven, pull-type combine. It has a single longitudinally mounted rotor, threshing and separating concaves, a discharge chopper, and a cleaning shoe. The closed-tube rotor has four intake fins (impeller blades), a combination of longitudinal and helical rasp bars, and four longitudinal separating fins (FIGURE 2). The threshing concaves are typical bar and wire construction, and the separating grates are slotted, formed metal (FIGURE 3). The discharge chopper has fixed hammers arranged in two helical rows (FIGURE 4). The cleaning fan is a single, six blade paddle fan, and the adjustable lip chaffer sieve and cleaning sieve move in opposed motion.

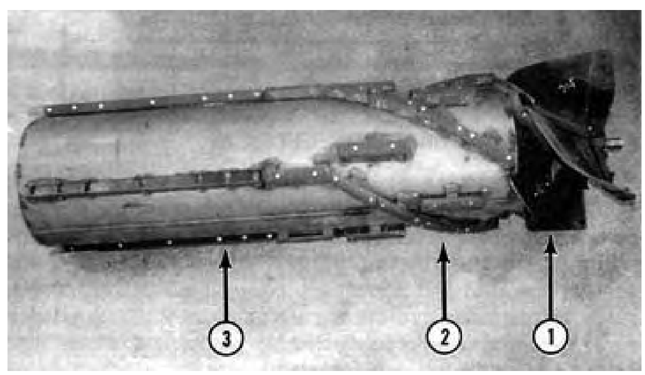

FIGURE 2. Rotor: (1) Intake Section, (2) Threshing Section, (3) Separating Section.

Crop is fed to the rotor intake fins, which spiral the material into the rotor. Threshing begins upon first contact with the rotor and continues throughout the length of the threshing concaves. The angled rasp bars and adjustable vanes in the top of the rotor housing move the crop rearward. Separation of grain from straw occurs throughout the full length of the threshing and separating concaves. The discharge chopper strips the processed crop away from the rotor and discharges it out the back of the combine. Grain and chaff passing through the concaves are conveyed to the front of the cleaning shoe by augers. The grain is cleaned by a combination of pneumatic and sieving action. Tailings are returned to the rotor above the third threshing concave (FIGURE 3).

The test combine was equipped with a 13 ft (3.9 m) pickup header, a 13 ft (3.9 m) two roller belt pickup, powered rock beater, and optional equipment as listed on page 2.

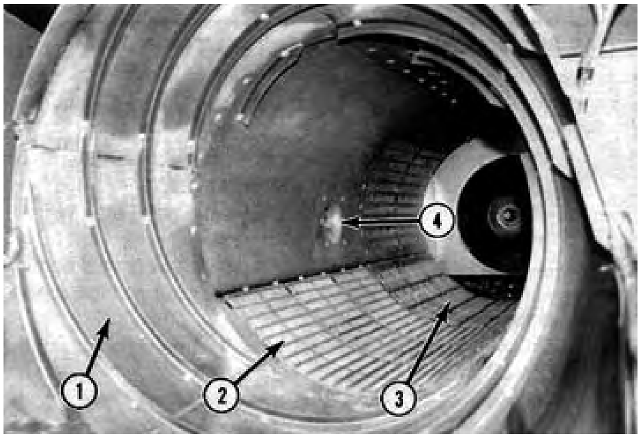

FIGURE 3. Rotor Cage: (1) Transition Cone, (2) Threshing Concaves, (3) Separating Grates, (4) Tailings Return.

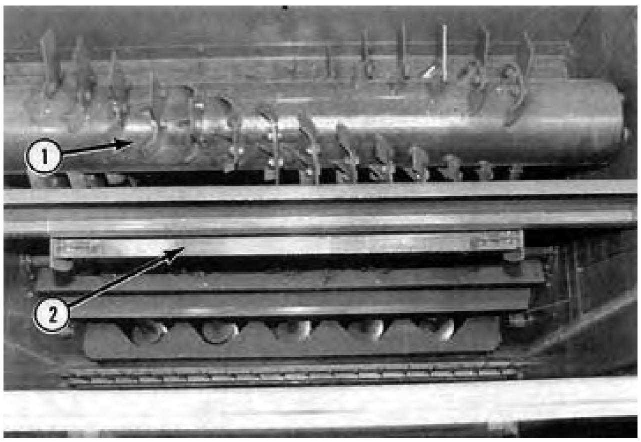

FIGURE 4. Discharge Chopper: (1) Rotor with Fixed Hammers, (2) Adjustable Knife Concave.

The separator drive is controlled through the tractor's power take-off clutch. Header engagement, unloading auger engagement, rotor speed, and fan speed are controlled electrically from the control console mounted in the tractor cab. The pickup is driven from the tractor's hydraulics and it's speed varied electro-hydraulically from the control console. Header height and unloading auger swing are controlled with the tractor's hydraulics, while concave clearance and sieve settings are adjusted externally on the machine. There is no provision to safely and conveniently inspect return tailings while operating. Important component speeds and harvest functions are displayed electronically on the control console.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The main purpose of the test was to determine the functional performance of the Case IH 1682. Measurements and observations were made to evaluate the Case IH 1682 for rate of work, quality of work, ease of operation and adjustment, power requirements, operator safety, and the suitability of the operator's manual. Although extended durability testing was not conducted, the mechanical failures, which occurred during the tests, were recorded.

The Case IH 1682 was operated for 120 hours while harvesting about 1320 ac (534 ha) of various crops. In addition, capacity tests were conducted in one barley crop and two wheat crops. The operating conditions for the season are shown in TABLES 1 and 2.

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".

TABLE 1. Operating Conditions

Crop	Variety	Yield Range		Width of Cut		Sep. Hours	Field Area		Crop Harvested	
		bu/ac	t/ha	ft	m		ac	ha	bu	t
Barley	Bonanza Ellice Herrington	60-77 50-55 25-45	3.2-4.0 2.7-3.0 1.3-2.4	25 30 30,50, 60	7.6 9.1 9.1,15.2 18.3	10 2 19	70 15 325	28 6 132	4570 785 10670	99.5 17.0 232.5
Canola	Tobin Westar	10-25 15-30	0.6-1.4 0.8-1.7	21,30 20,22 25	6.4,9.1 6.1,6.7 7.6	13 24	135 235	54 95	2490 4950	56.5 112.5
Peas	Trapper	25-30	1.7-2.0	21	6.4	6	40	16	1045	28.5
Flax	Norlin	20-25	1.3-1.6	20,24	6.1,7.3	4	45	18	965	24.5
Rye	Musketeer	10-20	0.6-1.3	20,21 24	6.1,6.4 7.3	23	250	102	4465	113.5
Wheat	Katepwa	25-40	1.7-2.7	18,30	5.5,9.1	19	205	83	6090	166.0
Total						120	1320	534	36100	850.5

TABLE 2. Operation in Stony Conditions

Field Conditions	Hours	Field Area	
		ac	ha
Stone Free	25	225	91
Occasional Stones	95	1095	443
Total	120	1320	534

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.

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 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.

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 larger conventional combine 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.

RATE OF WORK

Capacity Test Results: The capacity results for the Case IH 1682 are summarized in TABLE 3.

The performance curves for the capacity tests are presented in FIGURES 5 to 7. The curves in each figure indicate the effect of increased feedrate on rotor loss, shoe loss, unthreshed loss and total loss. From the graphs, combine capacity can be determined for loss levels other than 3%. The rate at which loss changes with respect to feedrate shows where the combine can be operated effectively. Portions of loss curves, which are "flat" or slope gradually indicate stable performance. Where the curves hook upward 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.

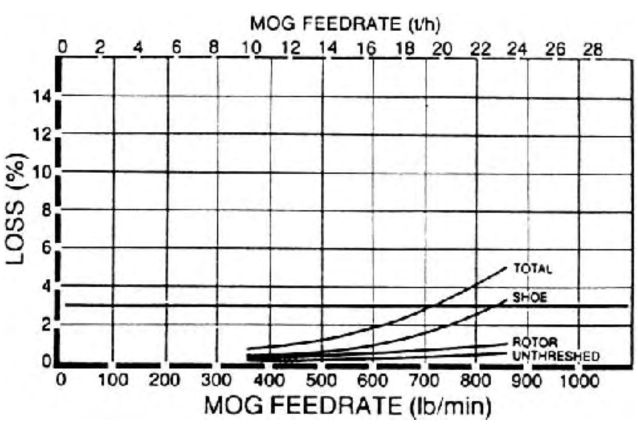

FIGURE 5. Grain Loss in Ellice Barley.

The Ellice Barley crop used for the test came from a uniform stand and was laid in a well-formed single windrow. The crop was mature and both the grain and straw were dry. The grain yield and the MOG/G ratio were average. Despite the dry straw, break-up was about average. The grain threshed easily, and the awns broke off readily.

In this barley crop, capacity at 3% total loss was 710 lb/min (19.4 t/ h) MOG. Shoe loss was the greatest component of total loss at all feedrates and limited capacity. Shoe loss was acceptable at MOG feedrates up to about 650 lb/min (17.7 t/h) but increased rapidly at higher feedrates, which made operating at these levels impractical.

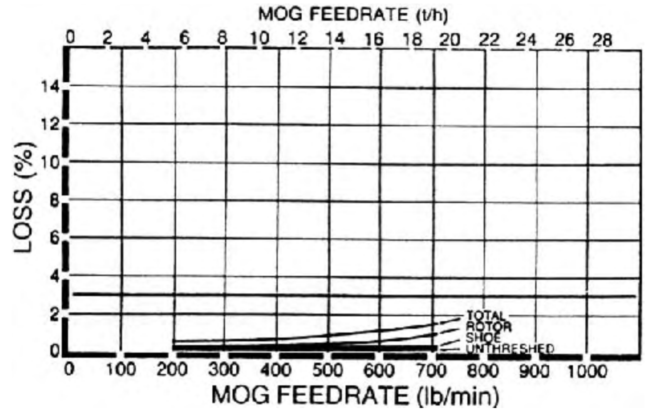

FIGURE 6. Grain Loss in Katepwa Wheat "A".

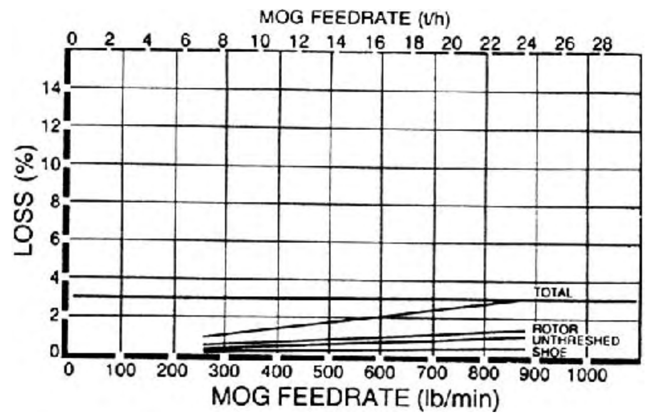

FIGURE 7. Grain Loss in Katepwa Wheat "B".

The Katepwa "A" wheat crop came from a stand that varied somewhat due to the drought conditions of 1988. However, the single windrow was well formed with the heads evenly distributed. Both the straw and grain were dry and break-up was slightly higher than normal.

The yield was about average and the MOG/G ratio was typical so that the grain feedrates accompanying the MOG feedrates were also quite typical. The grain threshed easily but was susceptible to grain damage due to its low moisture content.

In the Katepwa "A" wheat crop, the maximum feedrate achieved was just over 700 lb/min (19.1 t/h) MOG at a total loss of just under 2%. Feedrate was limited by rotor slippage. Rotor loss was the greatest component of total loss at all feedrates and would likely have limited capacity at higher feedrates if rotor slippage had not occurred. The relatively flat loss curves in FIGURE 6 indicate that losses would not change very much with normal changes in feedrate due to variations in ground speed and windrow density. The low loss over the operating range meant that the combine could be operated efficiently even at its maximum feed rate.

The Katepwa "B" wheat crop came from a heavy, uniform crop stand. It was laid in a well-formed, single windrow with the heads evenly distributed. Both the straw and grain were dry, but they had considerably higher moisture content than in the first test. The higher moisture resulted in less straw break-up and less grain damage. The yield was slightly above average and the straw yield was high resulting in a high MOG/G ratio. This meant that the grain feedrate

TABLE 3. Capacity of the Case IH 1682

Crop Conditions									Results									
		Width of Cut		Crop Yield		Moisture Content			MOG Feedrate		Grain Feedrate		Total Feedrate		Grain Cracks	Dockage	Foreign	Fig.
Crop	Variety	ft	m	bu/ac	t/ha	Straw %	Grain %	MOG/G	lb/min	t/h	bu/h	t/h	lb/min	t/h	%	%	Material	No.
Barley	Ellice	30	9.1	69	3.7	12.7	11.9	0.84	710	19.4	1055	23.0	1555	42.4	0.3	0.7	0.2	5
Wheat	Katepwa"A"	30	9.1	35	2.4	5.0	11.6	1.10	700	19.1	635	17.3	1335	36.4	1.2	1.9	0.4	6
Wheat	Katepwa"B"	30	9.1	40	2.7	9.9	13.9	1.49	850	23.2	570	15.5	1420	38.7	0.4	2.9	1.2	7

was low for the MOG feedrate achieved. The higher grain and straw moisture along with the long straw meant that less aggressive threshing was achieved even when using aggressive settings.

In the Katepwa “B” wheat crop, capacity at 3% total loss was about 850 lb/min (23.2 t/h) MOG. In this test, the rotor drive did not limit capacity. Rotor loss and unthreshed loss were both major components of total loss. Had higher rotor speed been available unthreshed loss may have been reduced. The loss curves in FIGURE 7 show that losses increased gradually with feedrate over the entire operating range. This meant that over the normal operating range, normal changes in feedrate due to variations in ground speed and windrow density would only have a small effect on loss. It also shows that large increases in feedrate can be achieved by accepting slightly higher loss rates.

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 workrates 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 ones. 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.

TABLE 4. Field Workrates

Crop	Range	Grain Feedrate		Area Rate		Width of Cut		Yield		Variety
		bu/h	t/h	ac/h	ha/h	ft	m	bu/ac	t/ha	
Barley	High	610	13.3	16.5	6.7	60	18.3	37	2.0	Harrington
	Low	370	18.1	5.0	2.0	25	7.6	74	4.0	Bonanza
	Avg.	520	11.3	13.5	5.5			39	2.1	
Canola	High	300	6.8	9.5	3.8	25	7.6	31	1.7	Westar
	Low	120	2.7	8.0	3.2	22	6.7	15	0.8	Westar
	Avg.	200	4.5	10.0	4.0			20	1.1	
Peas	High	180	4.9	6.5	2.6	21	6.4	28	1.9	Trapper
	Low	125	3.4	5.0	2.0	21	6.4	25	1.7	Trapper
	Avg.	165	4.5	6.0	2.4			27	1.8	
Flax	Avg.	215	5.5	6.0	3.8	24	7.3	23	1.4	Norlin
Rye	High	255	6.5	12.5	5.1	21	6.4	20	1.3	Musketeer
	Low	120	3.0	9.5	3.8	24	7.3	13	0.8	Musketeer
	Avg.	195	5.0	11.0	4.5			18	1.1	
Wheat	High	405	11.0	12.0	4.9	30	9.1	34	2.3	Katepwa
	Low	265	7.2	10.5	4.2	18	5.5	25	1.7	Katepwa
	Avg.	325	8.8	11.0	4.5			30	2.0	

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.

Once capacity ratios for different evaluation combines have been determined for comparable crops, they can be used to approximate capacity differences. 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 test combine 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, the difference in capacity may not be significant; where the bands do not overlap the difference in capacity is significant.

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 1.50 to 1.60 times the capacity of Reference I in wheat and about 1.40 to 1.50 times Reference I’s capacity in barley.

Capacity Compared to Reference Combine: The capacity of the Case IH 1682 was greater than that of the PAMI Reference II combine in both wheat and barley. At 3% total loss, the Case IH 1682 had about 1.8 times the Reference II’s capacity in Ellice barley, and 1.5 times its capacity in Katepwa “B” Wheat. In the Katepwa “A” Wheat test, rotor drive slippage limited the Case IH 1682’s feedrates so that at just under 2% total loss, it had only about 1.3 times the capacity of the Reference II combine at 3% total loss.

FIGURES 8 to 10 compare the total loss of both combines over their practical operating range of feedrates. The graphs show that at higher total losses (greater than 1.5 to 2.0%), the Case IH 1682 usually had significantly greater capacity than the Reference II combine. This difference in capacity would usually be easily noticed when operating. At lower total losses (less than 1.0 to 1.5%), the confidence belts in the graphs often overlap, indicating that the difference in capacity may not be statistically significant. Differences when operating at these very low loss levels would generally be much harder to distinguish in the field.

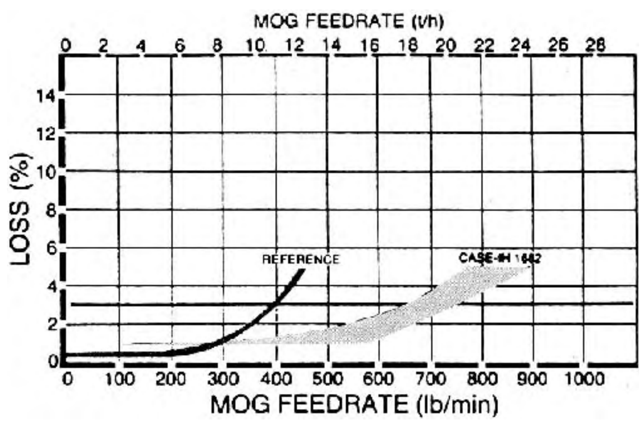

FIGURE 8. Total Grain Loss in Ellice Barley.

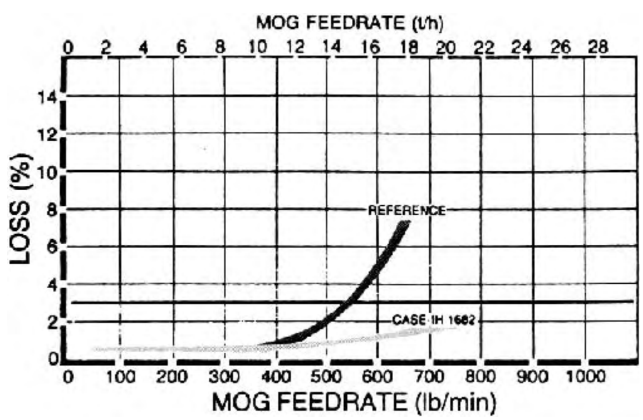

FIGURE 9. Total Grain Loss in Katepwa Wheat “A”.

QUALITY OF WORK:

Picking: Pickup performance was good in most crops.

The pickup was normally operated at about a 30° angle to the ground, with the gauge wheels adjusted so the teeth just cleared the ground. The picking speed was set just slightly faster than ground speed. With these settings, well supported windrows were picked cleanly at speeds up to 6 mph (9.7 km/h). Picking aggressiveness was increased in poorly supported windrows by increasing pickup speed and reducing the pickup angle. As with many other draper type pickups, in extremely hard-to-pick conditions, some crop was not picked, even at slow ground speeds when using aggressive settings.

In short barley crops, plugging frequently occurred between the drapers and the pickup stripper (FIGURE 11). Increasing the pickup angle, which usually minimizes this problem on other pickups, had no effect on the Case IH pickup.

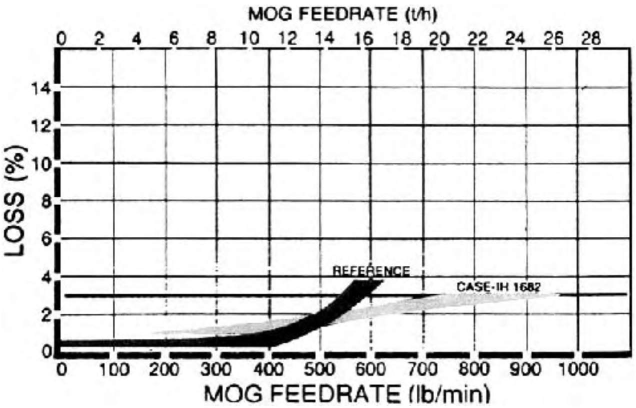

FIGURE 10. Total Grain Loss in Katepwa Wheat “B”.

FIGURE 11. Plugging at the Pickup Stripper.

The problem may have been aggravated by improper positioning of the stripper during assembly. Later in the test, the assembly error was discovered and corrected. However, the problem conditions were no longer available, thus the extent of the assembly error for causing plugging was not determined.

The pickup occasionally picked a few smaller stones when operated in stony conditions.

The wind guard was effective in directing material under the table auger, and could be easily positioned to provide adequate clearance for bushy canola windrows.

As with most pull-type combines, mobility was somewhat restricted compared to self-propelled models. Although the pickup was wide enough to pick around most corners, extremely sharp or poorly laid corners required extra maneuvering.

Feeding: Feeding was very good.

As is typical of many rotary combines, feeding windrows off-center did not noticeably affect combine performance. However, when feeding off-center, proper table auger stripper adjustment was necessary to prevent crop from spiralling with the auger.

The table auger was aggressive and fed crop smoothly to the feeder conveyor. The table auger plugged occasionally when dense bunches of swathed crop or green material was taken in. The table auger did not wrap in any crop.

The feeder conveyor was aggressive and did not plug, and there was no evidence of back feeding.

Stone Protection: Stone protection was good.

Although the test combine was not operated in stony conditions, some small stones and hard objects were found in the stone trap. Objects up to 4 in (101 mm) were emptied from the trap. The stone trap was most effective if emptied regularly to prevent grain and dirt from hardening in the trap. Although the rotor took in some hard objects, no stone damage to the rotor or concaves was apparent at the end of the test.

Threshing: Threshing was good. In most crops and conditions the crop fed through the threshing section smoothly.

The rotor speeds normally used produced threshing bar speeds equal to or higher than the threshing bar speeds of many conventional combines. Close concave clearance was used in hard-to-thresh crops such as wheat and flax, while wider concave settings provided adequate threshing in easy-to-thresh crops like barley and canola.

Unthreshed loss was usually low in most crops but became noticeable in tough conditions or when rotor drive slippage occurred. In all crops, rotor drive slippage became severe at moderate to high feedrates when using aggressive threshing settings. Using less aggressive threshing settings, such as opening the concave wider than normal, allowed higher feedrates before slipping occurred, but also increased unthreshed loss. Thus, in hard-to-thresh crops like Katepwa wheat, it was sometimes extremely difficult to attain threshing settings that simultaneously produced low unthreshed loss at reasonably high feedrates. It is recommended that the manufacturer consider modifications to eliminate rotor drive slippage. A slightly higher maximum rotor speed would have been desirable for damp crops and crops with high straw yield.

Grain damage was low in most crops. Very dry conditions and high rotor speed increased grain damage slightly but it was usually still within acceptable limits.

TABLE 5 shows the settings PAMI found to be suitable for different crops. Most of the threshing settings PAMI used were more aggressive than suggested in the operator’s manual.

TABLE 5. Crop Settings

Crop	Rotor Speed	Concave Setting Position #	Sieve Openings						Fan Speed
			Chaffer		Tailings		Cleaning		
	rpm		in	mm	in	mm	in	mm	rpm
Barley	850-910	1 - 2 WW	5/8	15	3/4	19	1/2	13	800-1000
Canola	470-510	4 - 5 NW	9/16	14	3/4	19	1/4	5	620-700
Peas	320-350	2 WW	11/16	17	13/16	21	3/8	10	1000
Flax	260	0 NW	5/16	8	5/8	15	1/16	2	530
Rye	600-730	5 - 6 NW	5/8	15	15/16	24	1/4	6	700-730
Wheat	900-950	0 - 1 NW	5/8	15	15/16	24	3/16	5	860-900

WW - Wide Wire Concave, NW - Narrow Wire Concave

Separating: Separating was very good.

In all crops, material flowed smoothly through the separating section. Plugging and bridging did not occur. Rotor drive slippage did cause the rotor to slow down at higher feedrates and may have decreased separation.

In barley, all three wide-spaced concaves were used and the transport vanes were left in the factory set (center) position. Rotor loss was usually low over the operating range and increased only gradually with feedrate. When using less aggressive settings, but still needing more separation, open area in the separating section was increased by removing the separating grate channels. This helped reduce rotor loss. However, it also increased shoe loading, which caused increased shoe loss.

In wheat, three narrow-spaced concaves were used and the transport vanes and separating grate channels were left in the factory set position. Rotor loss was low over the entire operating range even though it was the largest part of total loss.

In canola and flax, the narrow-spaced concaves were used, and in field peas the wide-spaced concaves were used. Rotor loss was usually low in these crops.

The settings used to achieve optimum separation in the different crops encountered are listed in TABLE 5.

Cleaning: Cleaning shoe performance was fair.

Shoe loading uniformity was hard to determine because the combine could not be shut down quickly. The shoe discharge appeared to be slightly heavier on the right in dry conditions. However, the lack of difference in loss across the shoe suggested that any extra load was adequately handled.

An area across the width of the chaffer about 18 in (460 mm) from the front and extending back about 20 in (510 mm) frequently plugged (FIGURE 12). Although some plugging occurred in most crops, it was most severe in barley where wide chaffer openings were used. In barley, the plugging resulted in high loss due to material sloughing over the chaffer. Simple tests showed that there was noticeably less airflow through this area, and as the chaffer was opened more than 0.6 in (16 mm) airflow further decreased or even reversed, flowing down through the chaffer. It is recommended that the manufacturer consider modifications to provide positive airflow through the chaffer over the full range of chaffer settings.

In barley, shoe loss limited capacity as it was the highest loss at all feedrates over the normal operating range. In the Ellice barley test, shoe loss was acceptable up to a feedrate of about 650 lb/min (17.7 t/h) MOG, but then rapidly increased making operating in this range impractical. More uniform airflow through the chaffer would have permitted using larger chaffer openings more typical for harvesting barley. In turn, this may have allowed higher feedrates with less loss.

In wheat, shoe loss did not limit combine capacity. Due to the different properties between wheat kernels and chaff, shoe performance was not as severely affected by the low air velocity across the middle of the chaffer. Shoe loss was usually very low.

In canola and flax, total loss less than 1 to 1.5% is generally considered acceptable. Within this loss range, the Case IH 1682 attained reasonable feedrates. Although most of the loss was over the shoe, it was not greatly affected by the airflow problems. Air distribution was much more uniform at the smaller chaffer openings and lower fan speeds used for these crops. The settings PAMI found suitable for the crops encountered are listed in TABLE 5.

Clean Grain Handling: Grain handling was good.

The open grain tank filled evenly in all crops, although the top corners usually did not fill completely. A full tank of dry wheat held about 245 bu (8.7 m³) of dry wheat. No full bin sensors were provided and if overfilled, grain spilled over the back of the tank first. It is recommended that the manufacturer consider providing full bin warning sensors for the grain tank.

The unloading auger had ample reach and clearance for all trucks encountered (FIGURE 13). The unloading auger was hydraulically positioned for unloading to the left. The optional longer unloading auger enabled the tractor to drive past a stationary truck or trailer while still having adequate reach for convenient unloading. The longer auger and hydraulic auger swing also aided topping loads and unloading on-the-go. The auger discharged the grain in a compact stream, unloading a full tank of dry wheat in about 135 seconds. The high discharge with the optional long unloading auger fully extended, resulted in some grain scattering and loss in moderate winds.

FIGURE 13. Unloading.

Straw Spreading: Straw spreading was fair.

In most conditions, most of the straw from the rotor entered the right side of the discharge chopper and in turn was fed to the right spreader. This resulted in a heavier concentration of straw to the right. The bat-type spreaders typically spread the straw about 15 to 20 ft (4.6 to 6.1 m) (FIGURE 14). The spread was narrow compared to the width of cut, which was suitable for this combine. It is recommended that the manufacturer consider modifications to improve straw spreading.

A small portion of the chaff was spread with the straw.

Removing the spreaders to drop the straw in a windrow took about 5 minutes. Removing the spreaders simply required the removal of the two bolts that secured the spreaders to their shafts. The optional discharge chopper produced very fine straw. Even with the stationary knife completely retracted, the straw was unsuitable for baling.

FIGURE 14. Straw Spreading.

EASE OF OPERATION AND ADJUSTMENT

Hitching: Ease of hitching was good.

Initial hook-up took one person about 1 day. The control console and loss monitor console were mounted in the tractor cab and electrical wires routed. The combine's PTO drive shaft was aligned, the position of the hitch pole adjusted, and wheel stops set on the hitch.

A tractor with either a standard 1.38 or 1.75 in (35 or 44 mm) splined, 1000 rpm PTO, a 12 V negative ground electrical system, and 3 remote hydraulic circuits was required. With many tractors, the continuous oil flow through the remote hydraulic circuit, for powering the pickup hydraulic motor, may cause excessive hydraulic oil temperatures. A "zero" pressure return circuit, which returns the oil directly into the transmission sump with minimal restriction, may be required.

After initial hook-up, subsequent hitching and unhitching was quick and easy, requiring about 10 minutes.

Operator Comfort: Operator comfort and visibility depended on the tractor used.

The control console and loss monitor console were easily mounted in the cab of the tractor used for the test. The consoles were compact and easily located in positions that did not reduce operator comfort or convenience of operating other controls.

The windrow was clearly visible as it entered the pickup and feeder. The unloader discharge was easily seen. Visibility of the grain in high truck boxes, such as would be suitable for a combine of this size, was usually restricted when viewed from the two-wheel drive tractor used in the test. A slightly better view may be provided if using a four-wheel drive tractor where the operator would be higher.

The Case IH 7140 tractor's power shift transmission was well suited to the capacity of the Case IH 1682. The working speeds were well spaced and on-the-go shifts maximized the combine's harvesting ability.

Instruments: Instrumentation was good.

The instruments were located in the control console (FIGURE 15). A single digital display was used to selectively show rotor speed or fan speed. It also showed speed slowdown of selected shafts, and the status of certain harvesting functions. The display also presented operating instructions when the operator selected the "instructions" mode. Although only one item could be displayed at one time, the display would switch automatically to the appropriate component function if a failure occurred. An audible alarm also signalled a shaft speed slowdown and the rotor and fan speed alarm set points were adjustable. The instruments also had a self-diagnostic function that signalled a failure in the combine sensing or control circuits.

All of the instruments worked well and were convenient to use. The display was easy to see day or night.

Controls: The controls were good.

The combine's main drive was engaged by the tractor's PTO clutch and the tractor remote hydraulics controlled header height, and unloading auger position. All other functions were controlled from the control console (FIGURE 15).

The switches in the console controlled the header and unloading auger clutches, rotor speed, fan speed, and feeder reverser. A rocker switch selected either automatic or manual pickup speed control, while a dial regulated the pickup speed in the manual mode and pickup speed to ground speed ratio in the automatic mode. Most of the switches were incorporated into the touch sensitive membrane keypad. Although these type of switches are often difficult to use while harvesting since they require precise finger placement and provide no indication that contact has been made, this was not the case on this unit. The switches on the console were large and easy to use, and “beeped” each time they were activated, to signal contact. This made console control convenient, while the tractor hydraulics provided familiar control of the other functions.

FIGURE 15. Control Console.

The pickup speed control worked well when operated manually, but malfunctioned in the automatic mode. This prevented its evaluation.

Loss Monitor: The loss monitor was good.

Two grain loss sensor pads were located at the rear of the rotor and two at the rear of the chaffer sieve. The monitor console was mounted separately from the control console for convenient viewing (FIGURE 16). A meter display on the monitor console indicated loss from the cleaning shoe, the rotor, or both, relative to acceptable loss observed behind the combine. The monitor console also contained four indicator lights that respectively signalled which sensor pads were being activated, but these lights did not indicate the amount of loss.

FIGURE 16. Loss Monitor Console.

Being an area based monitor, the ground speed input signal to the loss monitor regulated loss readings according to the distance travelled rather than to time. Although this should have enabled operating at fairly consistent loss on the ground behind the combine, PAMI found that in some conditions this didn’t happen. Occasionally an increase in ground speed resulted in a lower meter reading when actual loss had increased. Other times, loss had greatly increased while the meter had not changed. This was confusing and reinforces PAMI’s usual note of caution that meter readings have to be regularly compared to actual losses observed behind the combine. The reason for the unpredictable response was not apparent but may have been due to a change in shoe performance and consequent shift of the loss in relationship to the sensors.

Lighting: Lighting supplied by the combine for nighttime harvesting was good.

The two combine lights shining forward provided barely adequate lighting of the windrow and header area. Additional lighting from the tractor was essential for proper forward and rearward lighting.

The light on the unloading auger provided rear lighting when the auger was in the transport position. It provided adequate illumination for the auger discharge and truck box. The grain tank light’s effectiveness was reduced by the small holes in the grain tank screen. Control and instrument lighting was very effective.

Two red taillights and four amber warning lights were provided to aid in safe road transport.

Handling: Handling was good.

With the hitch pole set to its narrow position, a width of cut of at least 20 ft (5.5 m) was required to enable the tractor to drive between windrows. If the tractor was equipped with dual wheels, the hitch pole would have to be set to its widest position, and a width of cut of at least 24 ft (7.3 m) would be required. Some poorly laid corners could not be completely picked when turning.

Changing the hitch pole between field and transport position took about 5 minutes and required a hammer and a wheel chock. 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 travelled well at speeds up to 20 mph (32 km/h).

Adjustment: Ease of adjusting the combine components was good.

Pickup speed, rotor speed, and fan speed were adjusted from the control console, while concave clearance and sieve settings were adjusted externally on the machine.

Table auger finger timing, auger clearance, and auger stripper bar clearance were easily adjusted to suit crop conditions and once set, did not have to be readjusted.

The rotor speed and fan speed adjustments responded very slowly. It is recommended that the manufacturer consider modifications to improve response of the rotor speed and fan speed adjustments. Concave clearance was easily adjusted from the left side of the machine. The concaves could also be shifted side-to-side with respect to the rotor using draw bolts on the right hand concave hangers. This was a useful adjustment but was time consuming and was not frequently changed. Changing the threshing concaves for combining different crops was awkward. The rotor driveshaft and left tire greatly hampered access to the concave securing bolts. Once unbolted, the heavy concave sections had to be carefully maneuvered around several obstructions. Changing two concave sections took two men approximately 30 minutes, and changing all three took about 40 minutes.

Chaffer, tailings, and clean grain sieves were easily adjusted.

Field Setting: Ease of setting to suit crop conditions was good.

Once familiar with the rotor and shoe behavior, optimum settings could usually be determined quickly. After initial adjustments had been made, little fine tuning was required.

The discharge chopper made assessing unthreshed loss difficult, as most unthreshed heads that entered the chopper were likely threshed and discharged as free grain. Separation, or rotor loss, was easy to check when the spreaders were removed.

The settings that provided optimum threshing usually provided suitable separation as well. Generally, fast rotor speed and close concave clearance provided the best threshing and separating characteristics in cereal crops. However, rotor drive belt slippage usually prohibited these settings, and less aggressive settings were necessary to maximize throughput. Setting the shoe for optimum performance required a good understanding of its unusual airflow behavior. Checking shoe loss was complicated by some mixing of shoe and rotor effluent. More uniform airflow at wide chaffer settings would have made setting easier in most crops.

No provision was made for conveniently sampling the tailings. It is recommended that the manufacturer consider modifications to permit safe, convenient sampling of the return tailings while harvesting.

Unplugging: Ease of unplugging was good. Table auger and feeder obstructions were usually easy to clear using the electric feeder reverser. The rotor seldom plugged, and most plugs were attributed to the rotor drive slipping. When the rotor plugged, it could often be cleared by lowering the concave, shifting the rotor drive into low gear and powering the obstruction through. The slug wrench provided for rocking the rotor was helpful only when its chain wrench was used on the hub of the driven sheave of the rotor drive. Using the open end of the slug wrench on the driving sheave as pictured in the operator’s manual was ineffective because the rotor drive belt slipped. If the obstruction could not be powered through or loosened with the slug wrench, the concaves had to be partially removed and the material cleared by hand.

Machine Cleaning: Ease of cleaning the Case IH 1682 completely was fair.

Cleaning the grain tank was easy. Very little grain was retained except for about 0.1 to 0.3 bu (4 to 11 L), which stayed at the sump end. The grain tank and the auger troughs were easily accessible. However, the unloading auger sump was inconvenient to clean. The sump held about 0.7 to 1 bu (24 to 36 L) of grain and the clean out door did not open fully to provide easy access for cleaning (FIGURE 17). It is recommended that the manufacturer consider modifications to improve the ease of cleaning the unloading auger sump.

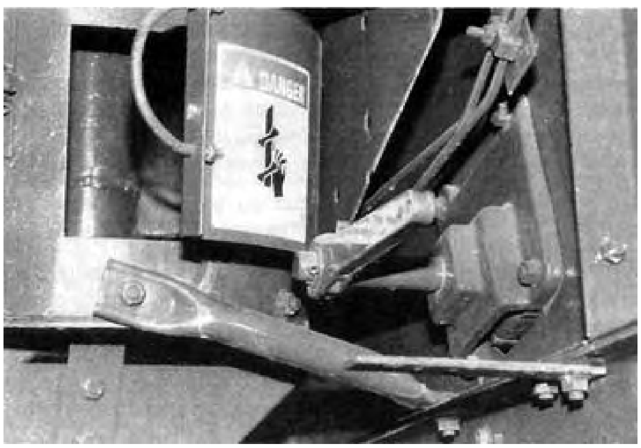

FIGURE 17. Interference Between Sump Door and Concave Adjusting Lever.

The sieves were easy to remove and provided access to the lower tailings and clean grain auger troughs. The shoe supply auger troughs were accessible from the sides and could be cleaned with a vacuum cleaner. Chaff and dust that built up on top of the rotor cage was difficult to remove (FIGURE 18). The outside of the combine collected large amounts of chaff, particularly on the rear deck, and although the chaff was easily removed, the task was usually very dirty.

FIGURE 18. Chaff Accumulation Above Rotor Cage.

Lubrication: Ease of daily lubrication was very good.

Daily lubrication was quick and easy, requiring only about 10 minutes. There were only a few grease points, and most were easily accessible. The combine had 55 pressure grease fittings. Eighteen required greasing at 10 hours, sixteen at 50 hours, an additional ten at 100 hours, and eleven more at 500 hours. Gearbox oil levels had to be checked regularly. Lubrication decals on the sides of the combine greatly aided greasing at the specified intervals, and grease banks were used wherever practical.

Maintenance: Ease of performing routine maintenance was very good.

Most belts and chains were easily accessed for lubrication or adjustment. Tension of many belts and chains was maintained with spring-loaded idlers. This greatly reduced the time required to check and adjust the drives.

Slip clutches protected the feeder conveyor, table auger, both elevators, and the shoe supply augers.

Switching tables or complete table and feeder removal was fairly easy. Rotor removal was somewhat difficult due to the weight of the rotor. Care was required after removing and replacing the front rotor cover. Small gaps at the corners of the cover, which were sealed with putty during factory assembly to control grain leaks, had to be checked and resealed every time the cover was removed.

POWER REQUIREMENTS

The manufacturer recommended a minimum tractor size of 130 PTO hp (97 kW) and suggests an optimum size of 160 to 220 PTO hp (119 to 164 kW).

Power measured at the PTO in Katepwa wheat was approximately 150 hp (112 kW) at capacity (FIGURE 19). In addition, extra tractor power was required to pull the combine, especially with a full grain tank in hills or soft ground. As well, extra power was required for hydraulic functions, harvesting tough crop, and unloading on-the-go. PAMI suggests that a tractor with at least 180 hp (134 kW) would be required to adequately power the Case IH 1682 in typical harvest conditions.

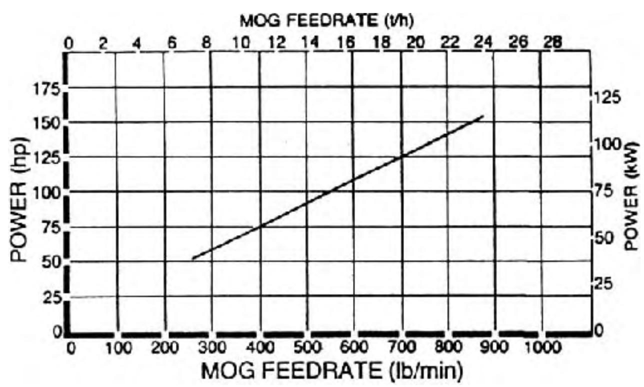

FIGURE 19. Power Requirements in Katepwa Wheat.

During the test, the combine was powered with a Case IH 7140 two-wheel drive tractor rated at 195 PTO hp (145 kW). This tractor had adequate power for the conditions encountered.

OPERATOR SAFETY

No safety hazards on the Case IH 1682 were apparent. However, normal safety precautions were required and warnings had to be heeded.

The operator’s manual emphasized safety. The Case IH 1682 had warning decals to indicate dangerous areas. All moving parts were well shielded. Most shields were easy to remove for access.

A header lift cylinder safety stop was provided and should be used when working near the header or when the combine is left unattended. If the operator must make adjustments or work in dangerous areas, all clutches should be disengaged and the engine shut off. These precautions are particularly important when adjusting the concave on the Case IH 1682, as the concave adjusting lever is located in the same area as the rotor drive shaft.

The combine was equipped with a hitch safety chain, a slow moving vehicle sign, warning lights, and taillights, to aid safe road transport. However, care had to be taken when transporting, as rear visibility was restricted.

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

OPERATOR'S MANUAL

The operator's manual was good.

Most information was clearly written and well organized, but some instructions were incomplete. No index was provided, which made locating information difficult. No information was supplied in the combine operator's manual regarding adjustment, lubrication, or servicing of the header, and a supplementary operator's manual for the header was not supplied. It is recommended that the manufacturer consider revising the operator's manual to provide correct and detailed information on header adjustment and lubrication.

The lubrication section in the operator's manual was incomplete and contained several errors. The lubrication decals on the sides of the combine also contained errors. Some lubrication points were difficult to find due to the lack of detail provided in the operator's manual. A few incorrect photos and references were found.

The operator's manual suggested initial chaffer sieve settings of 0.6 in (16 mm) for several crops, but did not indicate the adverse effects on shoe performance caused by settings wider than this. It is recommended that the manufacturer consider revising the operator's manual to strongly emphasize the importance of not exceeding chaffer settings of 0.6 in (16 mm).

The operator's manual provided useful information on safety, controls, trouble shooting, and machine specifications.

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 Case IH 1682 for the 120 hours of operation during which about 1320 ac (534 ha) of crop were harvested.

TABLE 6. Mechanical History

Item	Operating Hours	Field Area ac	(ha)
– The automatic pickup speed control didn't work	Throughout the test		
– The torque sensing rotor drive malfunctioned and substantially limited rotor throughput	Intermittently throughout the test		
– The loss monitor quit working due to a wiring harness defect at	85	963	(390)
– The actuating threads for adjustment of the variable speed rotor drive collected dust and disabled the rotor speed adjusting mechanism. The threads were freed from the hub and cleaned	Several times during the test		
– A retaining wire in one of the header lift cylinders failed, allowing the cylinder to come apart and lose hydraulic oil at	The end of the test		
– Excessive wear was found in the intake cone of the rotor cage adjacent to several welded seams at	The end of the test		

Automatic Pickup Speed Control: The automatic pickup speed control was intended to sense changes in ground speed and automatically adjust pickup draper speed accordingly. However, the pickup only responded to changes in ground speed after the forward travel of the combine reached 6 mph (10 km/h) or greater. Attempts to diagnose the problem included adjustment of the control console, and adjustment and replacement of the speed sensor, but no remedy was found. It is recommended that the manufacturer consider modifications to provide proper and reliable operation of the automatic pickup speed control.

Rotor Drive: On numerous occasions during the test, the rotor drive belt slipped under moderate load. The driven sheave assembly incorporated a torque sensing mechanism that was intended to respond to increased load by increasing the sheave pitch diameter, thus tightening the drive belt. During normal combine operation, however, this torque sensing mechanism was exposed to chaff, dirt, and debris (FIGURE 20). This may have caused binding of the mechanical components in the sheave assembly, and prevented proper drive belt tensioning under increased load.

When rotor drive slippage occurred, cycling the rotor speed through its full adjustment range displaced the dirt in the cam assembly and freed the components. The drive then worked well for a short time but the problem soon recurred. Similarly, the drive worked well for a short time after it had been disassembled and cleaned.

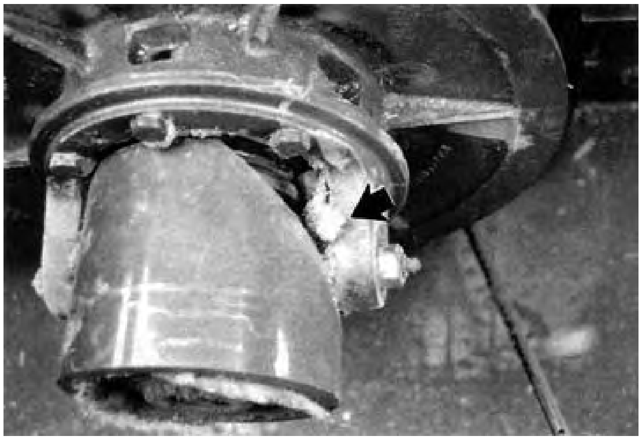

FIGURE 20. Debris in Torque-Sensing Hub.

Lubrication of the torque sensing hub was to manufacturer's specifications. Several parts of the assembly were inspected and replaced under the manufacturer's direction, but the problem was not rectified.

Rotor Speed Adjustment: On several occasions, when adjusting the rotor speed, the threaded hub of the adjustable sheave seized. This prevented speed adjustment and caused misalignment and stretching of the chain between the actuating motor and the threaded hub. The problem appeared to be caused by dirt in the hub threads and may have been aggravated by the sticking torque-sensing assembly. It is recommended that the manufacturer consider modifications to provide smooth, positive operation of the rotor speed adjusting mechanism.

Wear Beside Welds in Intake Cone: At the end of the test, excessive wear was observed adjacent to several welded seams on the inner surface of the rotor intake cone assembly. Some of the metal was worn to less than half of its original thickness. It is recommended that the manufacturer consider modifications to reduce wear in the rotor intake cone.

APPENDIX I
SPECIFICATIONS

MAKE:	Case IH Pull-type Combine
MODEL:	1682
SERIAL NUMBER:	header - 7070 body - 007075
MANUFACTURER:	J. I. Case Company 700 State Street Racine, Wisconsin 53404 U.S.A.

WINDROW PICKUP:

-- make	Case IH
-- type	rubber draper
-- pickup width	13 ft (3.9 m)
-- number of belts	7
-- type of teeth	plastic
-- number of rollers	2
-- height control	castoring gauge wheels
-- drive	tractor powered, hydraulic
-- speed control	electric over hydraulic
-- speed range	0 to 420 ft/min (0 to 2.13 m/s)
-- options	combine powered hydraulic reel or pickup drive

HEADER:

-- type	offset feed
-- table width	13 ft (3.9 m) - optional
-- feeder house width	45.2 in (1.1 m)
-- auger diameter	23.3 in (590 mm)
-- feeder conveyor	2 roller chains, undershot slatted conveyor
-- conveyor speed	462 ft/min (2.4 m/s)
-- range of picking height	+50 to -33 in (+1270 to -838 mm)
-- number of lift cylinders	2, with hydraulic accumulator - optional
-- raising time	depends on tractor used
-- lowering time	adjustable
-- standard equipment	11 ft pickup header, single lift cylinder

STONE PROTECTION:

-- type	sump with powered 3-wing beater
-- ejection	manually operated access door
-- options	rock trap finger grate, serrated beater blade extensions, stone retarder drum with no rock trap

ROTOR:

-- number of rotors	1
-- type	longitudinally mounted, closed tube with 4 intake impeller blades, multiple longitudinal and helical rasp bars, and 4 longitudinal separating fins
-- diameter	
-tube	25.4 in (644 mm)
-feeding	38.9 in (987 mm)
-threshing	30.0 in (762 mm)
-separating	29.9 in (760 mm)
-- length	
-feeding	20.5 in (520 mm)
-threshing	43.5 in (1105 mm)
-separating	46.0 in (1170 mm)
TOTAL	110.0 in (2795 mm)
-- drive	variable pitch belt through 2-speed gearbox, torque sensitive tensioning
-- speed range	
-low	280 to 680 rpm
-high	432 to 1090 rpm
-- options	specialty rotor

CONCAVE (THRESHING):

-- number	3	
-- type	bar and wire	
-- number of bars	30 for each concave	
-- configuration		
-narrow space	28 intervals with 0.2 in (4.9 mm) wires and 0.22 in (5.5 mm) spaces	
-wide space	28 intervals with 0.26 in (6.5 mm) wires and 0.57 in (14.5 mm) spaces	
-- area	Wide	Narrow
- concave total	1675 in² (1.08 m²)	1675 in² (1.08 m²)
- concave open - open area	920 in² (0.59 m²) 55%	698 in² (0.45 m²) 42%
-- wrap	1500	
-- grain delivery to shoe	5 auger conveyors	
-- options	concave filler bars	

CONCAVE (SEPARATING):

-- number	3, plus perforated upper cage
-- type	perforated formed metal
-- area total	2782 in² (1.80 m²)
-- area open	1094 in² (0.71 m²)
-- open area	39%
-- wrap	2660
-- grain delivery to shoe	5 auger conveyors
-- options	square bar grates, solid grates

THRESHING AND SEPARATING CHAMBER:

-- number of spirals	12
-- pitch of spirals	adjustable 11° - 33° normal position 220

DISCHARGE BEATER:

-- type	hammer and knife - optional
-- speed	2500 rpm
-- standard equipment	3-wing beater - 816 rpm

SHOE:

-- type	opposed action
-- speed	245 rpm
-- chaffer sieve and tailings sieve	
-type	adjustable louver, regular tooth
-louver spacing	1.1 in (29 mm) hinge to hinge, 0.9 in (2 .2 mm) teeth
-area	total 3379 in² (2.18 m²) tailings 609 in² (0.39 m²)
-travel	0.6 in (15 mm) vertical, 2.2 in (57 mm) horizontal
-- cleaning sieve	
-type	adjustable louver, regular tooth
-louver spacing	1.1 in (29 mm) hinge to hinge, 0.6 in (16 mm) teeth
-area	2775 in² (1.79 m²)
-travel	0.6 in (15 mm) vertical, 1.3 in (32 mm) horizontal
-- options	grain pan side hill dividers, alfalfa package, Peterson chaffer

CLEANING FAN:

-- type	six blade undershot
-- diameter	23.2 in (590 mm)
-- width	48.8 in (1240 mm)
-- drive	electrically controlled variable pitch belt
-- options	slow speed fan kit, high speed cleaning unit pulley

ELEVATORS:

-- type	roller chain with rubber flights
-- clean grain (top drive)	8 x 11.3 in (204 x 288 mm)
-- tailings (top drive)	6 x 7.9 in (153 x 1200 mm)
-- options	steel flights, perforated auger troughs and elevator doors

GRAIN TANK:

-- capacity	245 Imperial bu (8.9 m³)
-- unloading time	135 seconds
-- unloading auger diameter	12 in (300 mm)
-- unloading auger length	17.3 ft (5.3 m) - optional
-- standard equipment	14.3 ft (4.3 m) auger
-- options	perforated unloading auger tube

STRAW SPREADER:

-- number of spreaders	2
-- type	steel hub with 6 rubber bats
-- speed	248 rpm

CLUTCHES:

-- header	electro-magnetic
-- separator	PTO
-- unloader	electro-magnetic

NUMBER OF CHAIN DRIVES:	8
NUMBER OF BELT DRIVES:	9
NUMBER OF GEARBOXES:	4

LUBRICATION POINTS:

-- 10 hours	18
-- 50 hours	16
-- 100 hours	10
-- 500 hours	11

TIRES:	two, 28L x 26, 10-ply

OVERALL DIMENSIONS:

-- wheel tread	9.9 ft (3.0 m)
-- transport height	12.8 ft (3.9 m)
-- transport length	36.7 ft (11.2 m)
-- transport width	16.4 ft (5.0 m)
-- field height	13.1 ft (4.0 m)
-- field length	36.7 ft (11.2 m)
-- field width	21.0 ft (6.4 m)
-- unloader discharge height	12.8 ft (3.9 m)
-- unloader reach (in line with hitch pin)	8.9 ft (2.7 m) 7.9 ft (2.4 m) in dual wheel position
-- unloader clearance	12.5 ft (3.8 m)

WEIGHT:

-- right wheel	9325 lb (4230 kg)
-- left wheel	8200 lb (3720 kg)
-- hitch	1570 lb (710 kg)
TOTAL	19095 lb (8660 kg)

APPENDIX II

PAMI REFERENCE II COMBINE CAPACITY RESULTS

TABLE 7 and FIGURES 21 and 22 present the capacity results for the PAMI Reference II Combine in barley and wheat crops harvested from 1984 to 1988.

FIGURE 21 shows capacity differences in barley crops for 1984, 1986, 1987, and 1988. The 1988 Ellice barley crop shown in TABLE 7 had average grain and straw yield and average straw and grain moisture

FIGURE 22 shows capacity differences in wheat crops for the four years, In 1988, the Katebwa wheat crops had average straw yield and average grain yield, They also had average grain moisture and average straw moisture content,

Results showthat the reference combine is important in determining the effect of crop variables and in comparing capacity results of combines evaluated in different years

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

	CROP CONDITIONS									RESULTS								
			Width of Cut		Crop Yield		Moisture Content			MOG Feedrate		Grain Feedrate		Total Feedrate				
	Crop	Variety	ft	m	bu/ac	t/ha	Straw %	Grain %	MOG/G Ratio	lb/min	t/h	bu/h	t/h	lb/min	t/h	Grain Cracks %	Dockage %	Foreign Material %
1988	Barley	Ellice	30	9.1	68	3.7	12.9	11.4	0.75	400	10.9	665	14.5	930	25.4	1.3	0.6	0.1
	Wheat	Katepwa"A"	30	9.1	35	2.4	4.7	12.4	0.93	540	14.7	580	15.8	1120	30.5	1.7	2.0	0.3
	Wheat	Katepwa"B"	30	9.1	43	2.9	9.5	13.7	1.20	570	15.5	475	12.9	1045	28.4	2.3	3.3	1.3
1987	Barley	Argyle	24	7.2	69	3.5	12.6	13.0	0.82	395	10.8	600	13.1	876	23.8	0.5	1.5	1.2
	Barley	Harrington	20	6.4	79	4.3	7.7	10.8	0.81	370	10.1	570	12.4	825	22.5	1.5	3.0	0.1
	Wheat	Columbus	25	7.6	43	2.9	5.0	13.4	1.16	540	14.7	465	12.7	1005	27.4	1.5	3.5	0.1
	Wheat	Katepwa"A"	40	12.2	31	2.2	6.9	12.9	0.65	520	14.2	800	21.8	1320	35.9	1.5	2.5	0.2
	Wheat	Katepwa"B"	60	18.3	37	2.6	8.3	14.5	0.64	580	15.8	905	24.6	1485	40.4	2.0	2.0	0.1
	Wheat	Katepwa"C"	60	18.3	31	2.1	12.8	16.0	1.07	630	17.2	590	16.1	1220	33.2	1.5	1.5	0.1
1986	Barley	Harrington	56	17.0	62	3.3	10.5	10.8	0.64	424	11.6	828	18.1	1090	29.7	0.4	0.3	0.2
	Wheat	Columbus	56	17.0	51	3.4	8.8	16.7	1.14	647	17.7	568	15.5	1210	33.0	1.5	4.6	3.5
	Wheat	Katepwa	29	8.9	49	3.3	6.5	14.0	1.32	644	17.6	488	13.3	1135	31.0	1.8	1.7	1.0
1984	Barley	Bonanza	42	12.8	52	2.8	15.0	11.2	0.70	363	9.9	648	14.1	875	23.8	0.5	1.0	
	Barley	Bonanza	24	7.3	77	4.1	11.3	11.6	0.66	352	9.6	687	14.6	880	24.0	0.5	1.0	
	Wheat	Neepawa	44	13.4	36	2.4	6.3	10.9	1.32	539	14.7	408	11.1	950	25.9	1.1	5.5	
	Wheat	Neepawa	22	12.8	44	3.0	8.7	10.2	1.18	601	16.4	509	13.9	1110	30.3	4.5	7.0	

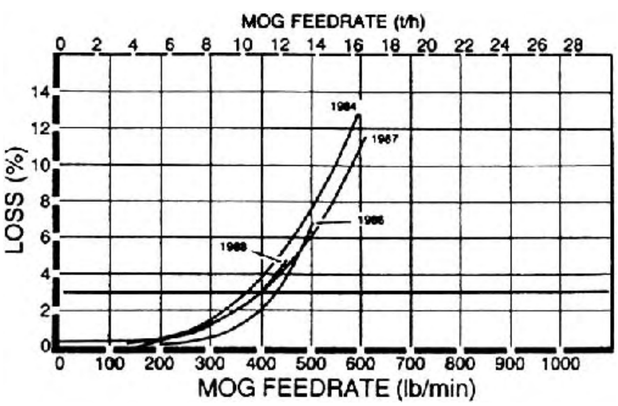

FIGURE 21. Total Grain Loss for the PAMI Reference II Combine in Barley.

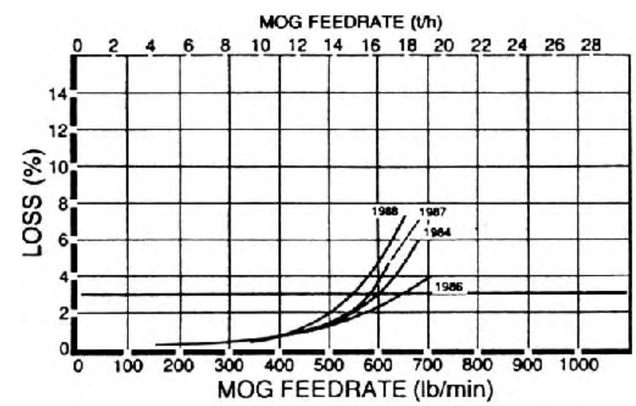

FIGURE 22. Total Grain Loss for the PAMi Reference II Combine in Wheat.

APPENDIX III
REGRESSION EQUATIONS FOR CAPACITY RESULTS

Regression equations for the capacity results shown in FIGURES 5 to 7 are presented in TABLE 8. In the regressions, U = unthreshed loss in percent of yield, S = shoe loss in percent of yield, R = rotor loss in percent of yield, F = the MOG feedrate in lb/min, while $\ln$ is the natural logarithm. Sample size refers to the number of loss collections. Limits of the regressions may be obtained from FIGURES 5 to 7 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 - Ellice	5	$U = 0.04 + 7.93 \times 10^{-7} \times F^2$ $S = 0.27 + 5.87 \times 10^{-12} \times F^4$ $R = 0.05 + 1.42 \times 10^{-6} \times F^2$	0.93 0.97 0.87	32.49 73.37 15.88	7
Wheat - Katepwa "A"	6	$U = 0.07 + 2.21 \times 10^{-4} \times F$ $S = -0.001 + 4.97 \times 10^{-4} \times F$ $R = 0.31 + 2.93 \times 10^{-12} \times F^4$	0.70 0.82 0.92	13.82 27.36 69.17	8
Wheat - Katepwa "B"	7	$U = -0.02 + 1.30 \times 10^{-3} \times F$ $S = -0.01 + 5.93 \times 10^{-4} \times F$ $R = 0.11 + 1.54 \times 10^{-3} \times F$	0.95 0.73 0.91	46.89 5.56 22.92	7

APPENDIX IV
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

SUMMARY CHART

CASE IH 1682 PULL-TYPE COMBINE

RETAIL PRICE	$89,943.00 (March, 1989, f.o.b. Humboldt, Sask.)
CAPACITY	
Compared to Reference II combine	
- Barley	1.8 x Reference II
- Wheat	1.3 and 1.5 x Reference II
MOG Feedrates	
- Barley - Ellice	710 lb/min (19.4 t/h) at 3% total loss, Figure 5
- Wheat - Katepwa “A”	700 lb/min (19.1 t/h) at 2% total loss, Figure 6
- Katepwa “B”	850 lb/min (23.2 t/h) at 3% total loss, Figure 7
QUALITY OF WORK	
Picking	**Good;** usually picked clean, plugged behind drapers in short barley
Feeding	**Very Good;** aggressive; very little plugging
Stone Protection	**Good;** stopped most stones
Threshing	**Good;** unthreshed loss usually low, but affected by rotor drive slippage
Separating	**Very Good;** rotor loss usually low
Cleaning	**Fair;** air distribution problems caused poor performance in barley
Grain Handling	**Good;** filled evenly, unloaded quickly
Straw Spreading	**Fair;** spread 15 to 20 ft (4.6 to 6.1 m)
EASE OF OPERATION AND ADJUSTMENT	
Hitching	**Good;** quick after initial hook-up
Operator Comfort depends on tractor used	
Instruments	**Good;** all important functions monitored
Controls	**Good;** most controls convenient to use
Loss Monitor	**Good;** shoe loss and rotor loss monitored
Lighting	**Good;** adequately lit but tractor lighting required
Handling	**Good;** stable in the field; manual hitch locking
Adjustment	**Good;** most adjustments convenient, slow fan speed and rotor speed response
Field Setting	**Good;** once familiar with the rotor and shoe behavior
Unplugging	**Good;** effective feeder reverser; most rotor plugs powered through
Cleaning	**Fair;** hard to clean chaff off rotor housing
Lubrication	**Very Good;** few daily lubrication points
Maintenance	**Very Good;** easily accessible
POWER REQUIRMENTS	PAMI recommends a minimum 180 hp (134 kW) tractor
OPERATOR SAFETY	no safety hazards apparent
OPERATOR’S MANUAL	**Good;** useful information but sometimes incomplete
MECHANICAL HISTORY	a few mechanical problems occurred

ALBERTA FARM MACHINERY RESEARCH CENTRE
3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:
P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080