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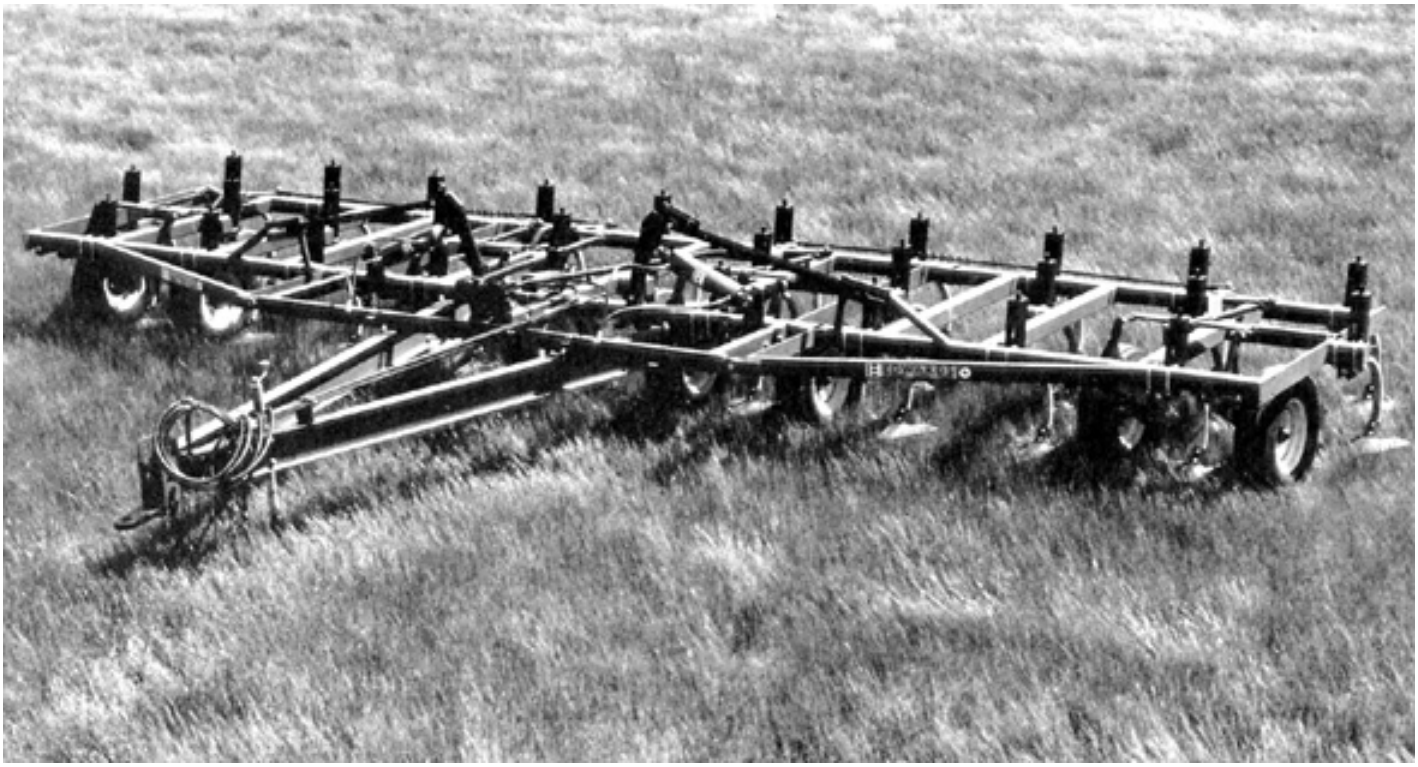
Evaluation Report 280



Edwards CSF-833 (9.9 m) Heavy Duty Cultivator

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

EDWARDS CSF-833 HEAVY DUTY CULTIVATOR

MANUFACTURER AND DISTRIBUTOR:

Edwards Rod Weeder Ltd.
3102- 5 Avenue North
Lethbridge, Alberta
T1J 4A2

RETAIL PRICE: $11,090.00 (May, f.o.b. Lethbridge, Alberta, 9.9 m width).

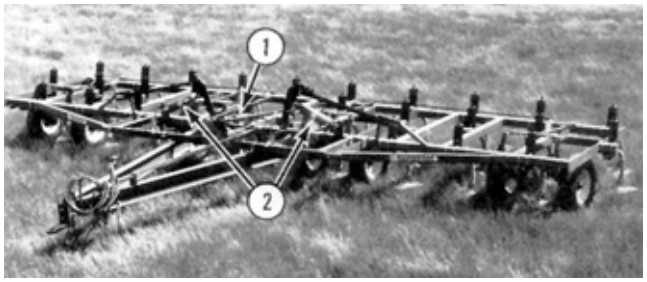


FIGURE 1. Edwards CSF-833: (1) Depth Cylinder, (2) Wing Lift Cylinders.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Edwards CSF-833 cultivator was good. Performance was reduced due to furrow bottom ridging in primary tillage operations.

The spring cushioned shanks could lift 147 mm (5.8 in) to clear stones. When the shanks were set at the manufacturer's setting, with sweeps having a 50 degree stem angle, sweep pitch varied from 5 to 8.5 degrees in secondary tillage and from5 to 15.5 degrees over the full primary tillage draft range. With 330 mm (13 in) spacing, shank cushioning preload was'exoeeded at drafts greater than 2.4 kN/m (168 lb/ft) which is within the secondary tillage draft range, indicating that at this setting the Edwards CSF-833 was not suited for primary tillage without experiencing excessive furrow bottom ridging. At an alternate spring setting, sweep pitch varied from 5 to 10.3 degrees over the normal primary tillage draft range. Spring cushion preload was exceeded at drafts greater than 7.2 kN/m, indicating that at this setting the Edwards CSF-833 shank holders were suited for primary tillage. Shank lift height was reduced from 147 mm (5.8 in) to 105 mm (4.2 in) at this setting. Shank protection was inadequate at both settings.

Although penetration was very good, in primary tillage, excessive furrow bottom ridging occurred due to the large variation in sweep pitch at higher drafts. Depth of tillage was uniform across the width of the cultivator. Weed kill was good in most conditions. The Edwards was quite stable. Trash clearance was very good in moderate trash conditions. In heavy trash, plugging occurred between the dual wheels.

The Edwards CSF-833 could be easily placed in transport in less than five minutes. The 130 mm (5.1 in) sweep to ground clearance provided sufficient ground clearance. The Edwards CSF-833 towed well at normal transport speeds. The tires were adequately sized to allow safe transport. Transport height of the 9.9 m (32.5 ft) wide test machine was 3.9 m (12.8 ft), permitting safe transport under prairie power lines. Transport heights of some wider models of this cultivator are greater than minimum power line heights.

The hitch link was fastened with two pins, permitting easy one-man hitching. The hitch jack provided adequate hitch height adjustment. Adequate adjustment was provided for both lateral and fore and aft frame levelling.

Average draft for the 9.9 m (32.5 ft) wide test machine, in light secondary tillage at 8 km/h (5 mph) varied from 7.9 kN (1788 lb) at 40 mm (1.6 in) depth to 19.8 kN (4453 lb) at 100 mm (4 in) depth. In heavy secondary and light primary tillage at 8 km/h (5 mph) average draft varied from 13.9 kN (3120 lb) at 40 mm (1.6 in) depth to 36.6 kN (8255 lb) at 125 mm (5 in) depth. In heavy primary tillage at 8 kmlh (5 mph), average draft varied from 17.8 kN (3998 lb) at 50 mm (2 in) depth to 64.4 kN (14,463 lb) at 125 mm (5 in) depth.

In light secondary tillage at 10 kmlh (6.2 mph) and 75 mm (3 in) depth, a tractor with 82 kW (109 hp) maximum power take-off rating will have sufficient power reserve to operate the 9.9 m (32.5 ft) wide Edwards CSF-833. In heavy secondary and light primary tillage, at the same depth and speed, a 119 kW (159 hp) tractor is needed, while in heavy primary tillage a 145 kW (194 hp) tractor is required.

The Edwards CSF-833 was equipped with a mechanical depth control lock and a mechanical wing transport lock for safe towing. A slow moving vehicle sign was not provided. The operators manual contained a parts list and safety warnings. Set-up and maintenance instructions were not included.

A number of mechanical problems occurred during the 166 hours of field operation. Many shanks bent during the test, one shank holder was damaged, the transport depth lock was bent, several nuts loosened, the depth control bolts loosened and the depth control cylinder mount sheared off.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Increasing shank lift height when encountering obstacles to reduce shank and sweep failure.
2. Providing a locking mechanism on the frame levelling adjustments to prevent them from loosening.
   Increasing the length of the right wing levelling adjustment to increase ground clearance when the cultivator frame is levelled.
3. Supplying a slow moving vehicle sign as standard equipment.
4. Providing a detailed operators manual.
5. Modifying the transport lock-up to reduce bending.
   Modifications to prevent depth control linkage cotter pin shearing.
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.

Senior Engineer: E. H. Wiens

Project Engineer: L. J. deBoer

THE MANUFACTURER STATES THAT:

With regard to recommendation number:

1. Shank holders and spring have been redesigned to increase shank lift height for clearing obstacles.
2. Modifications will be made to prevent loosening of the frame levelling adjustments.
3. Wing levelling adjustment linkages will be shortened to provide increased sweep to ground clearance.
4. Slow moving vehicle signs are available as optional equipment.
5. A detailed operator's manual is now being supplied with each machine.
6. Modifications are being considered to prevent transport lock-up bending.
7. A washer has been added to prevent depth control linkage cotter pin shearing.

8. & 9. We are continually striving to standardize in both these areas.

NOTE: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX III.

GENERAL DESCRIPTION

The Edwards CSF-833 is a trailing, flexible, three section cultivator. It is available in 19 widths ranging from 3.4 to 16.8 m (11 to 55 ft). The test machine was a 9.9 m (32.5 ft) model with a 3.5 m (11.5 ft) centre frame and two 3.2 m (10.5 ft) wings. It was equipped with 30 spring cushioned shanks, laterally spaced at 330 mm (13 in) and arranged in three rows.

The centre frame is carried on two dual wheel sets, while each wing is supported by one dual wheel set. One hydraulic cylinder controls tillage depth. The wings fold into transport with two cylinders connected in parallel. A tractor with dual remote hydraulic controls is needed to operate the Edwards CSF-833.

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

SCOPE OF TEST

The Edwards CSF-833 was operated in the field conditions shown in TABLE 1 for 166 hours while cultivating 1248 ha (3120 ac). It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety and suitability of the operator's manual.

TABLE 1. Operating Conditions

FIELD CONDITIONS	HOURS	FIELD AREA (ha)
Soil Type		
- light loam	75	564
- loam	34	256
- heavy loam	51	383
- clay	6	45
TOTAL	166	1248
Stony Phase		
- stone free	28	210
- occasional stones	112	842
- moderately stony	15	113
- very stony	11	83
TOTAL	166	1248

RESULTS AND DISCUSSION

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 stem angle from 0 to 5 degrees less than the shank stem angle to result in a slight 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 on some cultivators in normal tillage. 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.

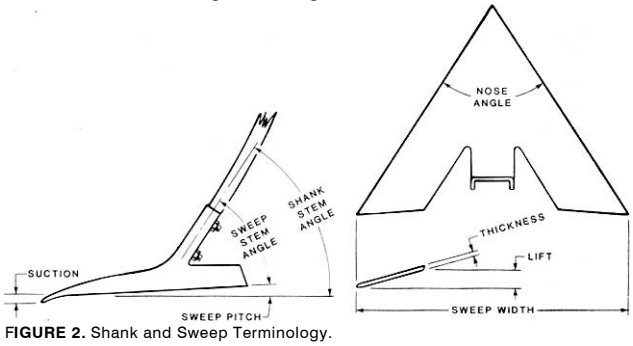


FIGURE 2. Shank and Sweep Terminology.

The Edwards CSF-833 was equipped with spring cushioned shank holders. Spring preload was adjustable. During the test, the cultivator was used with 406 mm (16 in) wide Edwards sweeps with a 50 degree stem angle, causing a no load sweep pitch of 5 degrees.

FIGURE 3 shows sweep pitch characteristics of the Edwards CSF-833 shank assembly. The low end of the pitch curve results from shank flexing while the steeper part is due to cushioning spring deflection. Increasing the spring preload increased the shank force required to overcome the cushioning spring preload, as shown by the dashed line on the curve.

At the manufacturer's recommended spring setting, with the spring length compressed to 265 mm (10.4 in), sweep pitch varied 3.5 degrees over the normal secondary tillage draft range, and 10.5 degrees over the normal primary tillage draft range. Spring cushion preload was exceeded at drafts greater than 2.4 kN/m (168 lb/ft), which occurred within the range of secondary tillage. At this setting, the Edwards CSF-833 would only be suitable for light tillage such as seedbed preparation, herbicide incorporation and secondary summerfallow. At an alternate spring setting, with the spring length compressed 245 mm (9.6 in), sweep pitch varied 5.3 degrees over the normal primary tillage draft range. Spring cushion preload was exceeded at drafts greater than 7.2 kN/m (504 lb/ft), indicating that at this setting the Edwards CSF-833 was suited for primary tillage.

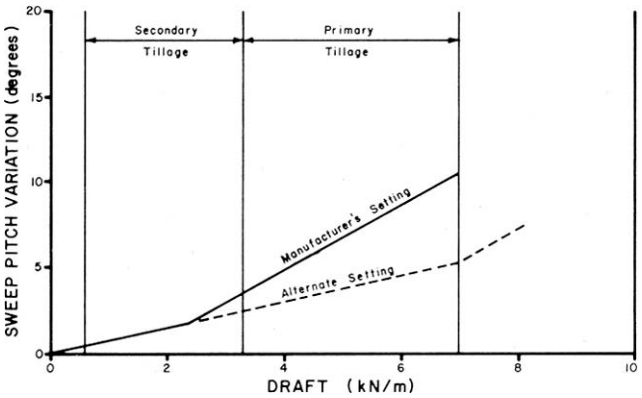


FIGURE 3. Sweep Pitch Variation over a Normal Range of Draft (330 mm Shank Spacing).

FIGURE 4 shows the lifting pattern when shanks encounter Stones or field obstructions. At the manufacturer's shank cushion spring setting, the maximum lift height was 147 mm (5.8 in). At the alternate spring setting, the maximum lift height was reduced to 105 mm (4.2 in). Field testing at the manufacturer's spring setting resulted in the bending of 13 shanks during the test. Shank protection was inadequate in conditions where high shank lift was required. As noted, with the shank cushion spring setting suitable for primary tillage, shank protection was further reduced. It is recommended that the shank lift height be increased to reduce shank failure when encountering obstacles.

A positive sweep pitch and a cultivator mass of 292 kg/m (196 lb/ft) was sufficient for adequate penetration in most conditions. In primary tillage, excessive furrow bottom ridging occurred due to the large variation in sweep pitch at higher drafts.

Penetration across the width of the cultivator was usually uniform. In very heavy primary tillage, occasionally the right side of the center section penetrated deeper than the left side. Tires were adequately sized to provide good floatation in most soil conditions. The wheels were positioned so that each center section wheel supported about 16 per cent of the total cultivator weight and each wing wheel supported about 8 per cent. In addition, each set of dual wheels supported about 25 per cent of the total tillage suction force. For good floatation and uniform penetration across the cultivator width, it is desireable to have wheels sized and positioned so that each wheel supports equivalent weight and a similar tillage suction force.

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

The Edwards CSF-833 followed gently rolling field contours fairly well. Similar widths of the centre and wing sections resulted in fairly uniform penetration across the cultivator width

in rolling fields. As with most wing cultivators, large variations in tillage depth could occur in fields with abrupt contour changes.

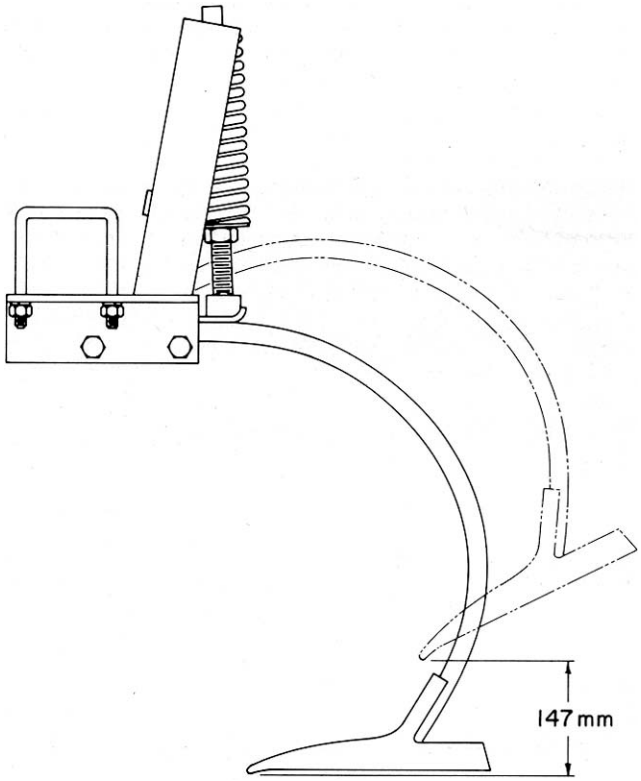


FIGURE 4. Shank Lifting Pattern.

Plugging: Trash clearance was very good in most conditions. In heavy or damp trash conditions, occasional plugging (FIGURE 5) occurred between the dual wheels due to reduced clearance between the wheels and the shank. This occurred at all four sets of dual wheels.

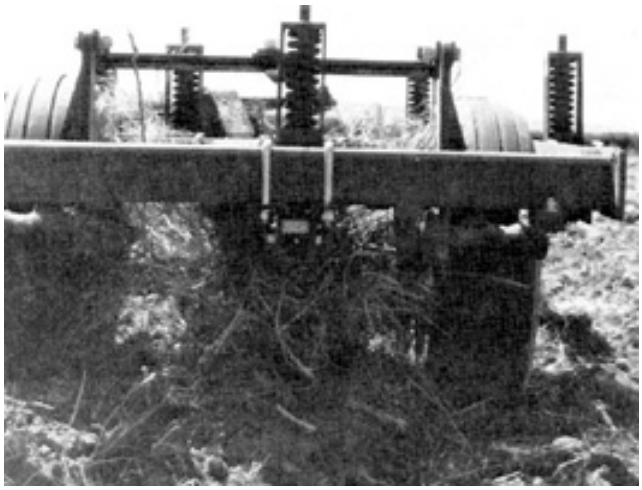


FIGURE 5. Trash Build-up between Wheels.

Trash Burial and Field Surface: When using 50 degree sweeps at a 75 mm (3 in) tillage depth at speeds below 6 km/h (4 mph), most stubble was left standing upright (FIGURE 6). The amount of trash buried increased at speeds greater than 6 km/h (4 mph).

The Edwards was not equipped with mounted harrows, leaving surface ridges from 25 to 50 mm (1 to 2 in) when operating at a depth of 75 mm (3 in)(FIGURE 7). Ridging increased with increased tillage depth.

Furrow Bottom Ridging: At the manufacturer's recommended shank cushion spring setting, furrow bottom ridging was excessive in primary tillage operations due to the shank spring cushioning preload being exceeded. In primary tillage, furrow bottom ridging was in excess of 50 mm (2 in) (FIGURE 8). At the alternate shank spring setting, with a spring length of 245 mm (9.6 in), furrow bottom ridging was reduced.

FIGURE 6. Trash Burial with 50 Degree Sweeps.

FIGURE 7. Field Surface Condition.

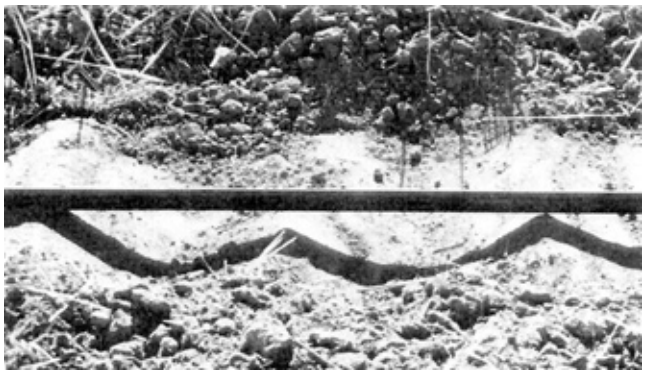


FIGURE 8. Furrow Bottom Ridging.

Skewing and Stability: The Edwards CSF-833 was stable and did not skew sideways in normal field conditions. The sweep pattern (FIGURE 9) was symmetrical and did not impose any resultant side forces on the cultivator during normal tillage. Slight skewing occurred on side slopes or in varying soil conditions. When equipped with 406 mm (16 in) sweeps, the cultivator had to skew more than 2.6 degrees to miss weeds.

Weed Kill: Weed kill was good in normal conditions when the cultivator was equipped with 406 mm (16 in) sweeps. The shank spacing of 330 mm (13 in) resulted in a 76 mm (3 in) sweep

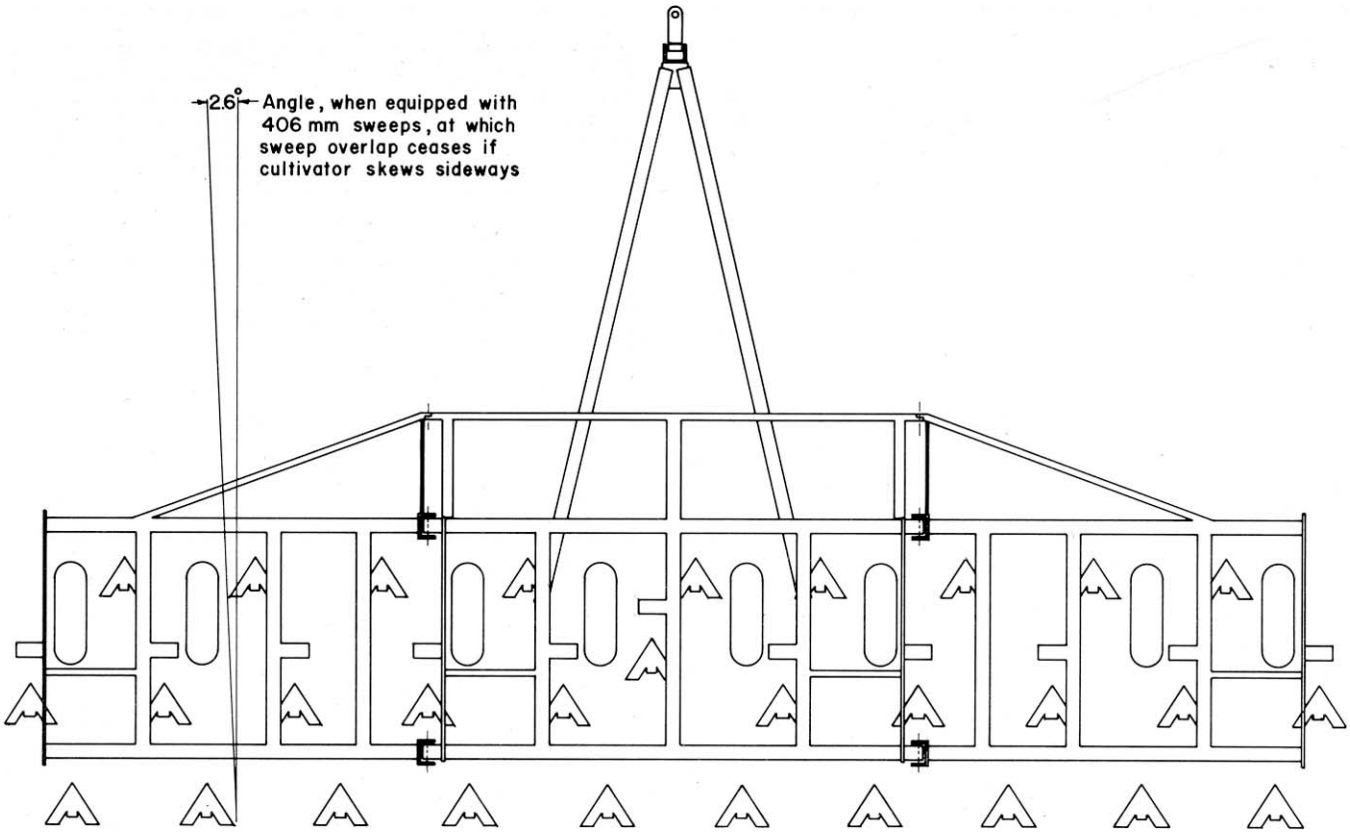


FIGURE 9. Sweep Pattern (330 mm Shank Spacing).

overlap. Considerable sweep wear could occur before weeds were missed. When sweeps wore, larger weeds could work their way between sweeps and be missed.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Edwards CSF-833 was easily placed in transport position (FIGURE 10)in less than five minutes using the hydraulic wing lift system. Mechanical transport locks were provided for the wings and depth control wheels. The wing lock mechanism did not always line up in the proper position and had to be aligned manually.

Transport width of the test machine was 5.8 m (19 ft) while transport height was 3.9 m (12.8 ft). Care was needed when transporting on public roads, through gates, over bridges and beneath power and telephone lines.

The Edwards CSF-833 towed well at transport speeds up to 32 km/h (20 mph). Sweep to ground clearance of 130 mm (5.1 in) and a wheel tread of 3.1 m (10 ft) usually provided ample ground clearance.

Hitching: The Edwards CSF-833 was equipped with a suitable hitch jack which permitted easy hitching. The hitch link was held in the horizontal position with two pins which made one-man hitching easy.

Hitch height could be adjusted 225 mm (8.8 in) in four increments by removing two pins. This range was adequate to allow fore-and-aft cultivator frame levelling with all tractors used during the test.

Frame Levelling: Adequate lateral levelling adjustments were provided for the center and wing sections. All frame sections were levelled by means of threaded connectors. Adjustments were easily made by lowering the machine and adjusting the fasterners as required.

When there was slack in the connectors, as was the case when penetration was reduced, the fasteners tended to work loose and go out of adjustment. It is recommended that a locking mechanism be provided on each of the four threaded connectors.

With the frame properly levelled, the adjustment for the right wing limited the sweep-to-ground clearance, in field position, to about 76 mm (3 in). It is recommended that the levelling adjustment be modified to provide for increased ground clearance when in field position.

Depth of Tillage: Tillage depth was controlled by one hydraulic cylinder located at the front of the centre section, linked to each set of wheels with connector links and chains. Depth was set by use of a depth stop on the hydraulic cylinder.

Sweep Installation: It took one man about one and one half hours to replace the 30 sweeps on the Edwards CSF-833. The 130 mm (5 in) sweep to ground clearance was adequate for easy sweep removal. High frame clearance permitted easy movement underneath the cultivator.

Shank Installation: Individual shanks could easily be replaced in less than 10 minutes by removing two bolts.

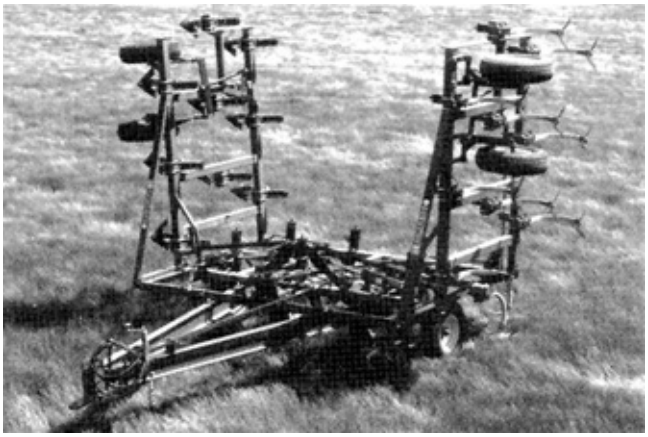


FIGURE 10. Transport Position.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 11 shows draft requirements for cultivators in typical primary and secondary tillage at a speed of 8 km/h (5 mph). This figure gives average requirements based on tests of 15 makes of cultivators in 56 different field conditions. Attempting to compare draft requirements of

different makes of cultivators usually is unrealistic. Draft requirements for the same cultivator, in the same field, may vary by as much as 30 per cent in two different years, due to changes in soil conditions. Variation in soil conditions affect draft much more than variations in machine make, usually making it impossible to measure any significant draft difference between makes of cultivators.

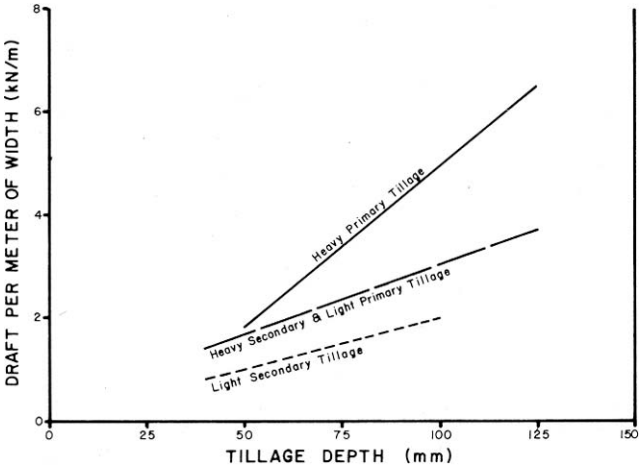


FIGURE 11. Average Draft Requirements for Cultivators at 8 km/h.

At the manufacturer's recommended setting, shank cushioning spring preload was exceeded within the secondary tillage draft range, indicating the Edwards CSF-833, at this setting, was primarily suited for light secondary tillage such as herbicide incorporation or seedbed preparation. In light secondary tillage, average draft at 8 km/h (5 mph), varied from 0.8 kN/m (55 lb/ft) at 40 mm (1.6 in) depth to 2.0 kN/m (137 lb/ft) at 100 mm (4 in) depth. For the 9.9 m (32.5 ft) Edwards CSF-833, this corresponds to a total draft ranging from 7.9 to 19.8 kN (1788 to 4453 lb.)

In heavy seconaary and light primary tillage, average draft, at 8 km/h (5 mph) varied from 1.4 kN/m (96 lb/ft) at 40 mm (1.6 in) depth to 3.7 kN/m (254 lb/ft) at 125 mm (5 in) depth, corresponding to a total draft ranging from 13.9 to 36.6 kN (3120 to 8255 lb) for the 9.9 m (32.5 ft) test maohine.

At the alternate shank cushion spring setting, cushioning spring preload was exceeded just beyond the normal primary tillage draft range, indicating that at this alternate spring setting, the Edwards CSF-833 was suitable for primary tillage. In heavy primary tillage, average draft, at 8 km/h (5 mph) varied from 1.8 kN/m (123 lb/ft) at 50 mm (2 in) depth to 6.5 kN/m (445 lb/ft) at 125 mm (5 in) depth, corresponding to a total draft ranging from 17.8 to 64.4 kN (3998 to 14,463 lb) for the 9.9 m (32.5 ft) test machine.

Increasing speed by 1 km/h (0.6 mph) increased draft by about 90 N/m (6.2 lb/ft). For the 9.9 m (32.5 ft) test machine, this represents a draft increase of 0.9 kN (202 lb) for a 1 km/h (0.6 mph) speed increase.

Tractor Size: TABLES 2 to 4 show tractor sizes needed to operate the 9.9 m (32.5 ft) wide Edwards CSF-833 in light and heavy secondary tillage as well as in primary 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 Edwards CSF-833 in 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 (3 in) depth and 10 km/h (6 mph), an 82 kW (109 hp) tractor is needed to operate the Edwards CSF-833. In heavy secondary or light primary tillage, at the same depth and speed, a 119 kW (159 hp) tractor is needed, while in heavy primary tillage a 145 kW (194 hp) tractor is required.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 9.9 m Edwards CSF-833 in Light Secondary Tillage.

DEPTH	SPEED (km/h)					
(mm)	7	8	9	10	11	12
40	23	30	37	45	54	64
50	31	38	47	57	66	77
75	49	59	70	82	95	108
100	67	80	94	108	123	139

TABLE 3. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 9.9 m Edwards CSF-833 in Heavy Secondary or Light Primary Tillage.

DEPTH	SPEED (km/h)					
(mm)	7	8	9	10	11	12
40	43	52	63	74	86	100
50	52	62	74	87	101	115
75	74	88	103	119	136	154
100	96	114	132	151	171	192
125	119	139	161	183	206	230

TABLE 4. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 9.9 m Edwards CSF-833 in Heavy Primary Tillage.

DEPTH	SPEED (km/h)					
(mm)	7	8	9	10	11	12
50	48	59	69	81	94	107
75	93	110	127	145	164	184
100	139	162	185	210	235	261
125	184	213	243	274	306	339

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 (17 ft) over farm land or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 4.8 m (16 ft) over farm land. In all three provinces, power lines in farmyards may be as low as 4.6 m (15 ft).

Transport height of the 9.9 m (32.5 ft) wide test machine was 3.9 m (12.8 ft), permitting safe transport under prairie power lines. On the other hand, wider models of the Edwards cultivator are high enough to contact some prairie power lines. 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 5.8 m (19 ft) wide in transport position, necessitating caution when transporting.

Mechanical wing and depth control transport locks were provided. Danger areas should be avoided when fastening these locks.

No slow moving vehicle sign or mounting bracket was provided. It is recommended that a slow moving vehicle sign be supplied as standard equipment.

The Edwards CSF-833 towed very well at normal transport speeds on level ground. A wheel tread of 3.1 m (10.2 ft) allowed safe transport on side slopes and rough ground. The tires were adequately sized to support the cultivator at transport speeds of 32 km/h (20 mph).

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 interchangability of sweeps.

OPERATOR'S MANUAL

The operator's manual provided, included a complete parts listing, but set-up and operating instructions were not provided. It is recommended that a more complete operator's manual be supplied.

DURABILITY RESULTS

TABLE 5 outlines the mechanical history of the Edwards CSF-833 during 166 hours of field operation while tilling about 1248 ha (3120 ac). 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.

TABLE 5. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA (ha)
SWEEPS AND SHANKS		
One sweep broke at	12	90
Four sweeps were lost when bolts sheared off at	112	842
Thirteen shanks bent and were replaced	throughout the test	
A shank pivot bracket loosened, causing damage to the rod attached to the cushioning spring at	91	684
A shank caught on a lip on the frame while tripping at	118	886
FRAME		
The nuts on the pivot points of the depth control loosened and were tightened at	91, 102	684, 767
The transport lock-up mechanism was damaged and replaced at	91, 144	684, 1083
A flat tire occurred at	123, 128	925, 963
The depth control cylinder mount sheared off at	123	925
The cotter pin on the depth control sheared at	144, 152	1083, 1143
The depth adjustment bolts for each section loosened at	152, 165	1143, 1241
A weld cracked on the left wing depth control bracket at	end of test	

DISCUSSION OF MECHANICAL HISTORY

SWEEPS AND SHANKS

Maximum lift height of the shanks when encountering obstacles was 147 mm (5.8 in). When working in stony conditions this height was often exceeded, resulting in shanks being bent, sweeps breaking and sweep bolts being sheared off. It has already been recommended that the maximum shank lift height be increased to reduce shank and sweep failure.

FRAME

The transport lock-up mechanism was easily damaged (FIGURE 12) when the hydraulic cylinder was adjusted while the lock mechanism was in place, it is recommended that the lock-up mechanism be reinforced to prevent frequent bending.

The depth control cylinder mount sheared off at the weld while raising the cultivator during tillage.

A cotter pin on the depth control linkage (FIGURE 12) sheared off causing the main pin to come out. When the main pin came out, loss of depth control occurred. This also presented the potential danger of the cultivator dropping during transport. It is recommended that a modification be considered to prevent cotter pin shearing.

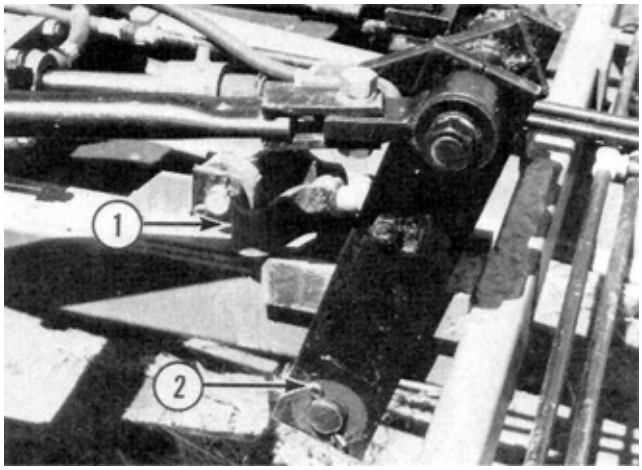


FIGURE 12. (1) Damaged Transport Lock Mechanism, (2) Cotter Pin.

APPENDIX I

SPECIFICATIONS

MAKE:	Edwards Cultivator	
MODEL :	CSF-833	
SERIAL NUMBER:	81-5-762	
MANUFACTURER:	Edwards Rod Weeder Ltd. Box 995 Lethbridge, Alberta T1J 4A2	
OVERALL DIMENSIONS:	**Field Position**	**Transport Position**
- width	9890 mm	5800 mm
- length	6010 mm	6010 mm
- height	1525 mm	3910 mm
- maximum ground clearance	130 mm	130 mm
- wheel tread	8960 m m	3060 m m
SHANKS:		
- number	30	
- lateral spacing	330 mm	
- trash clearance (frame to sweep tip)	620 mm	
- number of shank rows	3	
- distance between rows		
- first and second row	920 mm	
- second and third row	755 mm	
- shank cross section	50 x 25 mm	
- shank stem angle	55 degrees	
- sweep hole spacing	160 mm	
- sweep bolt size	7/16 x 2 in	
HITCH:		
- vertical adjustment range	225mm	
DEPTH CONTROL:	hydraulic	
FRAME:	102 x 102 mm x 6.4 mm	
TIRES:		
- center section	4, 9.5L-15, 6-ply	
- wings	4, 9.5L-15, 6-ply	
NUMBER OF LUBRICATION POINTS:	None	
HYDRAULIC CYLINDERS:		
- depth control	1, 102 x 254 mm (not supplied)	
- wing lift	2, 127 x 406 mm	
MASS:	**Field Position**	**Transport Position**
- right wing wheels	489 kg	
- right center wheels	915 kg	1380 kg
- left center wheels	940 kg	1410 kg
- left wing wheels	465 kg	
- hitch	40 kg	100 kg
TOTAL	2890 kg	2980 kg

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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

APPENDIX III

CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 millimetre (mm)	= 0.04 inches (in)
1 metre (m)	= 3.3 feet (ft)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 kilonewton (kN)	= 220 pounds force (lb)
1 kilonewtonlmetre (kN/m)	= 70 pounds force/foot (lbtft)

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