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Evaluation Report 146

Hesston 5500 Rounder

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

HESSTON 5500 ROUNDER

MAN U FACTU RER:
Hesston Corporation
Hesston, Kansas 67062
U.S.A.

DISTRIBUTOR:
Hesston Industries Ltd.
920 -26th Street N.E.
Calgary, Alberta
T2A 2M4

RETAIL PRICE:
$8,456.00 (January, 1979, f.o.b. Humboldt).

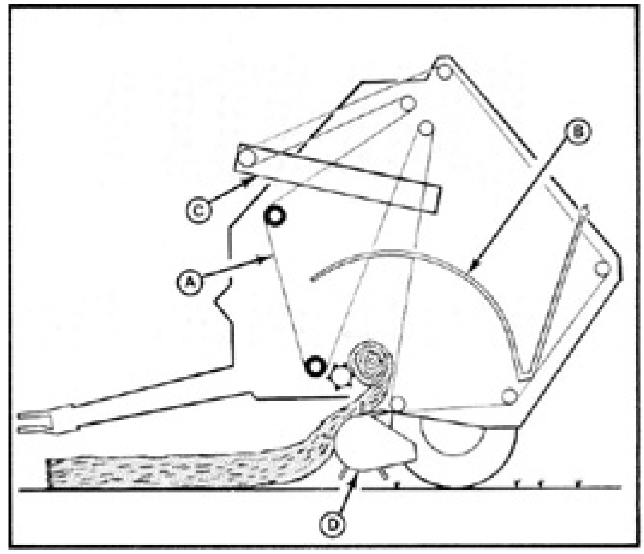

FIGURE 1. Hesston 5500 Rounder (A) Bale Forming Belts, (E) Bale Forming Grid, (C) Tension Arm. (D) Pickup.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Hesston 5500 round baler was *good.* Ease of operation and adjustment were very *good* in hay crops and *good* in straw. Operation of the twine wrapping mechanism was *fair.*

Average field speeds varied from 9.5 to 13.6 km/h (5.9 to 8.5 mph) while average throughputs varied from 1.7 to 6.5 t/h (1.9 to 7.2 ton/h). Maximum instantaneous feedrates up to 19 t/h (21 ton/h) were measured in heavy, uniform hay windrows. Capacity was usually limited by interference of the pickup compression bars with the bale carrier roller. Feeding was aggressive in most crops.

Bales were well formed and neat. The Hesston 5500 produced bales with an average length of 1.5 m (59 in) and an average diameter of 1.6 m (63 in). Hay bales weighed from 372 to 472 kg (820 to 1040 lb) with an average density of 143 kg/m^3 (8.9 lb/ft^3).

Resistance of bales to moisture penetration was *good.*

Peak power take-off requirements were about 20 kW (27 hp) in hay and 32 kW (43 hp) in straw on flat firm fields. More power was needed on soft or hilly fields.

Leaf loss was comparable to that of other large round balers. In heavy conditioned windrows at optimum moisture content, bale chamber loss was 2% while pickup loss was 1%. In light dry unconditioned hay an average bale chamber loss as high as 15% and pickup loss as high as 15% can be expected. Heavy windrows, proper conditioning and baling at the maximum permissible moisture content all were important in reducing bale chamber loss.

The Hesston 5500 was safe to operate if the manufacturer's safety recommendations were closely followed.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to reduce bale forming belt splice failures.
2. Modifications to improve twine cutter performance.
3. Modifications to reduce straw build up between the bale forming belts and to improve bale core formation in short straw.

Chief Engineer - E. O. Nyborg
Senior Engineer - L. G. Smith

Project Technologist - D. H. Kelly

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A new high tensile clipper lace is now in production for the 5500 Rounder. This new splice is 40 percent stronger to resist bending and opening up.
2. Improvements to twine cutoff performance are under active consideration and development. To achieve best performance, make sure the knife edges are razor sharp.
3. The scraper over the front drive roller has been relocated to improve performance.

GENERAL DESCRIPTION

The Hesston 5500 is a pull-type, power take-off driven baler with a cylindrical baling chamber and a floating drum pickup. The twine wrapping mechanism is electrically actuated.

Hay is fed directly into the baling chamber by the pickup. The baling chamber consists of nine 102 mm wide forming belts and one bale forming grid. Both the forming belts and the grid position themselves around the bale during formation.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Hesston 5500 was operated in a variety of Saskatchewan crops (TABLES 1 and 2) for 82 hours while producing 1144 bales. It was evaluated for rate of work, quality of work, power consumption, ease of operation, ease of adjustment, operator safety, and suitability of the operator's manual.

TABLE 1. Operating Conditions

CROP	HOURS	NUMBER OF BALES	FIELD AREA ha
Alfalfa	12	129	22
Alfalfa, Bromegrass and Crested Wheatgrass	20	231	52
Clover	10	174	21
Green Feed	10	202	23
Prairie Hay	7	90	14
Wheat Straw	16	240	57
Barley Straw	7	78	18
TOTAL		1144	207

TABLE 3. Average Throughputs

CROP	CROP YIELD t/ha	AVERAGE SPEED kmth	AVERAGE THROUGHPUTS t/h
Alfalfa	2.0 to 2.5	10.8	4.1
Alfalfa, Bromegrass and Crested Wheatgrass	1.0 to 4.0	10.3	6.5
Clover	2.0 to 2.5	10.6	4.7
Green Feed	2.0 to 2.5	10.5	5.2
Prairie Hay	2.2	9.5	4.4
Wheat Straw	0.5 to 1.0	13.6	2.7
Barley Straw	0.5 to 0.8	9.6	1.7

TABLE 2. Operation in Stony Fields

FIELD CONDITION	HOURS	FIELD AREA ha
Storm Free	5	9
Occasional Stones	44	102
Moderatety Stony	30	89
Very Stony	3	7
TOTAL	82	207

FIGURE 2. Typical Hay or Straw Bale.

RESULTS AND DISCUSSION

RATE OF WORK

Average throughputs for the Hesston 5500 (TABLE 3) varied from 1.7 t/h in barley straw to 6.5 t/h in an alfalfa, bromegrass and crested wheatgrass mixture. The average throughputs reported in TABLE 3 are average workrates for daily field operation. They are representative of the actual workrates that may be expected in typical field operation. These values are based on the total operating time and the total baler throughput for each day of baling.

In heavy uniform hay windrows, instantaneous feedrates up to 19 t/h were measured. These were peak values, representing maximum baler capacity, which cannot be achieved continuously.

Feeding was aggressive in most crops. Feedrate was usually limited by pickup compression bar interference with the fluted carrier roller. Although no damage occurred, the noise created was very annoying. Compression bar interference usually limited ground speed from 9.5 to 13.6 km/h. Heavy windrows were desirable to fully utilize baler capacity.

QUALITY Of WORK

Bale Quality: The Hesston 5500 produced firm, durable bales (FIGURE 2) with flat ends and uniform diameter. Bales averaged 1.5 m in length and 1.6 m in diameter. Average hay bales weighed from 372 to 472 kg with an average density of 143 kg/m^3. Density at the outer diameter was about twice as great as at the bale centre.

Bale Weathering: A common practice in the prairie provinces is to store round bales outside. FIGURE 3 shows the condition of a typical Hesston 5500 hay bale (bromegrass and alfalfa mixture) after 100 days of weathering. The weathering period was the time between baling and freeze-up. Bales were situated in a well drained area with prevailing winds striking one side. Bales were exposed to about 75 mm of rain and average prairie wind conditions.

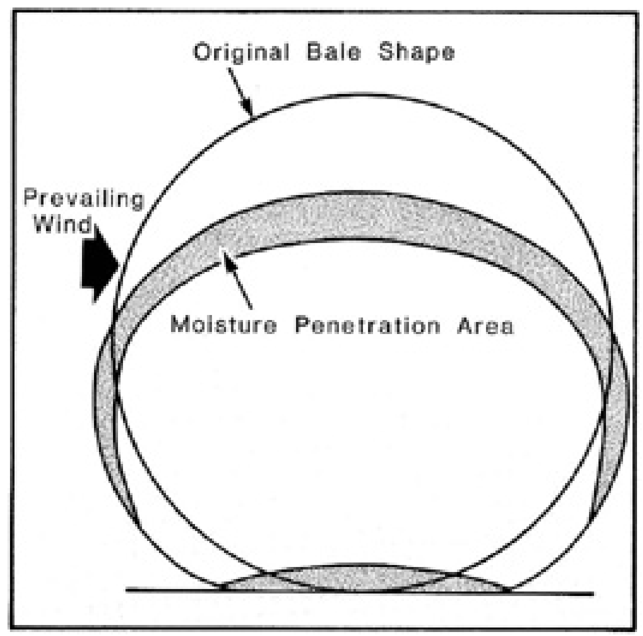

FIGURE 3. A Typical Hay Bale After 100 Days of Weathering.

The condition of weathered bales was good. Moisture had penetrated to a maximum of 170 mm on the windward bale side. Since bales had retained 81% of their original height, they were easy to pick with round bale handlers.

Leaf Loss: Leaf loss was comparable to that of other large round balers. In heavy, conditioned windrows, baled near optimum moisture content, pickup loss was about 1% while bale chamber loss was about 2%. In very light, dry windrows, which have not been conditioned, pickup and bale chamber losses as high as 15% each carl be expected.

FIGURE 4 shows the importance of baling at high moisture contents. This figure shows the total measured leaf loss, over a range of hay moisture contents, in fields of mixed alfalfa, crested wheatgrass and bromegrass. The crop had been cut with a 3.7 m mower-conditioner. Yields ranged from 2.7 to 4.6 t/ha with an average of 3.5 t/ha. As can be seen, total leaf loss ranged from about 15% when baled at 8% hay moisture content to 3% when baled at 22% hay moisture content. At 8% moisture content, pickup loss was about 9% and bale chamber loss about 6% whereas at 22% moisture content pickup loss was about 1% and bale chamber loss about 2%.

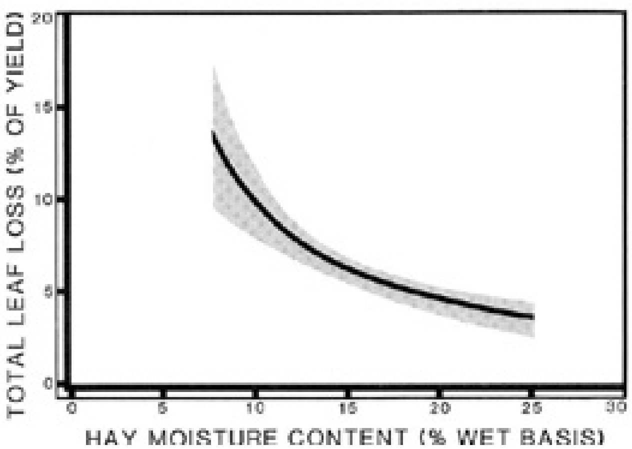

FIGURE 4. Leaf Loss in Mixed Alfalfa, Crested Wheatgrass and Bromegrass.

Although FIGURE 4 represents an accumulation of data for several round balers, performance of the Hesston 5500 was within the range presented in this figure. FIGURE 4 represents nearly ideal baling conditions with relatively heavy windrows which had been conditioned to enhance drying of the hay stems. Much higher leaf loss can be expected in light unconditioned windrows. While feedrate did not appreciably affect losses in the ideal conditions shown in FIGURE 4 loss tests in light unconditioned windrows have shown that round baler losses can be reduced by keeping the feedrate as high as possible to minimize time in the baling chamber. Bale chamber losses in light crops can also be reduced by running the tractor at a lower power take-off speed to reduce the number of turns needed to form a bale.

POWER CONSUMPTION

Power Requirements: FIGURE 5 shows the power take-off and drawbar input for the Hesston 5,500 in alfalfa. The power input is plotted against bale weight to show the power requirements while a bale is formed. Power take-off input varied from 2.4 kW at no load to a maximum of 20 kW in alfalfa and 32 kW in wheat straw. Drawbar requirements at 11 km/h were 6 kW.

Although maximum power requirements did not exceed 38 kW, additional power was needed to suit field conditions. In soft, hilly fields a 75 kW tractor was needed to fully utilize baler capacity.

Specific Capacity: Specific capacity is a measure of how efficiently a machine performs a task. A high specific capacity indicates efficient energy use while low specific capacity indicates inefficient operation. The specific capacity of the Hesston 5500 was about 0.55 t/kW.h in alfalfa and 0.28 t/kW.h in wheat straw.

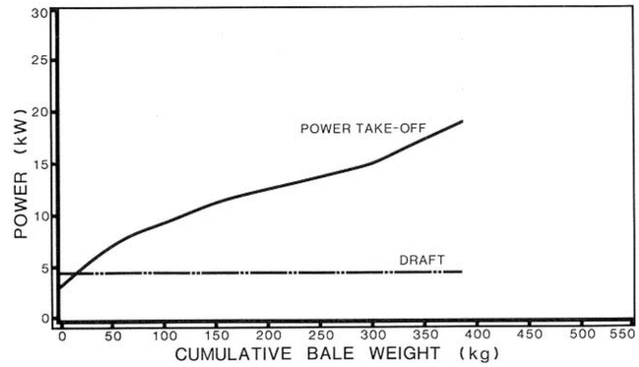

FIGURE 5. Power Consumption During Bale Formation in Alfalfa.

This compares to an average specific capacity of 0.98 to 1.45 t/kW.h for small square balers in alfalfa. These values represent average operating speeds in average field conditions and not peak outputs.

EASE OF OPERATION

Forming a Bale: It was easy to form a neat, durable bale with the Hesston 5500. Feeding hay across the entire width of the bale chamber during bale core formation was not as critical as with many round balers as the incoming hay distributed itself fairly uniformly. Only slight weaving was needed during bale formation to maintain a uniform diameter.

Some bale formation problems occurred in short straw. Short straw sometimes would not form a rotating core but would build up at the front of the bale chamber until it plugged the pickup. Once this occurred, the rear gate had to be opened and the straw removed by hand. During baling, the short straw also accumulated between the bale forming belts (FIGURE 6). The straw build up prevented full size bale formation due to interference with the bale forming belts. Modification to improve bale formation in short straw is recommended.

FIGURE 7 shows the position of the forming belts during bale formation.

Wrapping the Twine: A mechanical indicator at the front of the baler shows when a bale is full size and ready for twine wrapping. Standard equipment on the Hesston 5500 is an electrically operated twine wrapping mechanism. The electric drive is operated from the tractor seat through a remote control box.

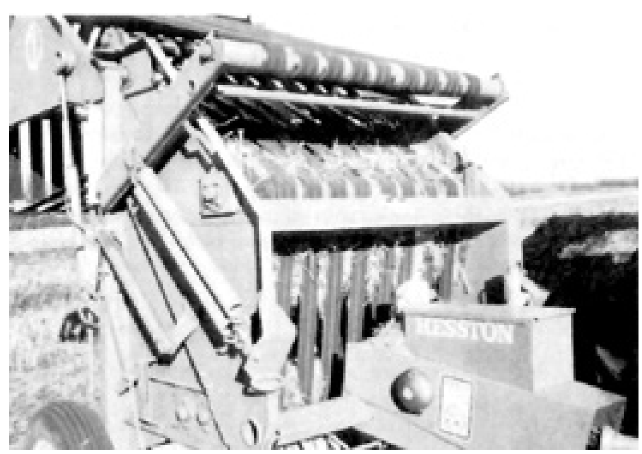

FIGURE 6. Material Build Up Between Belts..

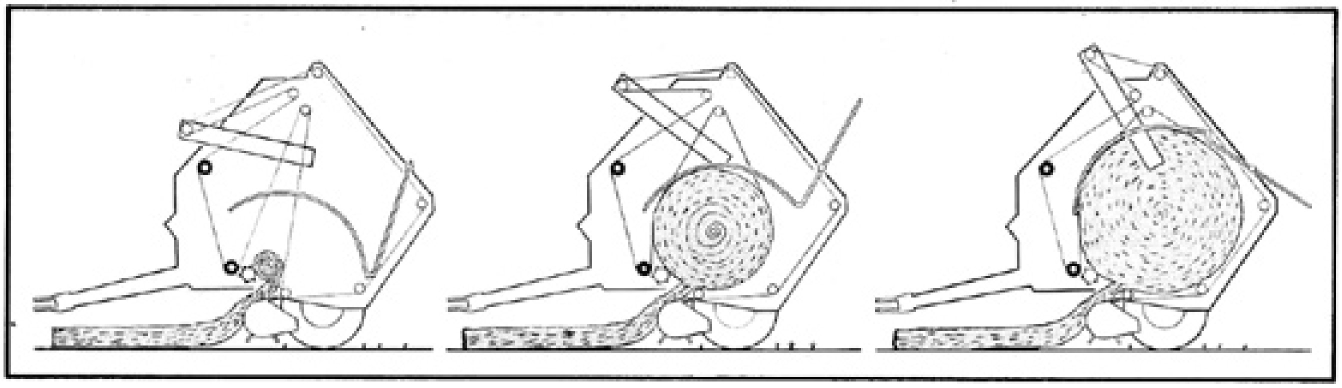

FIGURE 7. Stages of Bale Formation: (Left) Bale Core, (Centre) Half-Completed Bale, (Right) Completed Bale.

To start wrapping, the twine tube is moved to the centre of the bale chamber. Once the twine has been caught by the incoming hay, the electric control is actuated to move the twine tube to the extreme left of the bale chamber and the tractor forward movement is stopped but the power take-off is allowed to run. When the twine has made at least two full wraps around the left bale end, the control box is activated to move the twine tube across the front of the bale chamber. The control switch must be repetitively turned on and off to get the correct spacing of consecutive wraps around the bale. When the twine tube reaches the right side, the control switch is momentarily released so there is at least two complete twine wraps around the bale end. The control switch is then actuated to move the twine tube further to the right where the twine is automatically cut.

Hay sometimes built up on the twine cutter, preventing the twine from reaching the cutter knives. The cutter knives also did not cleanly cut sisal twines causing twine fibres build up on the knives, preventing proper cutting on successive bales. Modification to improve twine cutter performance is recommended.

Twine consumption was about 143 m/t. This compares to a twine consumption of about 225 m/t for small square balers.

Discharing a Bale: Once the twine is cut, the power take-off is shut off and the tractor and baler are backed up about 6 m. The gate is hydraulically opened and the bale falls out of the bale chamber. The tractor and baler are then moved ahead about 4.5 m and the gate closed. A slight pressure is required on the gate hydraulic cylinders to ensure that the gate lock is latched. About one minute was needed to wrap and discharge a bale.

Eight splice failures occurred on separate bale forming belts during the 82 hour test period. The splice failures were a result of impact loads applied to the forming belts when discharging a bale. Modifications to reduce belt splice failures are recommended.

Transporting: The Hesston 5500 was easy to maneuver and transport. Ground clearance was adequate and there was ample hitch clearance for turning sharp corners. The baler could easily be towed behind a tractor or a suitably sized truck.

Hitching: The Hesston 5500 was easy to hitch to a tractor. The control box for the electrical twine drive had to be mounted and connected to the tractor battery. The electric drive could be used on any positive or negative ground 12 V electrical system.

Feeding: Feeding was positive and aggressive in most crops with only infrequent plugging. When feeding large windrows, the pickup compression bars deflected upward contacting the fluted carrier roller. No damage occurred but the noise created was alarming to most operators.

Twine Threading: Twine threading was quite easy, however, a stiff piece of wire was needed to thread the twine through the twine tube.

The twine cutter performed erratically due to hay build up between the knives, and ragged cutting of sisal twine. Modifications to the twine cutter are recommended.

EASE OF ADJUSTMENT

Forming Belts: Two sets of adjustable springs maintained tension in the forming belts. Periodic spring adjustment was necessary to accommodate changes in belt length.

The forming belts and the fluted roller were chain driven. The chain drives needed infrequent adjustment.

Bale Forming Grid: The bale forming grid is held against the bale by two springs. No spring adjustment is possible.

Pickup: The pickup was raised and lowered by the rear gate hydraulic cylinders. The lowest position of the pickup was determined by adjustable stops on each side of the baler. Adjusting the pickup height with the hydraulic cylinders was very convenient when baling in irregular fields.

Servicing: The Hesston 5500 had four chains, 14 grease fittings and one gearbox. The operator's manual recommended chain oiling daily, lubrication of all grease fittings every eight hours and checking gearbox oil level every season. About 15 minutes were needed to service the Hesston 5500.

OPERATOR SAFETY

The Hesston 5500 was safe to operate and service as long as common sense was used and the manufacturer's safety recommendations were followed. Rotating parts were well shielded. The pickup3 was well shielded to discourage operators from attempting to clear blockages with the baler in operation.

The Hesston 5500 had rear gate cylinder locks to permit safe servicing with the rear gate open.

GENERAL SAFETY COMMENTS

The operator is cautioned that a round baler is potentially very dangerous. The operator must disengage the power take-off and stop the tractor engine to clear blockages or to make adjustments.

Many serious and fatal accidents have occurred with round balers. Most of these are caused by operators dismounting from the tractor while leaving the baler running. The manufacturer can only go to certain limits in providing shielding and safety devices and must rely on the operator's common sense in following established safety procedures.

OPERATOR'S MANUAL

The operator's manual was clear and well written, containing much useful information on operation, servicing, adjustment, and safety procedures.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Hesston 5500 during 82 hours of operation while baling about 207 ha. The intent of the test was functional evaluation. The following failures represent those which occurred during functional testing. An extended durability evaluation was not conducted.

TABLE 4. Mechanical History

ITEM	OPERATING HOURS	NUMBER OF BALES
Bale Forming Belts		
--A bale forming belt splice broke and was repaired at	8, 25, 38, 42, 46, 52, 58, & 62	112, 350, 532, 588, 644, 728, 812, & 868
Pickup		
-- Five pickup teeth were damaged and needed replacement at	21	294

DISCUSSION OF MECHANICAL PROBLEMS

Bale Forming Belts: Splices on individual bale forming belts broke at eight different times. Failures were a result of impact loads applied to the belts when discharging bales. Modification to reduce this problem is recommended.

Pickup Teeth: Five pickup teeth were damaged by rocks during the test. Teeth were easily replaced from the back of the pickup.

APPENDIX I

SPECIFICATIONS .

MAKE: Hesston Round Baler

MODEL: 5500 Rounder
SERIAL NUMBER: R550-1539
MANUFACTURER: Hesston Corporation
Hesston, Kansas 67062
U.S.A.

OVERALL DIMENSIONS:

-- width	2450 mm
-- height	2610 mm
-- length	3800 mm

TIRES:

-- size	2, 9.5L x 15, 6 ply

WEIGHT:

(With drawbar in field position and two balls of twine)

-- left wheel	644 kg
-- right wheel	704 kg
-- hitch point	318 kg
Total Weight	1666 kg

BALE CHAMBER:

-- width	1520 mm
-- maximum diameter	1700 mm
-- tension method	spring

FORMING BELTS:

-- number of belts	9
-- belt width	102 mm
-- belt length	11,046 mm
-- thickness	8 mm
-- spacing (centre to centre)	160 mm
-- belt speed (at 540 rpm)	2 m/s

BALE FORMING GRID:

-- number	1 set
-- construction	10, 33 mm formed pipes

BALE SIZE INDICATOR: mechanical linkage

PICKUP:

-- type	floating cylindrical drum with spring teeth
-- height adjustment	hydraulic with mechanical stops
-- width	1500 mm
-- diameter	340 mm
-- number of tooth bars	3
-- tooth spacing	85 mm
-- speed (at 540 rpm)	140 rpm

TWINE SYSTEM:

-- capacity	2 balls
-- recommended twine size	none
-- twine feed	electric
-- twine cutter	electric

SAFETY DEVICES: adjustable power take-off slip clutch, rear gate cylinder locks

SERVICING:

-- grease fittings	14, daily
-- chains	4, daily
-- gearbox	1, yearly

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

(a) excellent	(d) fair
(b) very good	(e) poor
(c) good	(f) unsatisfactory

APPENDIX III

METRIC UNITS

In keeping with the Canadian metric conversion program this report has been prepared in SI Units. For comparative purposes, the following conversions may be used.

1 hectare (ha)	= 2.47 acres (ac)
1 kilometre/hour (km/h)	= 0.62 miles/hour (mph)
1 tonne (t)	= 2204.6 pounds (lb)
1 tonne/hour (t/h)	= 1.10 ton/hour (ton/h)
1 tonne/hectare (t/ha)	= 0.45 ton/acre (ton/ac)
1000 millimetres (mm) = 1 metre (m)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.20 pounds (lb)
1 tonne/kilowatt hour (t/kW.h)	= 0.82 tons/horsepower hour (ton/hp.h)

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