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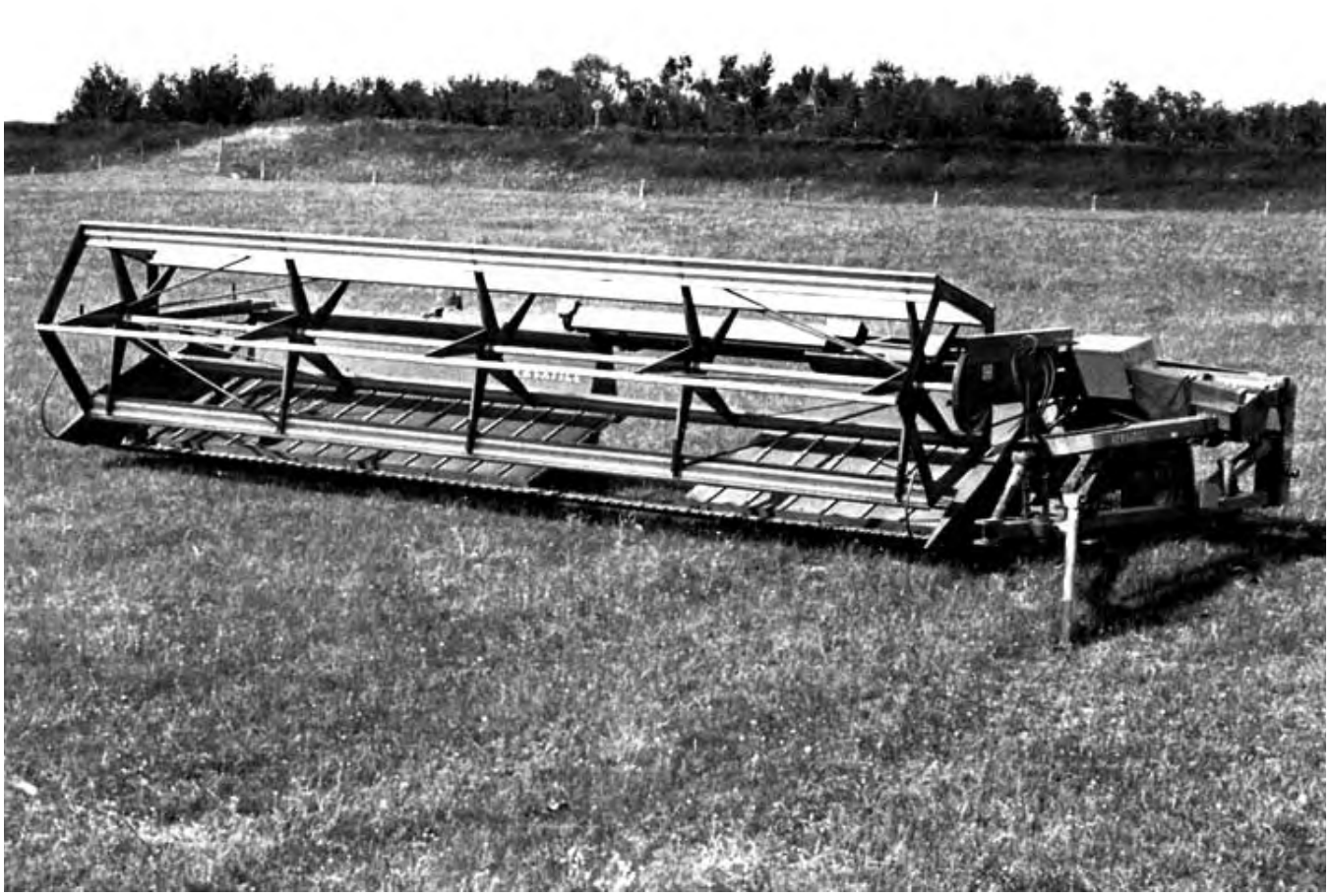
Evaluation Report 149



Versatile 10 Pull-Type Windrower

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

VERSATILE 10 PULL-TYPE WINDROWER

MANUFACTURER AND DISTRIBUTOR

Versatile Manufacturing Limited
1260 Clarence Avenue
Winnipeg, Manitoba
R3T 1T3

RETAIL PRICE:

$3,871.00 (March, 1979, f.o.b. Humboldt, Saskatchewan with 6.0 m cutter bar)

SUMMARY AND CONCLUSIONS

Overall functional performance of the Versatile 10 windrower was very good in all grain crops and was good in flax and rapeseed. Performance in hay crops, with the 6 m (20 ft) cutter bar, was good.

Cutting ability was excellent in most standing grain and hay crops. Feeding problems occurred in lodged crops. Table flotation was very good.

Windrow formation and quality varied from good to very good depending on crop type and stand. Parallel and angled parallel windrow patterns were predominant in hay and grain crops. Fantail patterns occurred in most heavy crops, while herringbone patterns occurred in light crops. The windrow opening was sometimes too narrow in very heavy crops.

Sideways skewing reduced performance on hillsides and in soft fields.

Peak power take-off requirements were about 10 kW (13 hp). A 30 kW (40 hp) tractor would have ample power reserve to operate the Versatile 10 in most field conditions. Suitable field speeds were from 3 to 11 km/h (2 to 7 mph) in average grain crops and from 3 to 7 km/h (2 to 4 mph) in average hay crops.

Reel and table height were easily controlled with the tractor hydraulics. Daily maintenance took from 20 to 25 minutes. No serious safety hazards were apparent, when the windrower was operated according to normal recommended procedures.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying or relocating the slip clutch to prevent universal joint misalignment and driveline chatter.
2. Supplying a different hitch jack to eliminate the need for double jacking when changing to full transport position.
3. Modifying the draper drive shaft mount or providing take-up bolts to facilitate drive belt tightening.
4. Modifying the reel drive shield mounts to permit use of the shield with the reel in the forward position.
5. Supplying a slow moving vehicle sign.

Chief Engineer -- E.O. Nyborg
Senior Engineer -- L.G. Smith
Project Technologist -- G.G. Burton

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Consideration is being given to relocating the slip clutch at the opposite end of the drive shaft, outside of the universal joints so as not to affect phasing. This slip clutch would also be of an improved design. This change is to be introduced at some future date.
2. A change to a new jack, with a greater lift height, will be considered for the future. This would eliminate double jacking.
3. A change in this area will be considered.
4. A change has been made for 1980 that will allow the reel to operate in the full forward position.
5. A slow moving vehicle sign is standard for 1980.

GENERAL DESCRIPTION

The Versatile 10 is a pull-type, power take-off driven windrower. The one piece cutting platform has dual drapers and a central, nonadjustable, windrow opening. The knife is actuated, through a swaybar, from a pitman on the power take-off drive line. A belt driven gearbox transmits power to the reel and, through a lateral shaft, to the draper drives.

The test machine was equipped with the 6.0 m cutter bar. Cutter bar height and reel height were controlled by the tractor hydraulics.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Versatile 10 was operated in the conditions shown in TABLES 1 and 2 for 94 hours while cutting about 286 ha. It was evaluated in forage, cereal grain and oil seed crops for windrow formation, cutting ability, ease of operation and adjustment, power requirements, operator safety, and suitability of the operator's manual.

TABLE 1. Operating Conditions

Crop	Soil Texture	Hours	Field Area ha
Alfalfa	sandy loam	3	9
Bromegrass/Alfalfa	sandy loam	2	8
Mixed Hay	light loam	9	29
Green Barley/Oats	loam	3	11
Fall Rye	loam	6	11
Barley	loam to sifty clay, loam	20	85
Oats	loam	3	11
Wheat	loam	27	40
Rapeseed	loam	8	31
Barley/Oats	loam	7	30
Barley/Flax	silty clay loam	5	20
Flax	loam	1	1
Total		94	286

TABLE 2. Operation in Stony Fields

Field Condition	Hours	Field Area ha
Stone Free	72	221
Moderately Stony	22	74
Total	94	286

RESULTS AND DISCUSSION

WINDROW FORMATION

Windrow Types: Windrows may be classified into four general patterns (FIGURE 1) although many combinations and variations exist. The Versatile 10 produced parallel and angled parallel windrows in most hay and grain crops. Herringbone windrows occurred in very light crops while fantail windrows occurred in heavy crops. TABLE 3 describes the types of windrows produced by the Versatile 10 in various crops while FIGURES 2 to 9 illustrate typical windrows.

TABLE 3. Windrow Formation in Various Crops

Crop	Yield t/ha	Cut Crop Length mm	Speed km/h	Windrow Type	Fig. No.
Alfalfa	3.1	300 to 600	4.5 to 6.5	Parallel and Angled Parallel	2
Bromegrass/ Alfalfa	1.7	300 to 900	3 to 5	Parallel and Angled Parallel	3
Mixed Hay	1.5	400 to 800	5 to7	Parallel	
Forage Barley/Oats	1.6	400 to 600	5.5 to 6.5	Herringbone	
Fall Rye	1.9	600 to 800	3 to 8	Fantail	4
Barley	2.6 to 3.2	200 to 800	3 to 11	Parallel and Angled Parallel; Fantail where heavy	5
Wheat	2.0 to 3.4	300 to 1000	3.5 to 10.5	Angled Parallel and Herringbone	6
Oats	2.2	400 to 800	3 to 11.5	Herringbone	7
Rapeseed	1.8	800 to 1000	3 to 8	Parallel and Fantail	8
Barley/Oats	3.7	300 to 700	4.5 to 10	Parallel and Angled Parallel	
Barley/Flax	2.5	400 to 500	6 to 8	Angled Parallel	
Flax	1.3	500 to 600	5 to 10	Parallel and Fantail	9

In general, good quality windrows have an even distribution of heads across the width of the windrow and a loose structure with heads near the top to assure proper curing. Windrows of mixed patterns seem to weather best in extended wet periods.

Leaning Crops: The direction of cut affected windrow

formation when windrowing lodged or leaning crops. Cutting parallel to the direction of lean resulted in parallel windrows while cutting at an angle to the direction of lean generally resulted in angled parallel windrows.

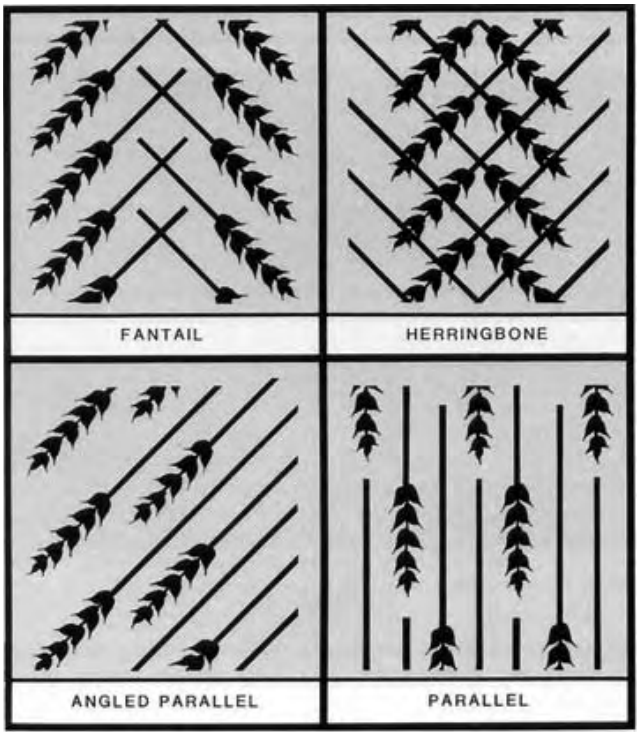


FIGURE 1. Windrow Types.

FIGURE 2. Alfalfa (3.1 t/ha).

FIGURE 3. Bromegrass/Alfalfa (1.7 t/ha).

Poor feeding occurred when cutting in the direction of lean while the crop hairpinned on the dividers when cutting at an angle to the direction of lean.

FIGURE 4. Fall Rye (1.9 t/ha).

FIGURE 5. Barley (2.6 t/ha).

FIGURE 6. Wheat (3.4 t/ha).

Uniformity: Windrows were uniform in most crops. In light, short hay crops, hay sometimes collected on the cutter bar causing slight bunching. Some bunching also occurred in badly lodged grain and hay due to uneven clearing of the cutter bar.

Draper Speed: Draper speed could be varied from 2.19 to 2.91 m/sec by changing the width of the set-screw-locked variable speed draper sheaves. Higher draper speeds were beneficial in forming denser, narrower, easier-to-pick windrows in light crops. Lower draper speeds were suitable for heavier crops, resulting in wider, more uniform windrows. In average conditions, suitable speeds were 2.9 m/s for the left draper and 2.3 m/s for the right draper.

FIGURE 7. Oats (2.2 t/ha).

FIGURE 8. Rapeseed (1.8 t/ha).

FIGURE 9. Flax (1.3 t/ha).

Forward Speed: Forward speed had little effect on windrow formation. Speed was usually limited by field roughness or cutting performance. In most heavy crops, the ability of the windrower to clear the crop through the windrow opening closely matched its ability to cut.

Windrow Opening: Windrow opening clearance was adequate in hay and most cereal crops. Some plugging occurred in very heavy rapeseed.

Cornering: The corners produced by the centre delivery design were not continuous, as shown in FIGURE 10. It was necessary to drive on the preceding windrow when cornering.

Driveline chatter occurred on sharp corners. Since the slip clutch was positioned between two universal joints in the power take-off drive line, the universal joints could not be maintained in phase, resulting in driveline chatter. It is recommended that the slip clutch be modified or relocated to prevent universal joint misalignment.

FIGURE 10. Typical Corner Formation.

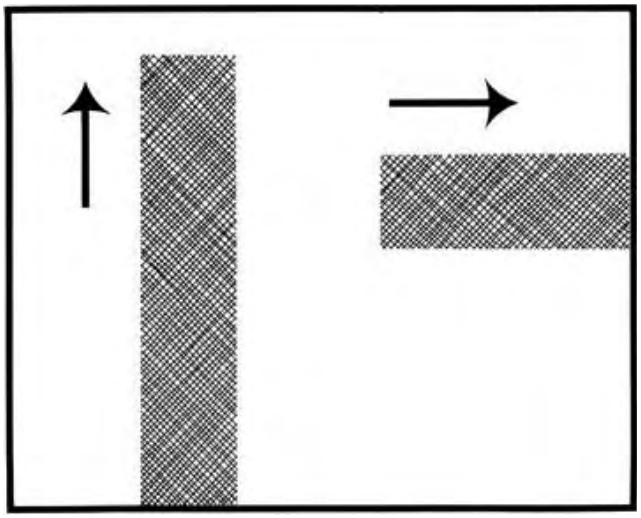


FIGURE 10. Typical Corner Formation.

CUTTING ABILITY

Cutter bar: Cutting ability was excellent in most hay and grain crops. Cutter bar hammering was not a problem, even in damp or very heavy crops.

Most field work was conducted with over-serrated, high-rise, knife sections. Low-rise knife sections, which provide a longer cutting surface for use in dead, damp leaf material, are available as an option.

Stubble: The types of stubble formed by a windrower may be divided into three types; ideal, undulating, and irregular as shown in FIGURE 11. The Versatile 10 generally produced ideal stubble in all grain and hay crops at speeds up to 10 km/h.

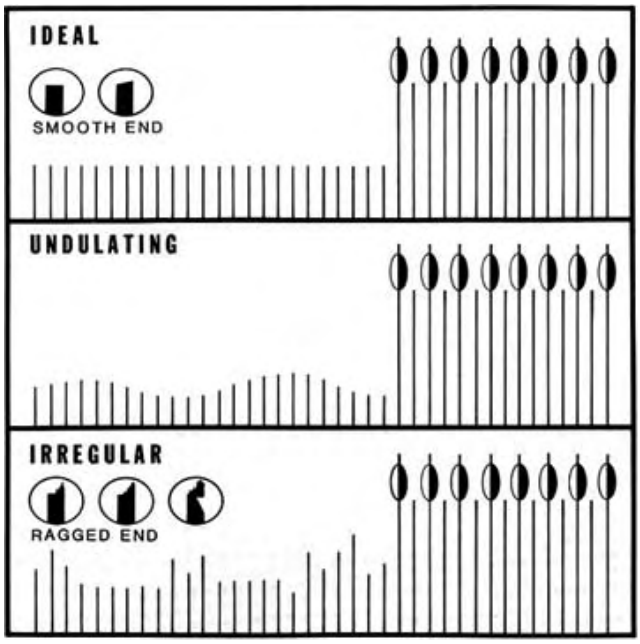


FIGURE 11. Types of Stubble.

Dividers: In average, straight standing grain and hay crops, divider performance was satisfactory. Slight hairpinning occurred in tall, leaning grain crops. The divider worked poorly in rapeseed and was replaced with one fabricated from sheet metal.

Reel: Reel performance was good in most crops. In tall fall rye, the reel could not be raised high enough to prevent stalks from hairpinning on the reel bats and being carried around over the top of the reel. Reel drive belt slippage was not a problem.

Reel speed was variable from 32 to 41 rpm by adjusting the belt drive sheave. For optimum performance it is best to have a reel index[1] from 1.1 to 1.2. The optimum reel index was obtained

[1]Reel index is the ratio of reel tip speed to travel speed.

at forward speeds ranging from 6.9 to 8.9 km/h. Operation at lower speeds was often necessary due to surface roughness and crop conditions.

Table Flotation: The Versatile 10 was equipped with a table flotation system, supplied as standard equipment (FIGURE 12). Table flotation was very good. To adjust the degree of flotation, the amount of load carried by each set of springs could be easily changed by repositioning the springs or by adjusting a take-up bolt.

FIGURE 12. Table Flotation System.

EASE OF OPERATION

Controls: The test machine was equipped with tractor operated hydraulics. Raising and lowering speeds of both the reel and table were satisfactory. An optional self-contained hydraulic system is available.

Soft and Muddy Fields: In soft and muddy fields the Versatile 10 skewed sideways. The amount of skew was dependent on surface conditions and was aggravated by hilly fields. In very soft, hilly fields, severe skewing under continued operation could result in damage to the windrower.

Transporting: The Versatile 10 has two transport positions. In semi-transport position, the hitch tongue is swung to the right to permit the tractor to pull from in front of the cutter bar. In full transport position, the hitch and wheel positions are changed, permitting the windrower to be pulled from the left end (FIGURE 13).

FIGURE 13. Full Transport Position.

It took one man about five minutes to change to semi-transport position and about twenty-five minutes to change to full transport position. To change to full transport the hitch pole must be jacked and supported on the castor arm. The jack is then repositioned and the hitch pole is raised high enough to install the wheel on the castor arm. It is recommended that a different jack be supplied to eliminate the need for double jacking.

Adjustments: Reel and draper speeds were adjusted by loosening the setscrews and positioning the two halves of the drive sheaves. Fore-and-aft reel position was adjusted by removing two bolts at each end of the reel and repositioning the wooden boxings. Drive belt tension had to be reset after adjustment. The reel belt drive shield could not be used when the reel was in full forward position. It is recommended that the reel drive shield mounts be modified to permit use of the shield with the reel in the full forward position.

The method of tightening the draper drive belts was inconvenient. It is recommended that the draper drive shaft mounts be modified or take-up bolts be provided to facilitate drive belt tightening.

Servicing: Daily lubrication of the Versatile 10 took from 10 to 15 minutes. Thirteen pressure grease fittings and two oiled boxings required daily service. A grease gun with a flexible hose was needed for greasing the universal joints and several other fittings.

POWER REQUIREMENTS

A 30 kW tractor had ample power to operate the Versatile 10 in most field conditions. A maximum of 10 kW was needed to drive the power take-off.

OPERATOR SAFETY

No safety hazards were apparent, if proper safety procedures were followed during servicing and operation. Drives were adequately shielded and safety locks were provided for the header and reel lifts.

OPERATOR'S MANUAL

The operator's manual contained useful information on operation, adjustment and servicing. It was clear and well written.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Versatile 10 during 94 hours of operation while windrowing about 286 ha. 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 Area ha
– The right draper drive belt broke and was replaced at	5	17
– The left draper drive belt broke and was replaced at	10	34
– The left bearing on the central shaft of the draper drive was replaced at	17	57
– The drive shaft slip clutch was disassembled, inspected and realigned at	17	57
– The reel and draper drive gear box failed and was replaced at	20	63
– The sickle drive counter-weight was replaced with a flywheel at	23	68
– The sickle drive swaybar broke and was repaired at	88	265
– The hitch swing assembly broke and was replaced at	92	280

DISCUSSION OF MECHANICAL PROBLEMS

The draper drive belts were damaged when they jumped out of the driven sheaves. Loose belts were suspected to be the cause. Failure of the draper drive bearing was due to lock collar over tightening during assembly.

The drive shaft slip clutch was inspected and the sickle drive fly wheel was installed in an attempt to solve the power take-off drive line chatter.

The manufacturer indicated that the gear box had been improperly assembled by the original supplier. Failure of the sickle drive swaybar was due to metal fatigue. The hitch swing assembly failed at a faulty plug weld.

APPENDIX I
SPECIFICATIONS

MAKE:	Versatile Pull-type Windrower
MODEL:	10
SERIAL NUMBER:	11 051 1978
MANUFACTURER:	Versatile Manufacturing Ltd. 1260 Clarence Ave. Winnipeg, Manitoba R3T 1T3

HEADER:	
-- width of cut (divider points)	6026 mm
-- effective cut (inside divider)	5937 mm
-- range of cutting height	-63 mm to 594 mm
-- guard spacing	76 mm
-- length of knife section (over-serrated)	76 mm
-- knife stroke	83 mm
-- knife speed	540 cycles/min
-- platform angle	
- fully raised	3° above horizontal
- fully lowered	26° below horizontal
-- number of drapers	2
-- draper width	1050 mm
-- draper speed range	2.19 to 2.91 m/s
-- draper roller diameter	65.3 mm
-- height of windrow opening	855 mm
-- width of windrow opening	
- between wind boards	1500 mm
- between rollers	1053 mm
- between roller shields	1000 mm
-- raising time	2.8 s
-- lowering time	2.75 s

REEL:	
-- number of bats	5
-- number of reel arms per bat	5
-- diameter	1320 mm
-- speed range	32.4 to 41.4 rpm
-- range of adjustment	
- fore and aft	230 mm
- height above cutter bar	750 mm
-- raising time	1.2 s
-- lowering time	2.5 s

HYDRAULIC SYSTEM:	tractor hydraulics
NUMBER OF CHAIN DRIVES:	4
NUMBER OF V-BELT DRIVES:	4
NUMBER OF LUBRICATION POINTS:	
-- pressure grease	13
-- oil	2

NUMBER OF PRE-LUBRICATED BEARINGS: 30

OVERALL DIMENSIONS:	FIELD POSITION	TRANSPORT POSITION
-- length	3632 mm	8306 mm
-- width	7303 mm	3910 mm
-- wheel tread	4559 mm	2350 mm
-- wheel base (hitch pin to rear axle)	3518 mm	6172 mm

TIRES:	
-- left	1, 6.70 x 15 SL, 6-ply rating
-- right	2, 6.70 x 15 SL, 6-ply rating

WEIGHT:	
-- hitch pin	324 kg
-- left wheel	310 kg
-- right wheels	700 kg
Total	1334 kg

OPTIONAL EQUIPMENT:
- -- hydraulics
  - - lock valve package
  - - self contained hydraulics
- -- knife
  - - low rise knife

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/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 mass (lb)

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