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Evaluation Report 144

International Harvester 241 Bigroll Baler

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

INTERNATIONAL HARVESTER 241 BIGROLL BALER

MANUFACTURER:
International Harvester Company
East Moline, Illinois 61244
U.S.A.

DISTRIBUTOR:
International Harvester of Canada
660 Wall Street
Winnipeg, Manitoba
R3C 2W8

RETAIL PRICE:
$8,776.00 (January, 1979, f.o.b. Humboldt complete with optional audible bale size indicator, electric twine wrapping drive and gate lock pressure gauge.)

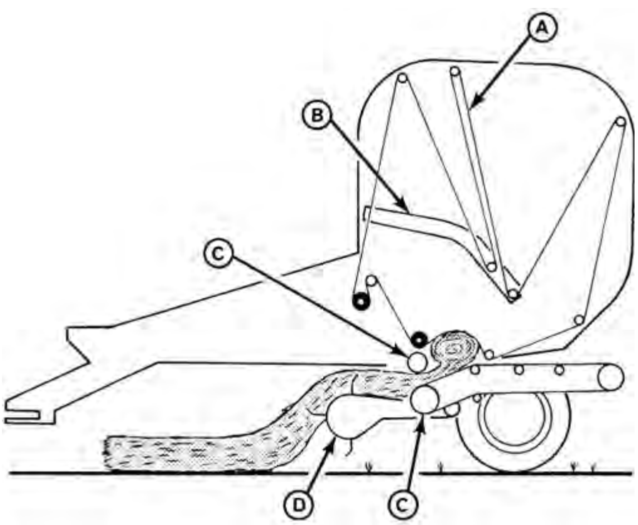

FIGURE 1. International Harvester 241 Bigroll Baler: (A) Bale Forming Belts, (B) Tensioning Arm, (C) Compression Rollers, (D) Pickup.

SUMMARY AND CONCLUSIONS

Overall functional performance of the International Harvester 241 round baler was good. Ease of operation was fair while ease of adjustment was good. Operation of the twine wrapping mechanism was good.

Average field speeds varied from 6 to 16 km/h (3.8 to 10.0 mph) while average throughputs varied from 1.7 to 7.5 t/h (1.9 to 8.3 ton/h). Maximum instantaneous feedrates up to 18 t/h (19.8 ton/h) were measured in heavy, uniform hay windrows. Ground speed was usually limited by pickup loss and not by baler capacity. Feeding was aggressive in most crops. In short wheat and barley straw, feeding was hesitant causing occasional plugging in front of the compression rollers.

Bales were well formed and neat. The International Harvester 241 produced bales with an average length of 1.5 m (59 in) and an average diameter of 1.9 m (75 in). Hay bales weighed from 590 to 731 kg (1300 to 1610 lb) with an average density of 140 kg/m^3 (8.7 lb/ft^3).

Resistance of bales to moisture penetration was good.

Peak power take-off requirements were about 19 kW (25 hp) in hay and 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 of 16% can be expected. Heavy windrows, proper conditioning and baling at the maximum permissible moisture content all were important in reducing bale chamber loss.

The International Harvester 241 was safe to operate if the manufacturer's safety recommendations were closely followed.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to improve bale core formation in light crops.
2. Modifications to the optional electric twine wrapping system to improve twine cutter operation.
3. Modifying the pickup to reduce problems associated with flotation and height adjustment.

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. An additional gate stop position has been added to prevent out-of-round core formation in light crops and instructions for its use have been incorporated in the current operator's manual. An optional dual spring attachment is also available for all balers and is effective in increasing the density of the bale centre.
2. This recommendation is under consideration at the present time. Increasing the return spring force will make the system less susceptible to cutting problems caused by high twine tension.
3. We are currently investigating the use of a stronger spring to improve pickup flotation and additional settings on the height control to increase pickup height adjustment.

GENERAL DESCRIPTION

The International Harvester Model 241 is a pull-type, power take-off driven baler with a cylindrical baling chamber and a floating drum pickup. The twine wrapping mechanism is manually actuated with an electric actuator available as an option.

Hay is fed to the baling chamber between two compression rollers. The upper roller is rubber covered while the surface of the lower roller is covered with the platform belt. The baling chamber consists of one 1524 mm wide platform belt on the bottom and nine 102 mm wide forming belts on top. Platform belt position is fixed while the forming belts are spring loaded to position themselves around the bale during formation.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The International Harvester 241 was operated in a variety of Saskatchewan crops (TABLES 1 and 2) for 81 hours while producing 891 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	118	39
Alfalfa, Bromegrass and Crested Wheatgrass	24	213	58
Clover	11	92	33
Green Feed	11	189	27
Prairie Hay	5	44	8
Wheat Straw	7	87	23
Barley Straw	11	148	34
Total	81	891	222

TABLE 2. Operation in Stony Fields

Field Condition	Hours	Field Area (ha)
Stone Free	5	14
Occasional Stones	41	112
Moderately Stony	35	96
Total	81	222

RESULTS AND DISCUSSION

RATE OF WORK

Average throughputs for the IH 241 (TABLE 3) varied from 1.7 t/h in barley straw to 7.5 t/h in clover. 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.

TABLE 3. Average Throughputs

Crop	Crop Yield	Average Speed	Average Throughput
	t/ha	km/h	t/h
Alfalfa	1.5 - 2.0	10.3	5.7
Alfalfa, Bromegrass and Crested Wheatgrass	2.2 - 3.5	10.4	6.9
Clover	2.5	9.5	7.5
Green Feed	2.5	15.6	6.1
Prairie Hay	0.8 - 3.0	6.0	3.0
Wheat Straw	0.3 - 1.0	10.5	2.1
Barley Straw	0.3 - 0.8	10.2	1.7

In heavy uniform hay windrows, instantaneous feedrates up to 18 t/h were measured. These were peak values, representing maximum baler capacity, which cannot be achieved continuously.

In most crops, the feedrate was limited by pickup performance and not by bale chamber capacity. Pickup loss usually limited ground speed from 6 to 16 km/h. Heavy windrows were desirable to fully utilize baler capacity.

Feeding was aggressive in most crops. In short wheat and barley straw capacity was reduced by feeding problems at the compression rolls, limiting the throughput to about 2 t/h.

QUALITY OF WORK

Bale Quality: The IH 241 produced firm, durable bales (FIGURE 2) with flat ends and uniform diameter. Bales averaged 1.5 m in length and 1.9 m in diameter. Average hay bales weighed from 590 to 731 kg with an average density of 140 kg/m³. Density at the outer diameter was about double that at the centre of the bale.

FIGURE 2. Typical Hay or Straw Bale.

Bale Weathering: A common practice in the prairie provinces is to store round bales outside. FIGURE 3 shows the condition of a typical IH 241 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.

The condition of weathered bales was good. Moisture had penetrated to a maximum of 120 mm on the windward bale side. Since bales had retained 84% 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 can 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%.

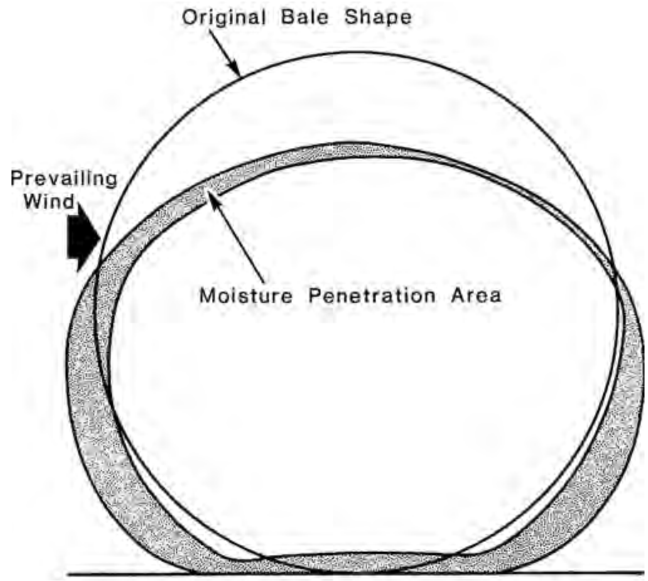

FIGURE 3. A Typical Bale After 100 Days of Weathering.

Although FIGURE 4 represents an accumulation of data for several round balers, performance of the IH 241 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.

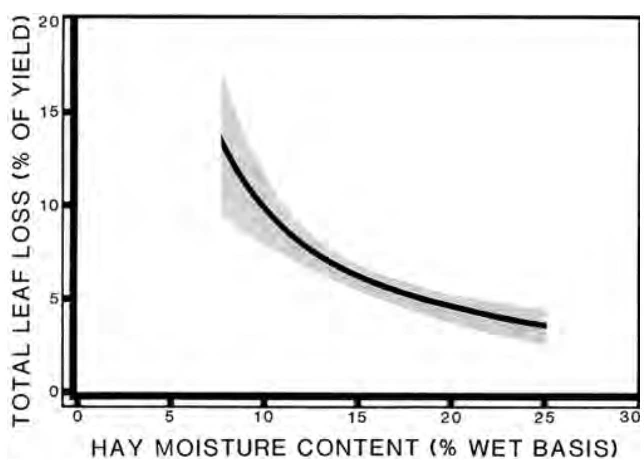

FIGURE 4. Leaf Loss in Mixed Alfalfa, Crested Wheatgrass and Bromegrass.

POWER CONSUMPTION

Power Requirements: FIGURE 5 shows the power take-off and drawbar input for the IH 241 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 5 kW at no load to a maximum of 19 kW in alfalfa and wheat straw. Drawbar requirements at 11 km/h were 4.5 kW.

Although maximum power requirements did not exceed 24 kW, additional power was needed to suit field conditions. In soft, hilly fields a 75 kW tractor would be needed to fully utilize baler capacity.

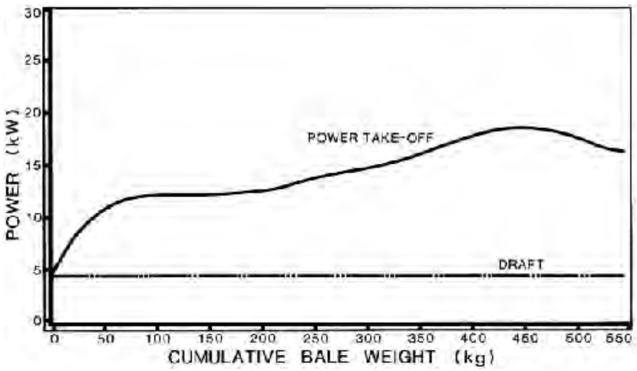

FIGURE 5. Power Consumption During Sale Formation in Alfalfa.

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 IH 241 was about 0.66 t/kW•h in hay and 0.57 t/kW•h in wheat straw. 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 field conditions and not peak outputs.

EASE OF OPERATION

Forming a Bale: An inexperienced operator found some difficulty forming a bale with the IH 241 in light windrows. When starting a bale, it was important to weave the baler back and forth across the windrow, to feed hay evenly across the width of the baling chamber. The bale forming belts on the IH 241 did not turn until the bale core was large enough to press the belts against the drive rollers. If the bale core did not have a uniform diameter when the forming belts began to turn, the belts on the smaller end of the bale core sometimes slipped past the core end preventing bale formation. If this happened, the baler had to be stopped and the bale core ejected without twine. Once the bale core was properly formed, a slight weaving was needed during bale formation to maintain a uniform diameter.

In light windrows, the bale core sometimes went out-of-round. The out-of-round core contacted the forming belts drive roller preventing further bale formation. By opening the rear gate slightly and reengaging the power take-off, the bale core could usually be wrapped with twine before ejecting. When this procedure did not work, the bale core had to be ejected without twine. Modifications to improve operation in light crops is recommended.

FIGURE 6 shows the position of the forming belts during bale formation.

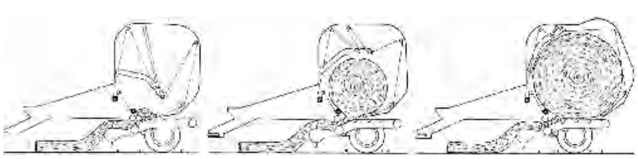

FIGURE 6. Stages of Bale Formation: (Left) Bale Core, (Centre) Half-Completed Bale, (Right) Completed Bale.

Wrapping the Twine: A mechanical indicator at the front of the baler shows when a bale is full size and ready for twine wrapping. The test baler was equipped with the optional audible size indicator, which was very effective in preventing over filling.

Standard equipment on the IH 241 is a manually operated twine wrapping mechanism. The test baler was equipped with an optional electric drive. The electric drive is operated from the tractor seat through a remote control box.

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.

Once the twine tube reaches the right end of the bale, the control switch is momentarily released so there is at least two complete twine wraps around the end. The switch is then actuated to move the twine further to the right to be cut by the twine knife.

The twine tube occasionally did not move into cut position with enough force to cut the twine. The force applied to the twine tube by the twine feeding into the bale chamber opposes the return spring. Although the twine force could be reduced to permit proper cutter operation by adjusting the twine tensioner plates, the tensioner plates had to be readjusted whenever a different type of twine was used. Modifications to the twine system to improve cutter operation is recommended.

Twine consumption was about 60 m/t. This compares to a twine consumption of about 225 m/t for small square balers.

Discharging a Bale: Once the twine is cut, the power take-off is allowed to run and the tractor and baler are backed up about 6 m. The gate is then hydraulically opened, ejecting the bale. The tractor and baler are then moved ahead about 4.5 m and the gate closed. Pressure is required on the gate hydraulic cylinders to ensure that the gate is fully closed. An optional hydraulic pressure gauge is available to indicate that the gate is properly closed. Otherwise, the hydraulics are actuated until relief pressure is reached. About one minute was needed to wrap and discharge a bale.

The operator's manual states that if the tailgate is quickly closed immediately after discharging a bale, it is not necessary to move the baler ahead to clear the bale. This was not possible in hilly fields or on rough ground and in such fields the tailgate could be damaged. Throughout the test, the baler was moved ahead after bale discharge to ensure tailgate clearance while closing the gate.

Transporting: The IH 241 was easy to manoeuvre 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 IH was easy to hitch to a tractor. If the optional electric twine drive was used, the control box 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. One exception was in short wheat and barley straw. In such crops, the short straw occasionally balled in front of the compression rollers, causing plugging.

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 well but adjustment of the twine wrapping mechanism was required when changing types of twines.

EASE OF ADJUSTMENT

Compression Rollers: The upper compression roller was held against the platform belt drive roller with adjustable springs. The operator's manual recommended a roller clearance of 1.6 mm. All evaluation was conducted with the recommended setting; no adjustment was needed.

Forming Belts: Two adjustable springs maintain tension in the forming belts. No adjustment to the springs was required during the test once the springs had been set to the manufacturer's recommended length.

The forming belts and the compression rollers were chain driven. The drive chain was spring tensioned needing only infrequent adjustment.

Platform Belt: Two adjustable springs maintained tension in the platform belt. Periodic adjustment was necessary to accommodate changes in belt length.

Pickup: Pickup flotation was controlled by an adjustable spring while ground clearance was adjusted with a mechanical stop. The mechanical stop did not allow the pickup to be set high enough in some situations, and the pickup flotation spring also was not strong enough to provide good pickup flotation on rough ground. Modifications to improve pickup height adjustment and flotation are recommended. The pickup drive chain had a spring-loaded tightener and did not need adjustment during the test.

The test baler was equipped with nine fixed pickup compression bars as well as eight free floating bars. Feeding in very fluffy windrows was improved by removal of the floating bars. The floating bars were effective in all other crops.

Servicing: The IH 241 had two chains, nine grease fittings and one gearbox. The operator's manual recommended checking the chains and lubricating three grease fittings twice daily. The operator's manual also recommended daily lubrication of one grease fitting and weekly lubrication of five grease fittings. Checking of wheel bearings and gearbox oil level was recommended every season. About 15 minutes were needed to service the IH 241.

OPERATOR SAFETY

The IH 241 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 pickup and compression rollers were well shielded to discourage operators from attempting to clear blockages with the baler in operation.

The IH 241 had rear gate cylinder locks to permit safe servicing with the rear gate open.

The test baler was equipped with an optional audible bale size indicator, which signalled the operator when the bale chamber was full. This acted as a safety device to protect the baler from damage due to overfilling. The baler was also equipped with an adjustable slip clutch on the power take-off and the pickup drive. A hitch safety chain was supplied as standard equipment.

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, well written and contained much useful information on operation, servicing, adjustments and safety procedures.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the International 241 during 81 hours of operation while baling about 222 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	Equivalent Bales
Pickup		
-Two pickup teeth were damaged and replaced at	47	517
-Several pickup guards, pickup teeth, tooth bars, and the pickup drive shaft needed repair at	61 & 77	671 & 847
Twine Tie Mechanism		
-The electric twine tie supply cable needed replacement at	63	693

DISCUSSION OF MECHANICAL PROBLEMS

Pickup: Poor pickup flotation allowed several pickup guards, pickup teeth, teeth bars and the pickup drive shaft to be bent by rocks on two occasions. Two pickup teeth were also damaged by rocks on another occasion. The pickup flotation spring could not be adjusted to allow the pickup to float freely over obstructions. Modifications to the pickup flotation mechanism are recommended.

Twine Tie Mechanism: The activating cable on the optional electric twine tie mechanism became damaged by the cable take-up spool. The activating cable was easily replaced.

APPENDIX I
SPECIFICATIONS

MAKE:	International Bigroll Baler
MODEL:	241
SERIAL NUMBER:	0100004U009264*78
MANUFACTURER:	International Harvester Company East Moline, Illinois 61244 U.S.A.
OVERALL DIMENSIONS:	
-- width	2340 mm
-- height	2584 mm
-- length	3982 mm
TIRES:	
-- size	2, 11L x 14, 4-ply
WEIGHT: (with drawbar in field position and two balls of twine)	
-- left wheel	664 kg
-- right wheel	615 kg
-- hitch point	288 kg
Total	1567 kg
BALE CHAMBER:	
-- width	1514 mm
-- maximum diameter	2100 mm
-- tension method	spring and hydraulic
PLATFORM BELTS:	
-- number of belts	1
-- belt width	1524 mm
-- thickness	4.5 mm
-- belt speed (at 540 rpm)	2 m/s
FORMING BELTS:	
-- number of belts	9
-- belt width	102 mm
-- spacing (centre to centre)	154 mm
-- thickness	4 mm
-- belt speed (at 540 rpm)	1.94 m/s
BALE SIZE INDICATOR:	mechanical linkage, optional audible bale size indicator-bell
COMPRESSION ROLLERS:	
-- number of rollers	2
-- roller surface	
-upper	tire carcass
-lower	rubber (platform belt drive roller)
-- length	1500 mm
-- diameter	
-upper	145 mm
-lower	215 mm
-- speed	
-upper	252 rpm
-lower	166 rpm
PICKUP:	
-- type	floating cylindrical drum with spring teeth
-- height adjustment	mechanical
-- width	1395 mm
-- diameter	305 mm
-- number of tooth bars	4
-- tooth spacing	72.5 mm
-- speed (at 540 rpm)	109 rpm
TWINE SYSTEM:	
-- capacity	2 balls
-- recommended twine size	none
-- twine feed	manual, (electric, optional)
-- twine cutter	manual, (electric, optional)

SAFETY DEVICES:
- -- adjustable slip clutch on power take-off and pickup drive,
- -- optional audible bale size indicator, rear gate cylinder locks

SERVICING:	
-- grease fittings	3, twice daily 1, daily 5, weekly
-- chains	2, twice daily
-- wheel bearings	2, yearly
-- 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)
I kilogram (kg)	= 2.20 pounds (lb)
1 tonne/kilowatt hour (t/kW•h)	= 0.82 tons/horsepower hour (ton/hp•h)

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