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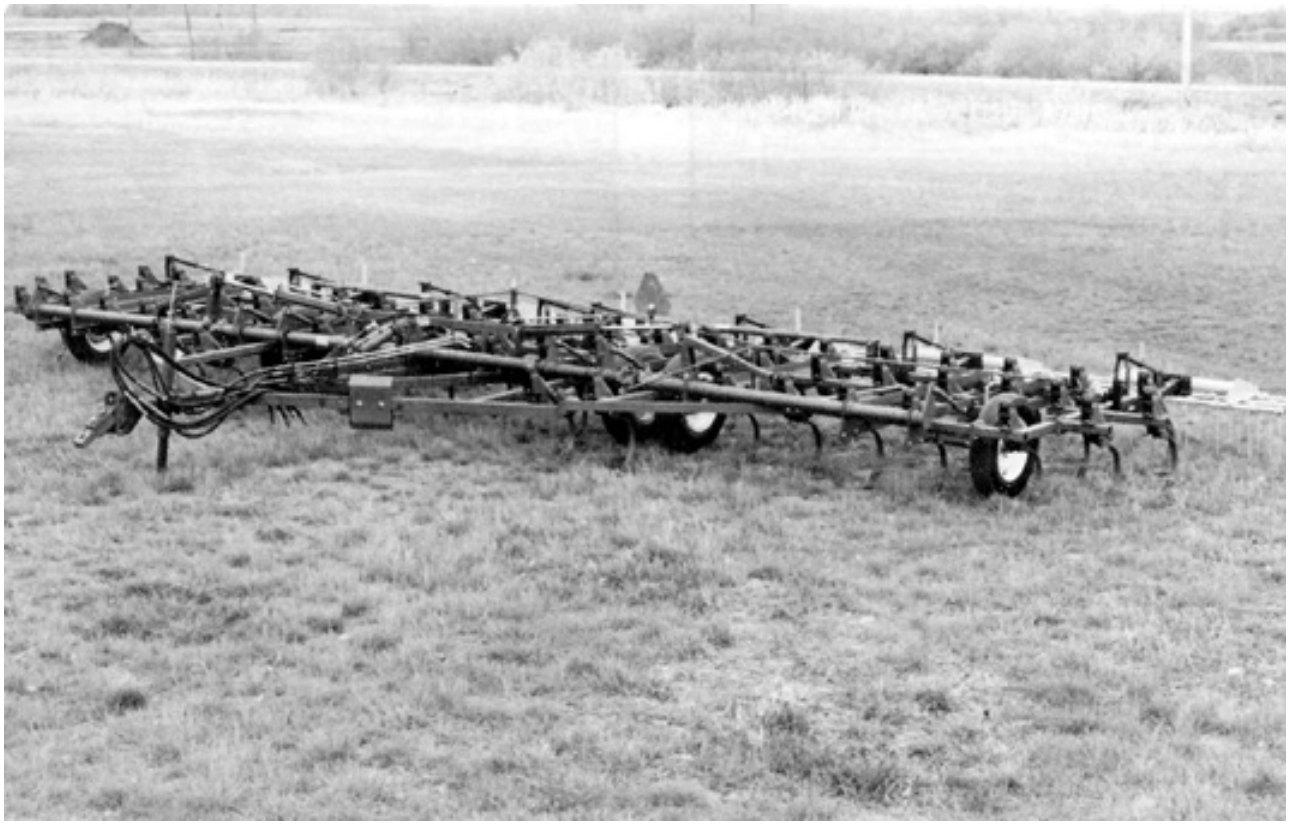
Evaluation Report 152



Case 1236W (11 m) Field Cultivator

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

CASE SERIES 1236W FIELD CULTIVATOR

MANUFACTURER:

Portable Elevator Co. Ltd.
Glencoe, Minnesota 55336
U.S.A.

DISTRIBUTOR:

J. I. Case Co. Ltd.
240 Henderson Drive
Regina, Saskatchewan
S4N 5P7

RETAIL PRICE:

$8,472.00 (May, 1979, f.o.b. Humboldt, with optional hitch jack and heavy duty shanks).

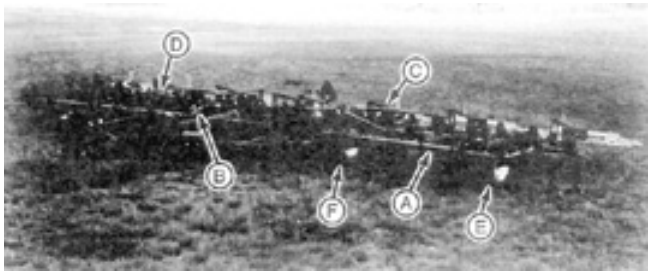


FIGURE 1. Case 1236W: (A) Depth Control Rockshaft, (e) Depth Control Cylinder mount (C) Wing Safety Stops, (D) Wing Lift Cylinders, (E) Wing Wheels, (F) Centre Wheels.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Case 1236W field cultivator was very good for seedbed preparation and herbicide incorporation, providing mounted finishing harrows were used. Its performance for second operation summerfallow was goodwith acceptable weed kill and minimal trash burial. As with most light duty field cultivators, the Case 1236W was unsuitable for first operation summerfallow or in moderate to heavy trash.

The spring-cushioned shanks could lift 216 mm (8.5 in) to clear stones. As with most field cultivators, the shanks were quite flexible. When equipped with recommended sweeps with 48.5 degree stem angle, sweep pitch varied from 1 to 5 degrees, over the normal secondary tillage draft range, resulting in a uniform, unridged furrow bottom. With 169 mm (6.6 in) shank spacing, shank cushioning spring preload was exceeded at drafts greater than 3.0 kN/m (206 lb/ft), occurring at the upper end of the secondary tillage draft range. Penetration was adequate in previously tilled soil, but was inadequate in harder soils. Plugging was a problem in moderately heavy trash in second operation summerfallow. The Case 1236W buried less trash than most heavy duty cultivators. The sweep pattern was symmetrical and sideways skewing was not a problem in normal field conditions. Slight skewing occurred on hillsides.

The Case 1236W could be conveniently placed into transport position in less than five minutes. The 260 mm (10 in) sweep-to-ground clearance was adequate for normal transport. Due to its large transport width and height, transporting on public roads had to be with extreme caution. The Case 1236W was stable and towed well, however the weight of mounted harrows caused moderate sway at transport speeds above 16 km/h. The 11.0 m (36.2 ft) wide test machine was 4.4 m (14.4 ft) high in transport, permitting safe passage under power lines in the three prairie provinces. Transport height of the 11.7 m (38.4 ft) wide model of the Case 1200W series was high enough for power line contact but could be reduced with optional secondary wing hinges.

When equipped with finishing harrows, hitch weight was negative, making hitching inconvenient. Adequate adjustment was provided for both fore-and-aft, and lateral levelling. Tillage depth was normally uniform across the cultivator width. The hitch pole and wheels were positioned to permit very good maneuverability.

Average draft for the 11.0 m (36.2 ft) wide test machine, in light secondary tillage, at 8 km/h (5 mph), varied from 8.7 kN (1946 lb) at 40 mm (1.5 in) depth to 22.0 kN (5221 lb) at 100 mm (4 in) depth. In heavy secondary tillage, at 8 km/h (5 mph), average draft varied from 15.1 kN (3389 lb) to 33.0 kN (7420 lb) over the same depth range.

In light secondary tillage, at 10 km/h (6.2 mph) and 75 mm (3 in) depth, a tractor with 91 kW (122 hp) maximum power take-off rating will have sufficient power reserve to operate the 11.0 m (36.2 ft) wide Case 1236W. In heavy secondary tillage at the same depth and speed, a 132 kW (177 hp) tractor is needed.

The Case 1236W was equipped with wing and depth control transport locks, an optional slow moving vehicle sign and reflectors at the frame ends, to aid in transport safety. The operator's manual was clear, concise and well illustrated.

A few mechanical problems occurred during the 218 hours of field operation. The rear frame members bent. Eleven shanks bent and eight shank bolts broke.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the shank cushion assemblies to improve shank protection.
2. Using higher strength shank bolts to prevent breakage.
3. Modifying the wing locks to permit easier pin insertion.
4. Modifying the depth control stops to permit easier adjustment.
5. Providing an alternate location for the hitch jack at the rear of the cultivator, to facilitate hitching when equipped with mounted harrows.
6. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads.
7. Working with the agricultural equipment industry to standardize shank and sweep stem angles, and sweep fastener spacings and sizes.

Chief Engineer - E. O. Nyborg
Senior Engineer - L. G. Smith
Project Engineer - D. E. Gullacher

THE MANUFACTURER STATES THAT

With regard to recommendaton number:

1. Our supplier will be informed of the recommendation to modify shank assemblies.
2. The recommendation for higher strength bolts for shank assemblies will be reported to the supplier.
3. The 1300 Series Field Cultivator (replaces 1200 Series) employs a redesigned wing lock assembly. The problem reported by PAMI on the 1200 Series will be communicated to the supplier.
4. In the design of the 1300W Series, wheel stops are not used. This feature has been replaced by a rephasing hydraulic cylinder design. We will report to the supplier regarding wheel stop problems on the 1200.
5. The new 1300 Series provides for a rear mounted hitch jack.

6. Hydraulic hoses furnished with the 1300W Field Cultivator utilize 1/2 inch NPT ends to fit adapters for male couplers. The dealer makes installation of correct male coupler for the customer.
7. The implement industry follows the American Society of Agricultural Engineering standards on "chisel plow, field and row crop cultivator shanks and ground tool mountings"
ASAE #$225.1. Ground tool standards are continually being updated by ASAE and FIEI committees.

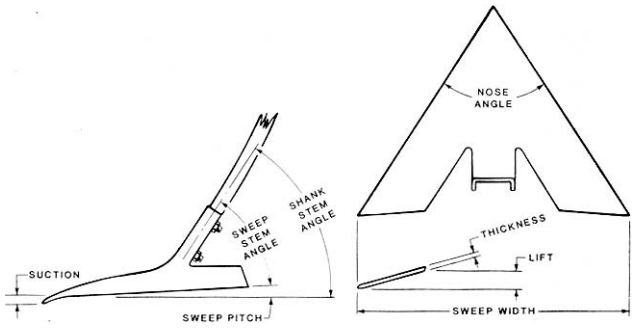


FIGURE 2. Shank and Sweep Terminology.

GENERAL DESCRIPTION

The Case 1236W is a trailing, flexible, three-section field cultivator suitable for light tillage such as seedbed preparation, herbicide incorporation and secondary summerfallow. The Case 1200W series is available in 14 widths ranging from 7.2 to 11.7 m. The test machine was a 11.0 m model, with a 4 m centre frame and two 3.5 m wings. It was equipped with 65 optional, heavy duty spring cushioned shanks, laterally spaced at 169 mm, arranged in three rows on the wings and in four rows on the centre section.

The centre frame is carried on two dual wheels sets, while each wing is supported by a single wheel. Tillage depth is set with a standard 203 mm hydraulic cylinder, controlling a rockshaft for the centre section and wing wheels. Two hydraulic cylinders fold the wings into upright transport position. A tractor with dual remote hydraulic controls is needed to operate the Case 1236W.

Detailed specifications are given in APPENDIX I while FIGURE 1 shows the location of major components.

SCOPE OF TEST

The Case 1236W was operated in the field conditions shown in TABLE 1, for 218 hours, while cultivating about 1179 ha. It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety and suitability of the operator's manual.

Optional mounted finishing harrows are available for the Case 1200W series but could not be supplied at the time of tests. Bourgault mounted harrows were used instead.

TABLE 1. Operating Conditions

FIELD CONDITION	HOURS	FIELD AREA (ha)
Soil Type		
—loam	140	757
—clay	78	422
TOTAL	218	1 179
Stony Phase		
—stone free	2	11
—occasional stones	190	1 027
—moderately stony	26	141
TOTAL	218	1 179

RESULTS AND DISCUSSION

QUALITY OF WORK

Shank Characteristics: There is a large variation in shank and sweep stem angles (FIGURE 2) on cultivators from different manufacturers. Sweeps and shanks must be matched to obtain sufficient sweep pitch to achieve and maintain penetration. Usually manufacturers recommend sweeps with a stern angle from 0 to 5 degrees less than the shank stem angle to result in a slightly positive no-load sweep pitch.

Sweep pitch increases in proportion to draft due to shank flexing and, depending on shank stiffness and cushioning-spring preload, may become excessive in normal tillage, on some cultivators. A slightly positive sweep pitch results in uniform tillage depth and a smooth furrow bottom while excessive sweep pitch causes furrow bottom ridging and rapid sweep tip wear. Shanks which maintain a low, relatively constant sweep pitch, over the normal range of tillage forces, are desirable.

The Case 1236W was equipped with adjustable, spring-cushioned shank holders, the spring clamps could be set in two positions to suit soil conditions. The normal position was recommended for use with sweeps in typical secondary tillage, while the alternate position was recommended for use with chisel points in harder soils. During most of the test, the Case 1236W was used with 228 mm wide Case sweeps with a 48.5 degree stem angle, giving a no load sweep pitch of 0 degrees.

FIGURE 3 shows pitch characteristics of the optional heavy duty shank assemblies used on the test machine. The low end of the pitch curve results from shank flexing, while the steeper upper part of the curve occurs when draft is large enough to overcome cushioning spring preload. Sweep pitch varied 4 degrees over the full range of draft normally occurring in secondary tillage. When equipped with 48.5 degree sweeps, as used during the test, sweep pitch varied from 1 to 5 degrees over this draft range. Cushioning spring preload was exceeded at drafts greater than 3.0 kN/m, occurring at the upper end of the normal secondary tillage draft range. This shows that the Case 1236W with optional heavy duty shanks is well suited for most secondary tillage but is not intended for primary tillage.

FIGURE 4 shows the lifting pattern when shanks encounter stones or field obstructions. Maximum lift height was 216 mm with the spring clamp in normal position and 180 mm with the clamp in the alternate position. Eleven shanks bent during the test. Some bends occurred because of binding of painted parts of new spring cushion assemblies while others occurred because of the excessive forces generated by the cushioning-springs at high shank lift. Shank protection was inadequate in conditions where high shank lift was required.

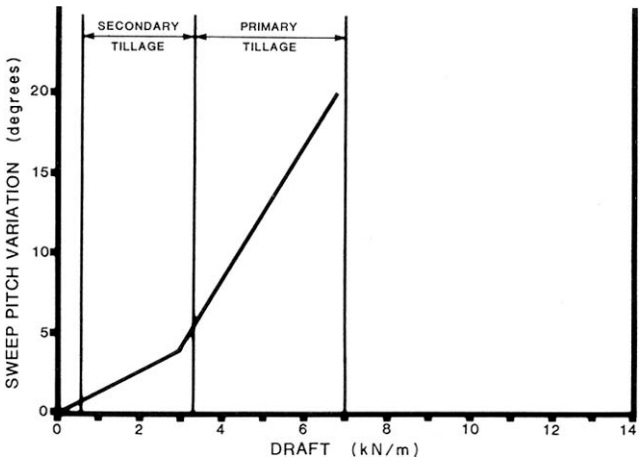


FIGURE 3. Sweep Pitch Variation over a Normal Range of Draft (169 mm Shank Spacing).

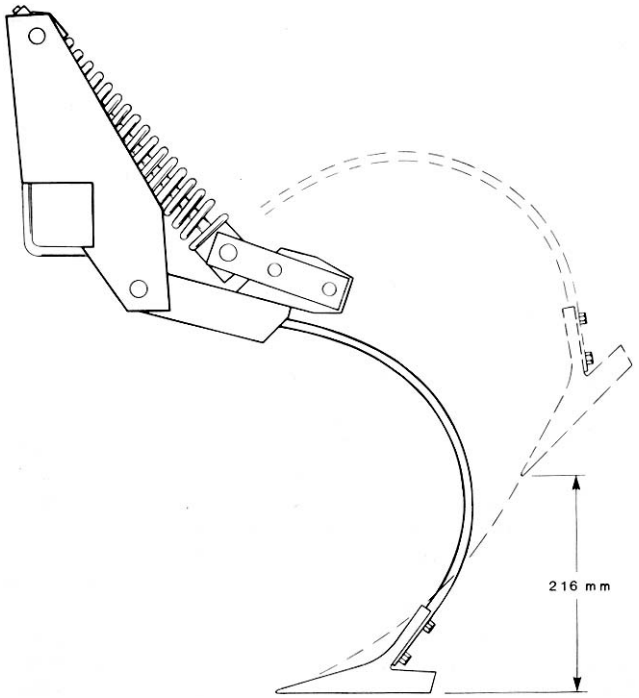


FIGURE 4. Shank Lifting Pattern (Spring Clamp In Normal Position).

Penetration: Penetration was good in light tillage, such as seedbed preparation, herbicide incorporation and secondary summerfallow. Penetration was inadequate in most primary tillage operations. As with most field cultivators, the Case 1236W was not intended for primary tillage.

In most conditions, penetration was uniform across the cultivator width. Tires were adequately sized to provide uniform flotation in most soil conditions. The wheels were positioned so that each centre section wheel supported about 17% of the cultivator weight while each wing wheel supported about 16%. In addition, each centre section wheel supported about 14% of the total tillage suction force while each wing wheel supported about 22%. The centre wheels were spaced 2.9 m apart to avoid running in the wheel tracks of single wheeled tractors.

Depth differences between the front and rear rows of shanks were slight, once the frame had been properly levelled. In normal secondary tillage, the frame remained relatively level with little twisting of the wing frames.

The Case 1236W followed gently rolling field contours very well, maintaining quite uniform depth across its width. As with most wing cultivators, large variations in tillage depth occurred in fields with abrupt contour changes.

Plugging: The 169 mm lateral shank spacing and 440 mm sweep-to-frame trash clearance was suitable only for light trash and light weed growth. Plugging occurred across the entire cultivator width during second operation summerfallow in fields with moderate buried or surface trash. Plugging also occurred between shanks while using chisel points in stubble, making it unsuitable for autumn trash burial. Plugging was not a problem in those light, secondary tillage operations for which the cultivator was intended.

Trash Burial and Field Surface: The Case 1236W buried less trash than most heavy duty cultivators. In light, secondary tillage, the Case 1236W left a smooth, even and unridged soil surface. Mounted finishing harrows also aided in smoothing the soil surface resulting in very uniform seedbed preparation (FIGURE 5).

Furrow Bottom Ridging: Shank and spring-cushion stiffness on the optional heavy duty shanks were sufficient to hold the sweeps fairly level. Furrow bottom ridging did not exceed 10 mm over the normal range of use. In fields with a hard subsoil layer, ridging was severe due to excessive sweep pitch at high draft (FIGURE 3).

FIGURE 5. Typical Seedbed Preparation.

Skewing and Stability: The Case 1236W was very stable and did not skew sideways in normal field conditions. The shank pattern (FIGURE 6) was symmetrical and did not impose any side forces on the cultivator during normal tillage. As with most field cultivators, slight skewing occurred on hillsides or where soil hardness varied across the machine width. When equipped with 228 mm sweeps, weeds were missed if the cultivator skewed more than 1.4 degrees (FIGURE 6). With 254 mm sweeps, the skew angle for weed misses was 2.1 degrees.

Weed Kill: Weed kill was good, with 228 mm sweeps and 169 mm shank spacing. Sweeps were positioned behind each wheel to pulverize the compacted soil and uproot weeds in the tracks. Mounted harrows increased weed kill by uprooting and exposing loosened weeds.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Case 1236W was easily placed in transport by one man in less than five minutes (FIGURE 7). The hydraulic wing lift system, supplied as standard equipment, raised the wings into vertical position. Pins had to be inserted by hand to lock the wings and depth control rockshaff in transport position. The wing lock pins were difficult to install because of hole misalignment. It is recommended that the locks be modified to allow easier pin insertion.

Transport width of the test machine was 5.4 m while transport height was 4.4 m. Extreme care was needed when transporting on public roads, through gates, over bridges and beneath power or telephone lines.

The manufacturer recommends a maximum transport speed of 16 km/h. The cultivator swayed when travelling faster than this because of hitch pole flex under the added weight of mounted harrows. Sway did not occur at any normal speed, when transporting without mounted harrows.

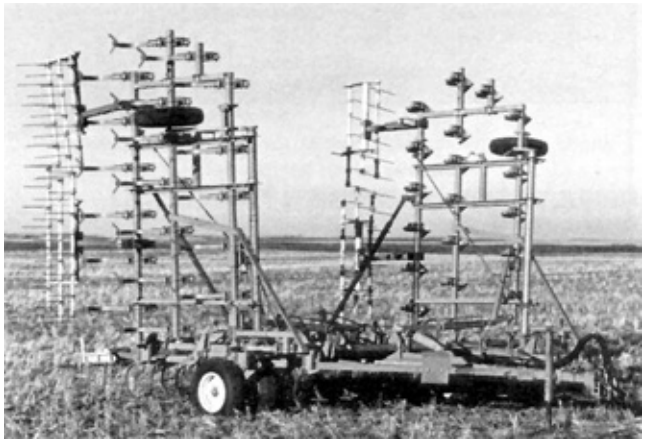


FIGURE 7. Transport Position.

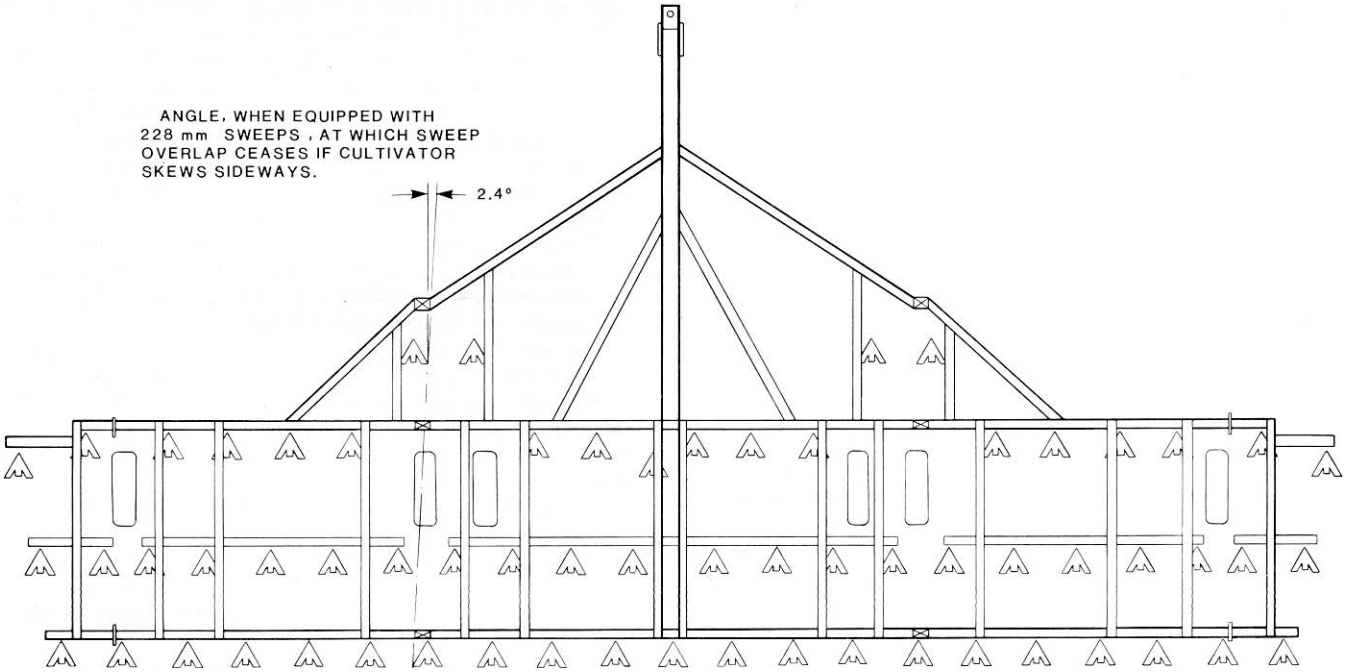


FIGURE 6. Sweep Pattern (169 mm Shank Spacing).

Sweep to ground clearance was 260 mm, while the inside minimum transport wheel tread was 2.9 m. This provided ample ground clearance. The cultivator had a low centre of gravity in transport position, and a wide wheel tread which made it resistant to upset in normal situations.

Hitching: The Case 1236W was equipped with an optional hitch jack. The jack permitted easy hitching, only if the cultivator was not fitted with mounted harrows. When mounted harrows were attached, the resulting negative hitch weight made it difficult for one man to hitch the cultivator to a tractor. It is recommended that an alternate location for the hitch jack be provided at the rear of the cultivator, to facilitate hitching when equipped with mounted harrows.

The swivel hitch link remained in a nearly extended position when not hitched to a tractor, making one-man hitching possible.

Hitch height could be adjusted 170 mm in four increments by removing one pin. This range was adequate to allow fore-and-aft cultivator frame levelling with all tractors used during testing.

Maneuverability: The hitch pole on the Case 1236W was narrow, with the wing braces positioned to permit normal turns without interference with the tractor wheels. The dual centre section wheels were positioned to eliminate skidding during turns.

There was sufficient overhang beyond the wing wheels to allow moderate overlap without running a wing wheel on the cultivated ground.

Frame Levelling: Adequate lateral levelling adjustment was provided for both the centre and wing sections. Each wheel could be individually adjusted by changing the length of the rockshaff connecting links.

Tillage Depth: Tillage depth is controlled with a single, standard 203 mm hydraulic cylinder linked to a common rockshaft. Adjustable depth stops are provided for each wheel. Adjusting the stops was made difficult due to interference of the adjusting cranks with the wheels (FIGURE 8) and binding in the screw threads. It is recommended that the stop adjustment be modified to eliminate wheel interference and to reduce thread binding.

Sweep Installation: It took one man about three hours to remove and replace the 65 sweeps on the Case 1236W. The sweep bolts were short enough to have their ends completely covered by the retaining nuts, preventing thread damage to the sweep bolts during tillage. Sweep-to-ground clearance of 260 mm was adequate for easy sweep removal.

FIGURE 8. Interference of Depth Stop Crank with Depth Control Wheel.

Shank Installation: Shanks could be easily replaced by removing one shank fastener bolt. A shank could be replaced in less than five minutes.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 9 shows draft requirements for field cultivators in typical secondary tillage, at a speed of 8 km/h. This figure gives average requirements based on tests of six makes of field cultivators in two seasons and 12 different field conditions. Attempting to compare draft requirements of different makes of field cultivators usually is unrealistic, Draft requirements for the same cultivator, in the same field, may vary by as much as 30% in two different years, due to changes in soil conditions. Variation in soil conditions affect draft much more than variation in machine make, usually making it impossible to measure any significant draft differences between different makes of field cultivators.

In light secondary tillage, such as herbicide incorporation or seedbed preparation, average draft per metre of width, at 8 km/h, varied from 0.8 kN at 40 mm depth to 2.0 kN at 100 mm depth. For the 11.0 m wide test machine, this corresponds to a total draft ranging from about 8.7 to 22.0 kN.

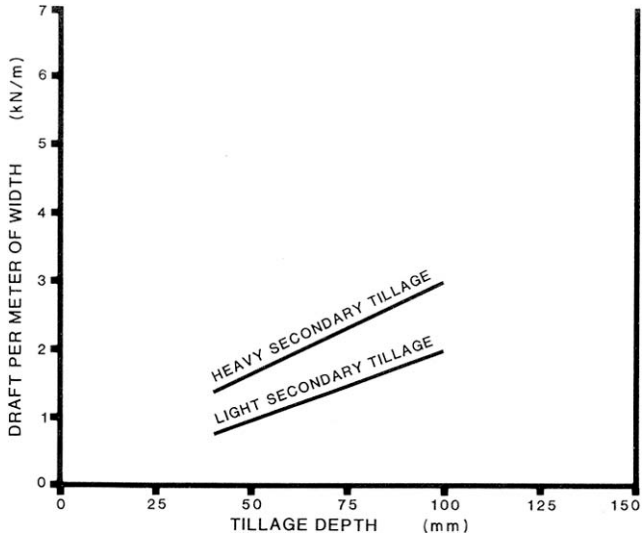


FIGURE 9. Average Draft Requirements for Field Cultivators at 8 km/h.

In heavy secondary tillage, such as firm summerfallow, average draft per metre of width, at 8 km/h, varied from 1.4 kN at 40 mm depth to 3.0 kN at 100 mm depth, corresponding to a total variation from about 15.1 to 33.0 kN for the 11.0 m test machine.

Increasing speed by 1 km/h, increased draft by about 90 N per metre of width. For the 11.0 m wide test machine this represents a draft increase of about 990 N for a 1 km/h speed increase.

Tractor Size: TABLES 2 and 3 show tractor sizes needed to operate the 11.0 m wide Case 1236W in light and heavy secondary tillage. Tractor sizes have been adjusted to include tractive efficiency in loose soils and represent a tractor operating at 80% of maximum power on a level field. The sizes presented in the tables are the maximum power take-off rating, as determined by Nebraska tests or as presented by the tractor manufacturer. Selected tractor sizes will have ample power reserve to operate the Case 1236W for the stated conditions.

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example, in light secondary tillage at 75 mm depth and 10 km/h, a 91 kW tractor is needed to operate the Case 1236W. In heavy secondary tillage at the same depth and speed, a 132 kW tractor is needed.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.0 m Wide Case 1236W In Light Secondary Tillage.

DEPTH (mm)	SPEED (km/h) 7	8	9	10	11	12
40	26	33	41	50	60	71
50	34	43	52	62	73	85
75	54	66	78	91	105	120
100	75	89	104	120	137	155

TABLE 3. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.0 m Wide Case 1236W in Heavy Secondary Tillage.

DEPTH (mm)	SPEED (km/h) 7	8	9	10	11	12
40	47	58	70	82	96	111
50	57	69	83	97	112	128
75	82	98	115	132	151	171
100	107	126	147	168	190	213

OPERATOR SAFETY

Extreme caution is needed in transporting most folding cultivators, to avoid contacting power lines. Minimum power line heights vary in the three prairie provinces. In Saskatchewan, the energized line may be as low as 5.2 m over farm land or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 4.8 m over farm land. In all three provinces, feeder lines in farmyards may be as low as 4.6 m.

Transport height of the 11.0 m wide test machine was 4.4 m, permitting safe transport under prairie power lines. On the other hand, transport height of the 11.7 m wide model of the Case 1236W series is 4.8 m, which is high enough for contact with some prairie power lines. The height of wide models can be reduced with optional secondary wing hinges. The legal responsibility for safe passage under utility lines rests with the machinery operator and not with the power utility or the machinery manufacturer. All provinces have regulations governing maximum permissible equipment heights on various types of public roads. If height limits are exceeded, the operator must contact power and telephone utilities before moving.

The test machine was 5.4 m wide in transport position. This necessitated caution when towing on public roads, over bridges and through gates. It was equipped with an optional slow moving vehicle sign as well as warning reflectors on the rear of the cultivator for transport safety.

Pins were provided to lock the wings and depth control in transport position.

The four tires supporting the main frame were adequately sized for transporting the cultivator. Individual tire loads did not exceed the Tire and Rim Association maximum rating for 7.60 x 15, 6-ply tires.

The operator's manual clearly outlined all safety precautions.

STANDARDIZATION

Hydraulics: During the test, considerable difficulty was encountered due to differences in hydraulic couplers on various tractors. The difficulty was in the lack of standardization both in couplers and in hose threads. More standardization is needed in this area.

Sweep Bolt Holes: The bolt hole size and spacing on cultivator sweeps and shanks, as well as stem angles, should similarly be standardized to provide some degree of interchangeability of sweeps.

OPERATOR'S MANUAL

The operator's manual contained useful information on safety, operation, maintenance and assembly. It was clear, concise, and well illustrated.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Case 1236W during 218 hours of field operation while tilling about 1179 ha. The intent of the test was evaluation of functional performance. The following mechanical problems represent those which occurred during the functional testing. An extended durability evaluation was not conducted.

DISCUSSION OF MECHANICAL PROBLEMS

Frame Members: The frame members bent and the frame truss deformed while the cultivator was in the transport position.

TABLE 4. Mechanical History

ITEMS	OPERATING HOURS	EQUIVALENT FIELD AREA ha
Frame		
--The rear centre frame truss deformed	During the Test	
--The rear centre and wing frame members bent during transport and were straightened at	69	373
--The right hitch pole brace belts broke and were replaced at	204	1103
Shank and Holder		
--Eleven shanks bent and were replaced	During the Test	
--Eight shank belts broke and were replaced	During the Test	
Hydraulic System		
--A wing lift hydraulic hose failed and was replaced at	58	314

The failures were caused by the added weight of the Bourgault mounted harrows used during the test. These problems may not have occurred if the cultivator had been fitted with the lighter harrows supplied by the manufacturer as optional equipment. Care should be taken to avoid overloading the frame when using harrows other than those recommended by the manufacturer.

Shanks: Eleven shanks failed during the test because of inadequate protection from the spring-cushion assemblies. Paint on the sliders of new assemblies caused binding which hindered shank release over obstructions. Once the paint wore away the assemblies moved freely at low shank lift but excessive forces were imposed on the shanks by the cushioning-springs at high lift. It is recommended that the spring-cushion assemblies be modified to prevent binding and to give good shank protection at high lift.

Eight shank bolts broke during the test because of inadequate strength. It is recommended that higher strength bolts be used to prevent breakage.

APPENDIX I

SPECIFICATIONS

MAKE: Case Field Cultivator
MODEL: 1236W
SERIAL NUMBER: 1 626 225
MANUFACTURED FOR: J.I. CASE CO. LTD.
700 State Street
Racine, Wisconsin 53404
U.S.A.

DIMENSIONS:	FIELD POSITION	TRANSPORT POSITION
--width	11,020 mm	5400 mm
--length	5320 mm	5320 mm
--Height	800 mm	4400 mm
--max ground clearance	260 mm	250 mm
--wheel tread	8860 mm	3570 mm
SHANKS:		
--number	65	
--4ateral spacing	169 mm	
--trash clearance (frame to sweep tip)	440 mm	
--number of shank rows:		
--centre section	4	
--wings	3	
--distance between rows:		
--extension--front	776 mm	
--front--middle	953 mm	
--rniddle--rear	635 mm	
--shank cross section	12 x 45 mm	
--shank stem angle	48.5°	
--sweep hole spacing	45 mm	
--sweep bolt size	3/8 x 1-1/4	
HITCH:		
--vertical adjustment range	170 mm	
DEPTH CONTROL:	hydraulic	
FRAME:		
--cross section	65 ram, square tubing, 4.5 mm thick	
TIRES:		
--centre section	4, 7.60 x 15, 6-ply	
--wings	2, 6.70 x 15, 6-ply	
NUMBER OF LUBRICATION POINTS:	12 grease fittings, 8 hour service 6 wheel boarlngs, yearly service	
HYDRAULIC CYLINDERS:		
--depth control	1, 102 x 203 mm	
--wing lift	2, 76 x 610 mm	

WEIGHTS: (Without Harrows)	FIELD POSITION	TRANSPORT POSITION
--right wheel	425 kg	
--right centre wheels	1017 kg	1441 kg
--left centre wheels	1016 kg	1441 kg
--left wheel	447 kg	
--hitch	21 kg	46 kg
TOTAL	2928 kg	2928 kg
WEIGHTS: (With Mounted Harrows)	**FIELD POSITION**	**TRANSPORT POSITION**
--right wheel	539 kg	
--right centre wheels	1298 kg	1798 kg
--left centre wheels	1298 kg	1797 kg
--left wheel	561 kg	
--hitch	-305 kg	-204 kg
TOTAL	3391 kg	3391 kg

OPTIONAL EQUIPMENT:

--14 width options from 7.2 to 11.7 m
--hitch jack
--hydraulic depth control cylinder (203 mm stroke)
--implement trail hitch
--transport warning lamp
--slow moving vehicle emblem, and mount
--three shank and two shank holder options for light, medium or heavy duty operation
--secondary wing hinges end lift cylinders for wide machines
--outrigger guage wheels for wide machines
--mounted finishing harowe

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 (ec)
1 kilometre/hour (kin/h)	= 0.62 mile/hour (mph)
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)
1 Newton (N)	= 0.22 pounds force (lb)
1 kilonewton (kN)	= 220 pounds force (lb)
1 kilonewton/metre (kN/m)	= 70 pounds force/foot (lb/ft)

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