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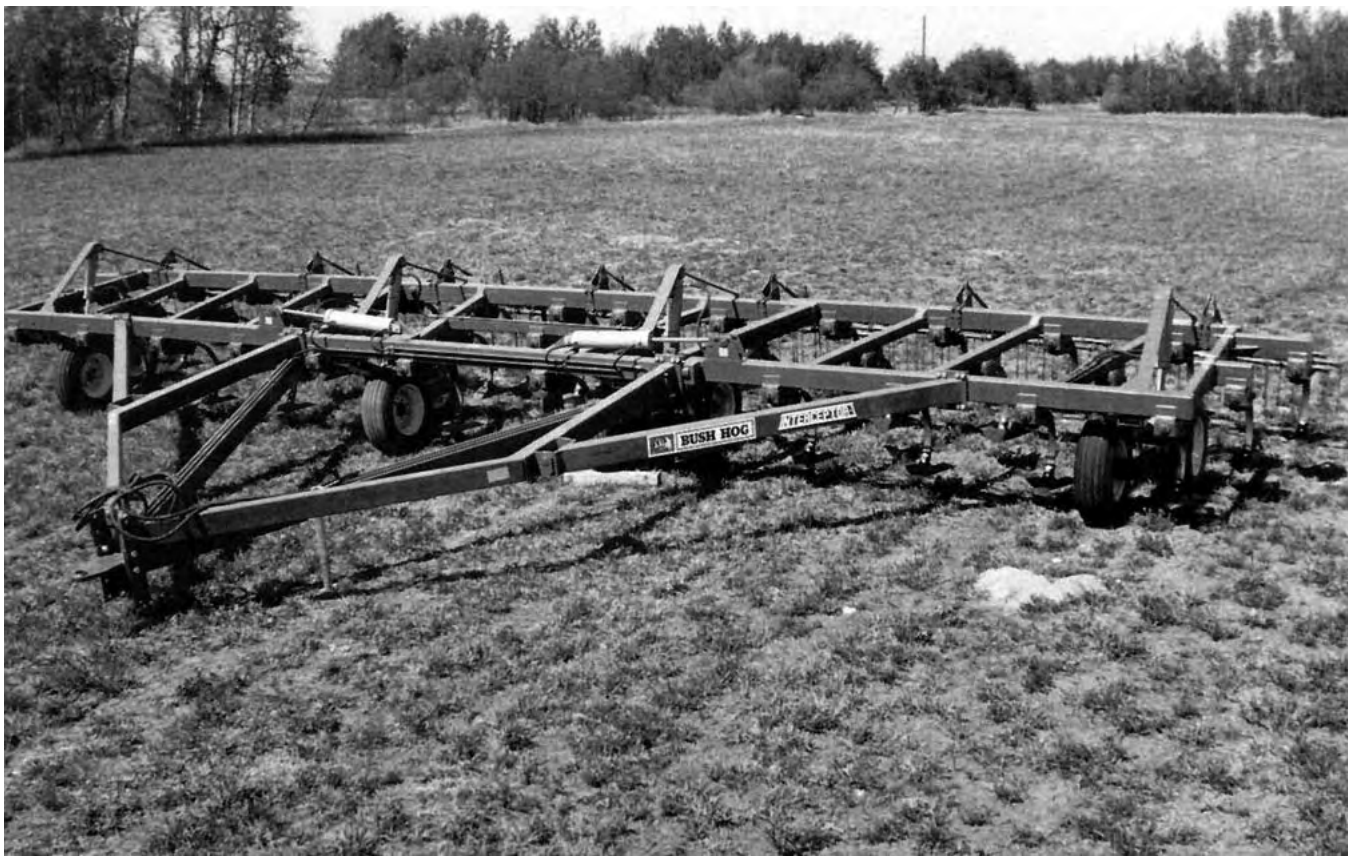
Evaluation Report 229



Bush Hog CP-7815 (12 m) Chisel Plow

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

BUSH HOG CP-7815 CHISEL PLOW

MANUFACTURER:

Bush Hog Equipment Ltd.
P.O. Box 328Imperial, Saskatchewan
S0G 2J0

DISTRIBUTOR:

Bush Hog Equipment Ltd.
717- 43rd Street East
Saskatoon, Saskatchewan
STK 0V7

RETAIL PRICE:

$13,744.00 (May, 1981, f.o.b. Humboldt, 12 m width, with optional tandem wing wheels and optional Bush Hog finishing harrows).

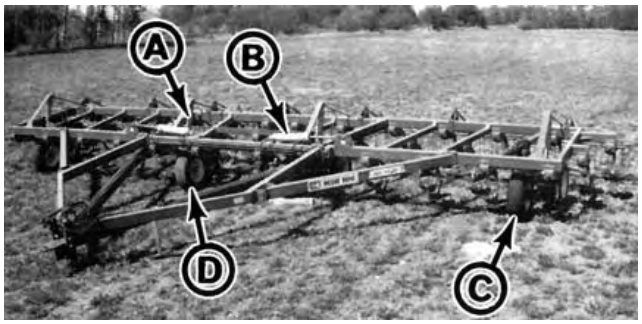


FIGURE 1. Bush Hog CP-7815 (A) Depth Control Cylinders, (B) Wing Lift Cylinders, (C) Tandem Wing Wheels, (D) Tandem Centre Wheels.

SUMMARY AND CONCLUSIONS

The overall functional performance of the Bush Hog CP-7815 heavy duty cultivator was very good. Performance was reduced by plugging in heavy trash.

The spring trip shanks could lift 150 mm (6 in) to clear stones. When equipped with 50 degree sweeps, sweep pitch varied from 0 to 3.5 degrees over the normal draft range for heavy duty cultivators. With 305 mm (12 in) spacing, shanks began to trip at a draft of 9.6 kN/m (660 lb/ft), well above the normal primary tillage draft range.

Penetration was uniform in most field conditions. In very hard soil, wing frame twist caused the outer front sweeps to penetrate only 20 mm (0.8 in) deeper than the outer rear sweeps. Furrow bottom ridging was less than 20 mm (0.8 in) in all conditions.

The Bush Hog CP-781 5 effectively followed the contour of rolling land. Weed kill was very good in most conditions. The Bush Hog CP-7815 was quite stable. Weed misses due to skewing occurred on steep hillsides. Trash clearance was very good in moderate trash. In heavy trash plugging occurred between the two centre shanks, and between the depth control wheels and adjacent shanks. The mounted harrows were effective in smoothing surface ridges. Furrow bottom ridging was usually less than 20 mm (0.8 in) with 50 degree sweeps.

The Bush Hog CP-781 5 could be easily placed in transport position in less than five minutes. The 225 mm (9 in) sweep-to-ground clearance was adequate, however the narrow 2.4 m (7.9 ft) transport wheel tread made caution necessary when transporting on slopes or rough ground, to prevent possible upset. The Bush Hog CP-7815 towed well, without sway, at normal transport speeds on smooth roads. The centre section tires were slightly overloaded during transport with mounted harrows. Transport speeds should not exceed 16 km/h (10 mph) when equipped with mounted harrows.

The 12 m (39 ft) test machine had a transport height of 5.3 m (17.4 ft) which is greater than the minimum power line heights in the three prairie provinces.

When equipped with mounted harrows, hitch weight was negative, making hitching inconvenient. Adequate adjustment was provided for both lateral and fore-aft frame leveling.

Average draft for the 12 m (39 ft) wide test machine in light primary tillage at 8 km/h (5 mph) varied from 19.3 kN (4329 lb) at 50 mm (2 in) depth to 42.9 kN (9652 lb) at 125 mm (5 in) depth. In heavy primary tillage at 8 km/h (5 mph) average draft varied from 23 kN (5162 lb) at 50 mm (2 in) to 77.5 kN (17,424 lb) at 125 mm (5 in) depth.

In light primary tillage at 10 km/h (6 mph) and 75 mm (3 in) depth, a tractor with 141 kW (190 hp) maximum power take-off rating will have sufficient power reserve to operate the 12 m (39 ft) wide Bush Hog CP-7815. In heavy primary tillage at the same depth and speed a 180 kW (241 hp) tractor is needed.

The Bush Hog CP-7815 was equipped with a mechanical depth control lock and mechanical wing transport locks for safe towing. A slow moving vehicle sign was not provided. The operator's manual was concise and well illustrated.

A number of mechanical problems occurred during the 161 hours of field operation. Welds cracked on many shank holder assemblies, the shank trip pivot pin holes wore excessively, several hitch frame welds cracked, and the centre section wheel support members flexed noticeably during transport.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the shank holder assemblies to reduce breakage and reduce pivot pin hole wear.
2. Providing 125 mm (5 in) diameter wing lift hydraulic cylinders as standard equipment.
3. Modifying the centre section wheel support members to reduce deflection during transport.
4. Supplying an alternate hitch jack location at the rear of the cultivator when equipped with mounted harrows.
5. Providing the longer hitch link as standard equipment to improve maneuverability.
6. Providing a slow moving vehicle sign as standard equipment.
7. Modifications to reduce hitch frame weld failures.
8. Modifying the harrow bar height and pressure adjustments so settings can be maintained during operation.
9. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads.
10. 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: J. D. MacAulay
Project Technologist: A. R. Boyden

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The shank holder was modified shortly after this test machine was produced. The new holder greatly reduces pin hole wear.
2. The 125 mm (5 in) diameter wing lift cylinders are provided as standard equipment on all machines 35 ft (10.7 m) wide or wider.
3. The strength of the centre section wheel support members has been increased.
4. An alternate hitch jack mount is being considered.
5. A longer hitch link is optional because of the wide variation in tractor drawbar lengths.
6. Consideration will be given to supplying a slow moving vehicle sign.
7. The hitch frame has been reinforced and no subsequent failures have occurred.
8. A heavier locking collar is used on all new production harrows.

9. & 10. We support a move to standardize hydraulic couplers and fittings, shank and sweep stem angles, sweep fastener spacings and fastener sizes.

MANUFACTURERS ADDITIONAL COMMENTS

1. The walking axle has been modified and the two centre rear shanks have been offset to reduce plugging in heavy trash conditions.
2. All changes that have been made to the newer production machines can be easily made on the older machines.

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

GENERAL DESCRIPTION

The Bush Hog CP-7815 is a trailing, flexible, three-section heavy duty cultivator suitable for medium and heavy primary tillage operations. It is available in 10 widths ranging from 6.8 to 12 m (21 to 39 ft). The test machine was a 12 m (39 ft) model with a 4 m (13 ft) centre frame and two 4 m (13 ft) wings. It was equipped with 39 spring-trip shanks, laterally spaced at 305 mm (12 in), and arranged in three rows.

The centre frame is carried on two tandem wheel sets, while each wing is supported by one tandem wheel set. Four hydraulic cylinders, connected in series, control tillage depth. The wings fold into transport position with two hydraulic cylinders connected in parallel. A tractor with dual remote hydraulic controls is needed to operate the Bush Hog CP-7815.

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

SCOPE OF TEST

The Bush Hog CP-7815 was operated in the field conditions shown in TABLE 1 for 161 hours, while cultivating about 1550 ha (3825 ac). It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety, and suitability of the operator's manual.

Optional attached finishing harrows were used during the test.

TABLE 1. Operating Conditions

FIELD CONDITIONS	HOURS	FIELD AREA (ha)
Soil Type		
- light loam	15	155
- loam	75	695
- clay	71	700
TOTAL	161	1550
Stony Phase		
- stone free	92	897
- occasional stones	21	210
- moderately stony	20	183
- very stony	28	260
TOTAL	161	1550

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 stem angle from 0 to 5 degrees less than the shank stem angle to result in a slightly positive no-load sweep pitch.

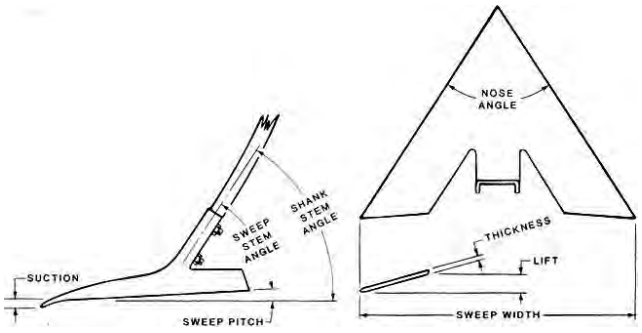


FIGURE 2. Shank and Sweep Terminology.

Sweep pitch increases in proportion to draft due to shank flexing and, depending on shank stiffness and trip 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 relatively constant sweep pitch, over the normal range of tillage forces, are desirable.

The Bush Hog CP-7815 was equipped with spring-trip shank holders. Tripping force was not adjustable. During the test, 406 mm (16 in) wide McKay sweeps with a 50 degree stem angle were used, giving a no-load sweep pitch of 0 degrees.

FIGURE 3 shows pitch characteristics of the Bush Hog shank assembly. The increase in sweep pitch with increased draft resulted from shank flexing. Sweep pitch varied 3.5 degrees over the full draft range normally occurring in primary tillage. When equipped with 50 degree sweeps, sweep pitch varied from 0 to 3.5 degrees over this range. Shank tripping occurred at a draft of 9.6 kN/m (660 lb/ft). This was well beyond the normal primary tillage draft range, indicating that the Bush Hog CP-7815 was well suited for heavy primary tillage.

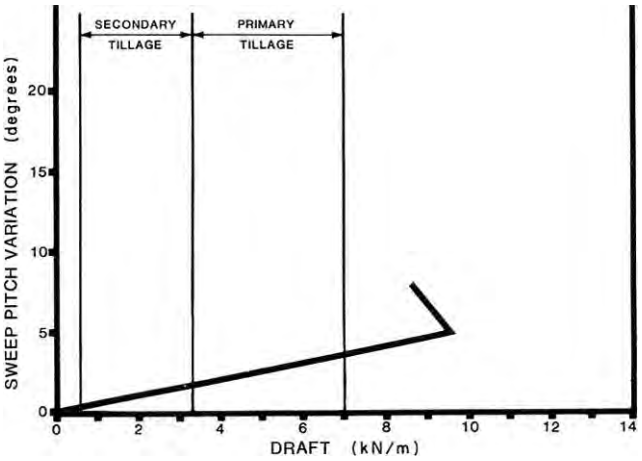


FIGURE 3. Sweep Pitch Variation Over a Normal Draft Range.

FIGURE 4 shows the lifting pattern when shanks encounter stones or field obstructions. Maximum lift height was 150 mm (6 in). Considerable durability problems occurred with the shank holders and trip assemblies (see "Durability Results").

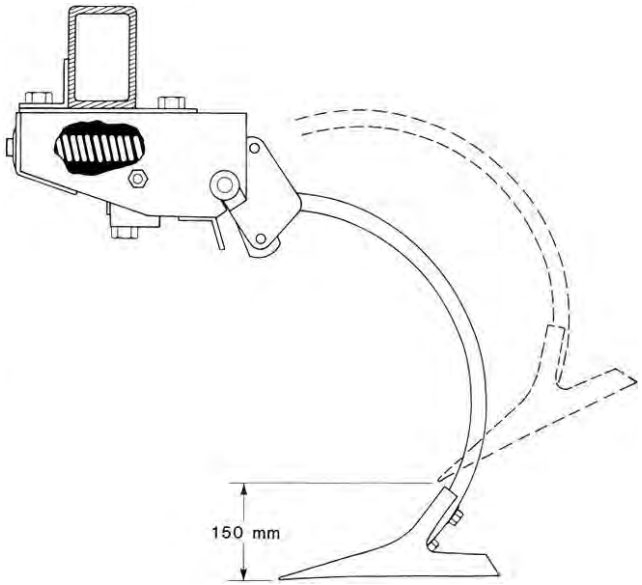


FIGURE 4. Shank Lifting Pattern.

Penetration: The cultivator mass of 298 kg/m (200 lb/ft) was sufficient for adequate penetration in all conditions. Penetration was uniform across the cultivator width provided the frame was properly levelled and the depth control cylinders were kept synchronized. Tires were adequately sized and positioned to provide good flotation and uniform penetration in all conditions.

Depth differences between the front and rear rows of shanks were slight, once the frame had been properly levelled. In heavy primary tillage, slight twisting of the wing frames caused the outer

front sweeps to penetrate only 20 mm (0.8 in) deeper than the outer rear sweeps.

The Bush Hog CP-7815 followed gently rolling field contours very well. The 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 occurred in fields with abrupt contour changes.

Plugging: Trash clearance was very good in moderate trash. In heavy trash, plugging occurred between the two centre shanks and the finishing harrows (FIGURE 5), and between the depth control wheels and adjacent shanks.

FIGURE 5. Plugging Between the Centre Shanks and Finishing Harrows.

Trash Burial and Field Surface: When using 50 degree sweeps at 75 mm (3 in) tillage depth, at speeds below 6 km/h (4 mph), most stubble was left standing upright. The amount of trash burial increased appreciably with increased speed. In normal conditions, enough trash was buried in first operation summerfallow to permit the use of a field cultivator for subsequent tillage.

Trash burial with chisel points was good (FIGURE 6). The chisel points moved enough soil for adequate trash burial while leaving some standing stubble for snow retention.

The optional mounted harrows were effective in smoothing the surface ridges left by the cultivator sweeps (FIGURE 7). The tine angle and harrow bar pressure were adjustable.

FIGURE 6. Typical Trash Burial with Chisel Points.

Furrow Bottom Ridging: In heavy primary tillage furrow bottom ridging was about 20 mm (0.8 in).

Skewing and Stability: The Bush Hog CP-7815 was stable and did not skew sideways in normal field conditions. The sweep pattern (FIGURE 8) was symmetrical and did not impose any side forces on the cultivator during normal tillage. Slight skewing occurred in varying soil conditions, or on hillsides. When equipped with 406 mm (16 in) sweeps, the cultivator had to skew more than 3 degrees to miss weeds. Weed misses occurred on steep hillsides.

Weed Kill: Weed kill was very good in most soil conditions when the cultivator was equipped with 406 mm (16 in) sweeps spaced at 305 mm (12 in). Sweeps were located behind the depth control wheels to uproot weeds in the wheel track. In secondary tillage the mounted harrows effectively uprooted and exposed weeds loosened by the cultivator. In very trashy fields, since the mounted tine angle had to be decreased for trash clearance, the harrows were less effective in exposing loosened weeds.

FIGURE 7. Typical Field Surface with Optional Mounted Harrows.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The test machine was supplied with 113 mm (4.5 in) diameter hydraulic wing lift cylinders. These cylinders were not large enough to lift the wings with normal tractor hydraulic systems. The 125 mm (5 in) diameter replacement cylinders, as supplied by the manufacturer, effectively raised the wings. A minimum tractor hydraulic system pressure of 11,000 kPa (1600 psi) was needed. It is recommended that the manufacturer provide 125 mm (5 in) diameter wing lift cylinders as standard equipment.

Mechanical transport locks were provided for the wings and for the centre section depth control cylinder. One man could place the Bush Hog CP-7815 in transport position in about 5 minutes.

Transport width was 5.1 m (16.6 ft)while transport height was 5.3 m (17.4 ft). Care was needed when transporting on public roads, through gates, over bridges, and beneath power and telephone lines.

The Bush Hog CP-7815 towed well without sway at speeds up to 32 km/hr (20 mph). Sweep-to-ground clearance of 225 mm (9 in) and a wheel tread of 2.4 m (7.9 ft) gave good transport ground clearance.

Hitching: The hitch jack and the rigid hitch link made one-man hitching easy in both transport and field positions, when not equipped with mounted harrows. When the cultivator was equipped with mounted harrows, the hitch weight was negative in both field and transport positions making hitching difficult. It is recommended that an alternate location for the hitch jack be provided at the rear of the cultivator to simplify hitching when equipped with mounted harrows.

Two hitch links were used during testing. The first hitch link provided 408 mm (16.3 in) of hitch height adjustment in 5 increments. The second hitch link provided 350 mm (13.8 in) of hitch height adjustment in 8 increments. Both hitch links permitted frame levelling with all tractors used during the test.

Maneuverability: The hitch pole was wide, and interfered with the rear tractor wheels on normal turns, when equipped with the original hitch link. A longer hitch link which was installed by the manufacturer, eliminated tractor tire interference on normal turns. It is recommended that the manufacturer supply the longer hitch link as standard equipment.

Frame Levelling: Adequate lateral levelling adjustment was provided. The threaded cylinder anchor rods could be adjusted to raise or lower the appropriate wheel assemblies.

Depth of Tillaqe: Tillage depth was controlled with four hydraulic cylinders connected in series. A hydraulic stop valve on one cylinder could be adjusted to set tillage depth. As is common with series hydraulic systems to maintain the centre and wing frame at the same depth, periodic synchronization of the cylinders, by completely extending them to fully raised position, was necessary.

Sweep Installation: It took one man about three hours to change the 39 sweeps on the Bush Hog CP-7815. The sweep bolt threads extended beyond the retaining nuts and were subject to damage and wear during tillage, making sweep removal difficult.

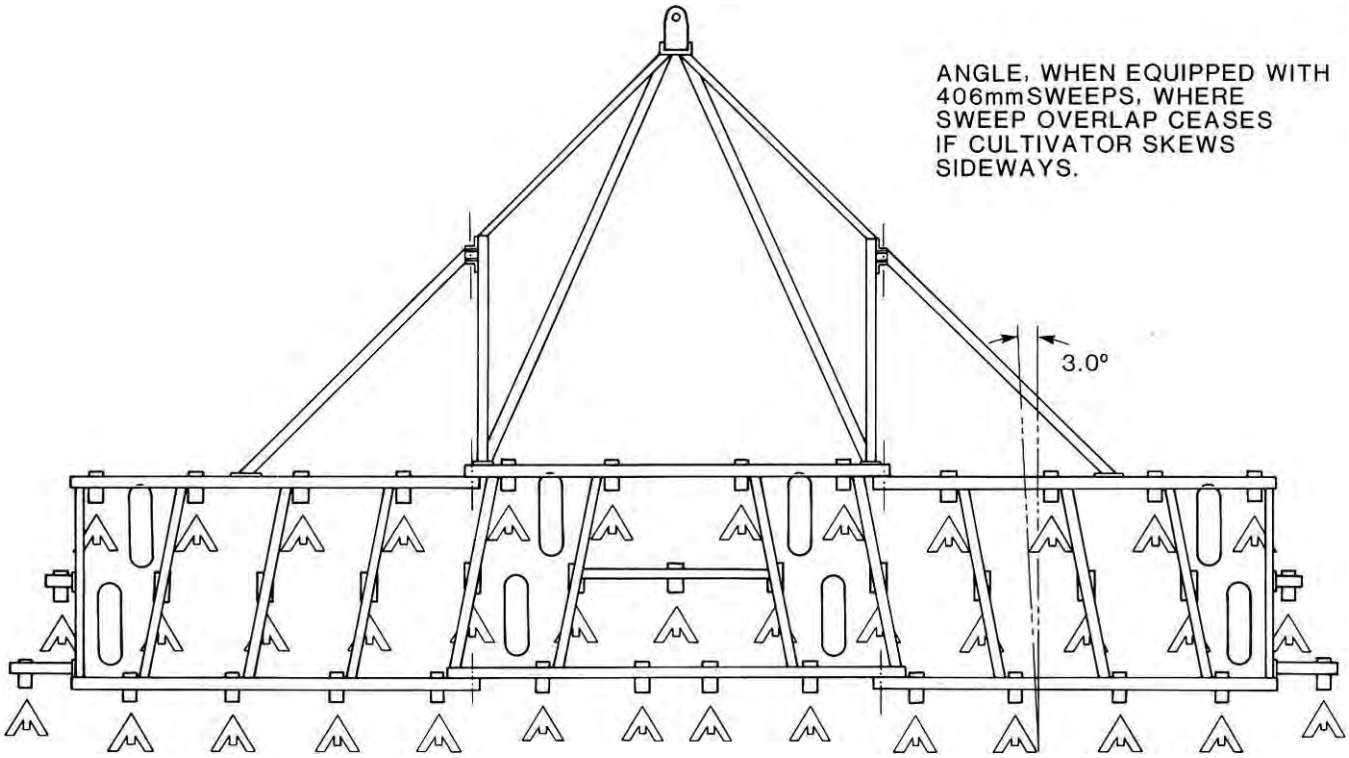


FIGURE 8. Sweep Pattern (305 mm Shank Spacing).

Care should be taken to install proper length bolts to prevent thread damage. The 225 mm (9 in) sweep-to-ground clearance was adequate for easy sweep removal.

Shank Installation: Individual shanks could be easily replaced in less than 15 minutes by removing one bolt.

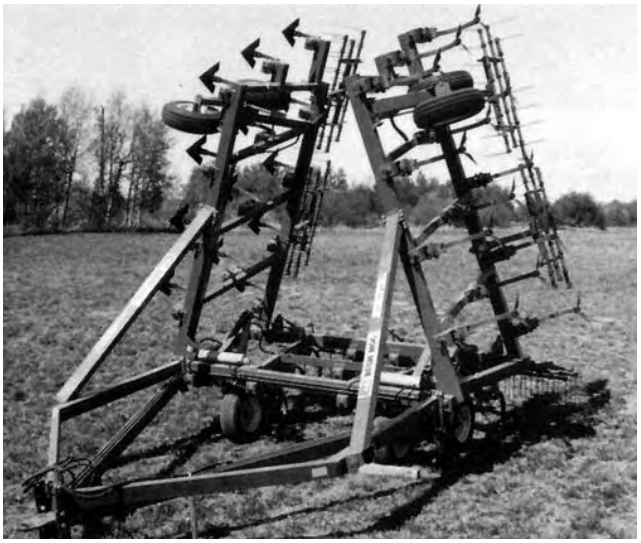


FIGURE 9. Transport Position.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 10 shows draft requirements for heavy duty cultivators in typical primary tillage, at a speed of 8 km/h (5 mph). This figure gives average requirements based on tests of 14 makes of heavy duty cultivators in 53 different field conditions. Attempting to compare draft requirements of different makes of heavy duty 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 heavy duty cultivators.

In light primary tillage, average specific draft at 8 km/h (5 mph), varied from 1.6 kN/m (110 lb/ft) at 50 mm (2 in) depth to 3.6 kN/m (246 lb/ft) at 125 mm (5 in) depth. For the 12 m (39 ft) Bush Hog CP-781 5, this corresponds to a total draft ranging from 19.3 to 42.9 kN (4329 to 9653 lb).

In heavy primary tillage, average specific draft at 8 km/h (5 mph), varied from 1.9 kN/m (132 lb/ft) at 50 mm (2 in) depth to 6.5 kN/m (444 lb/ft) at 125 mm (5 in) depth, corresponding to a total draft from 23 to 77.5 kN (5162 to 17,424 lb) for the 12 m (39 ft) test machine.

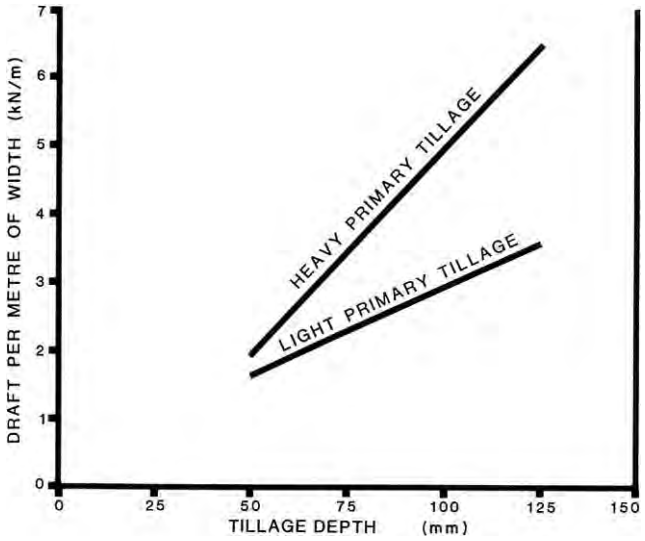


FIGURE 10. Average Draft Requirements for Heavy Duty Cultivators at 8 km/h.

Increasing speed by 1 km/h (0.6 mph)increased draft by about 95 N/m (6.5 lb/ft). For the 12 m (39 ft) test machine, this represents a draft increase of 1.1 kN (247 lb) for a 1 km/h (0.6 mph) speed increase.

Tractor Size: TABLES 2 and 3 show tractor sizes needed to operate the 12 m (39 ft) Bush Hog CP-7815 in light and heavy primary tillage. Tractor sizes have been adjusted to include tractive efficiency 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 Bush Hog CP-7815 in the stated conditions.

TABLE 2. Tractor Size (Maximum Power Take-Off Rating, kW) to Operate the 12 m Bush Hog CP-781 5 in Light Primary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
50	61	74	88	103	119	136
75	87	104	122	141	161	181
100	114	135	157	179	202	227
125	141	165	191	217	244	273

TABLE 3. Tractor Size (Maximum Power Take-Off Rating, kW) to Operate the 12 m Bush Hog CP-781 5 in Heavy Primary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
50	63	76	90	105	121	138
75	117	136	157	180	203	228
100	168	196	225	255	286	318
125	221	256	293	330	368	408

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example, in light primary tillage at 75 mm (3 in) depth and 10 km/h (6 mph), a 141 kW (190 hp) tractor is needed to operate the Bush Hog CP-7815. In heavy primary tillage, at the same depth and speed, a 180 kW (240 hp) tractor is needed.

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 (15.7 ft) over farm land. In all three provinces, lines in farmyards may be as low as 4.6 m (15 ft).

Transport height of the 12 m (39 ft) wide test machine was 5.3 m (17.4 ft) which is high enough for contact with many prairie power lines. The legal responsibility for safe passage under utility lines rests with the machine operator and not with the power utility or 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 5.1 m (16.4 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 Bush Hog CP-7815 was stable and towed well at normal transport speeds on level ground. Because of its narrow transport wheel tread, care had to be taken when transporting on slopes or rough ground to prevent possible upset.

The centre frame tires were adequately sized to support the cultivator without mounted harrows, at normal transport speeds. According to load limits recommended by the Tire and Rim Association, the centre section tires were slightly overloaded with the added weight of the mounted harrows. Transport speeds should not be above 16 km/h (10 mph) when equipped with mounted harrows.

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 supplied information on set-up, operation, maintenance, and safety. It was well written and clearly illustrated.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Bush Hog CP-7815 during 161 hours of field operation while tilling about 1550 ha (3825 ac). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

TABLE 4. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA (ha)
Frame		
-The centre section wheel support members deflected, under load	During the Test	
-several welds on the hitch frame were found cracked	At End of Test	
Shank and Holder		
-Three shank holders broke and were replaced at	13, 140	132, 1287
-28 shank holder welds had cracked at	140	1287
-The pivot pin holes in several shank holders showed excessive wear at	119	1156
-The spring guide bolt holes showed excessive wear at	46	116
-One shank stayed in tripped position and had to be manually returned at	104, 140, 147	1003, 1352, 1417
-One shank bent and was replaced at	140	1352
Finishing Harrows		
-Adjustment locking collars on the outer harrow bars slid and were repositioned	Many Times During Test	
-A harrow bar bent while passing over a stone at	119	1156

DISCUSSION OF MECHANICAL HISTORY

FRAME

Wheel Support Members: Misalignment of the centre section wheel support members during manufacture resulted in excessive wheel camber. In addition, the centre section wheel support members (FIGURE 11) deflected significantly when in transport position. It is recommended that the centre section wheel support members be modified to reduce deflection.

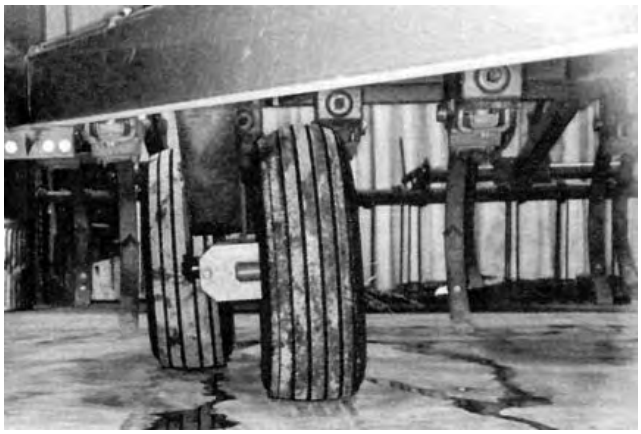


FIGURE 11. Centre Section Wheel Support Deflection in Transport Position.

Weld Failures: The hitch frame welds cracked at six points (FIGURE 12). It is recommended that the manufacturer modify the hitch frame to improve weld durability.

SHANK AND HOLDER

Shank Holder: The welds on most shank holders cracked (FIGURE 13). The trip link supports on several shank holders broke and were replaced.

The pivot pin holes on several shank holders wore excessively. The resulting free movement of the shank holder in the trip housing, caused the shanks to jam in the tripped position.

It is recommended that the shank holders be modified to reduce breakage and pivot pin hole wear. Shanks: Only one shank bent during testing. This failure does not represent a serious problem.

FINISHING HARROWS

Locking Collars: The locking collars used to adjust the height and pressure of the harrow bars slipped during operation. Frequent repositioning of the collars was necessary. It is recommended that the harrow bar be modified so height and pressure adjustments can be maintained.

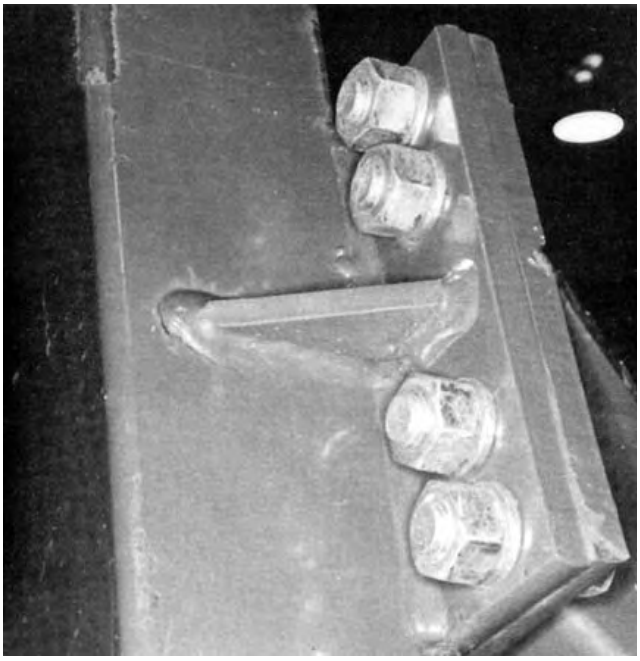


FIGURE 12. Hitch Frame Weld Failure.

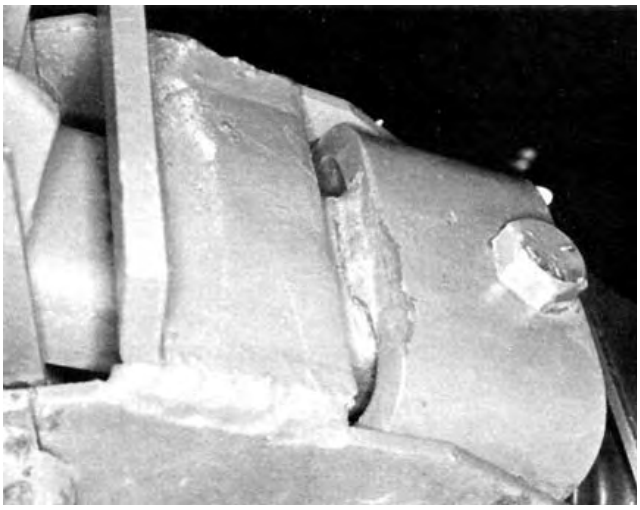


FIGURE 13. Shank Holder Cracks.

APPENDIX I

SPECIFICATIONS

MAKE: Bush Hog Chisel Plow
MODEL: CP-781 5 (1 2 m size)
SERIAL NUMBER: 80110
MANUFACTURER: Bush Hog Equipment Ltd,
Box 328
Imperial, Saskatchewan
S0G 2J0

DIMENSIONS:	**FIELD POSITION**	**TRANSPORT POSITION**
-width	11,960 mm	5070 mm
-length-with harrows	7390 mm	7390 mm
-height	1,850mm	5320 mm
-maximum ground clearance	225 mm	225 mm
-wheel tread	9750 mm	2425 mm

SHANKS:	
-number	39
-lateral spacing	305 mm
-trash clearance (frame to sweep tip)	725 mm
-number of shank rows	
-centre section	3
-wings	3
-distance between rows	
-front to centre	920 mm
-centre to rear	880 mm
-shank cross section	25 x 50 mm
-shank stem angle	50°
-sweep hole spacing	57mm
-sweep bolt size	1/2 x 2in

HITCH	
-vertical adjustment range	408 mm or 350 mm
DEPTH CONTROL:	hydraulic
FRAME:	102 x 153 mm tubing, 4.8 mm thick
TIRES:	
-centre section	4, 9.5L x 1 5, 6 ply
-wings	4, 9.5L x 15, 6 ply

NUMBER OF LUBRICATION POINTS: 14 pin connections, daily service 8 grease fittings, daily service 8 wheel bearings, yearly service

HYDRAULIC CYLINDERS:	
-depth control	
-centre section	1, 89 x 305 mm
	1, 102 x 305mm
-wings	1, 76 x 305 mm
	1,114 x 305mm
-wing lift	2, 11 4 x 508 mm

WEIGHTS: (Without Harrows)	**FIELD POSITION**	**TRANSPORT POSITION**
-right wheels	692 Kg	
-right centre wheels	1074 kg	1730 kg
-left centre wheels	996 kg	1722 kg
-left wheels	692 kg	
-hitch	108 kg	110 kg
TOTAL	3562 kg	3562 kg

WEIGHTS: (With Mounted Harrows)	**FIELD POSITION**	**TRANSPORT POSITION**
-right wheels	786 kg	
-right centre wheels	1258 kg	2052 kg
-left centre wheels	1330 kg	2058 kg
-left wheels	764 kg	
-hitch	-151 kg	-123 kg
TOTAL	3987 kg	3987 kg

OPTIONAL EQUIPMENT:
-11 width options from 4.6 into 12 m
-mounted finishing harrows
-tandem centre and wing wheels

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

CONVERSION TABLE

1 hectare (ha)	= 25 acre (ac)
1 kilometre/hour (km/h)	= 0,6 miles/hour (mph)
1 millimetre (mm)	= 0.04 inches (in)
1 metre(m)	= 3.3feet (ft)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 Kilogram (kg)	= 22 pounds mass (lb)
1 kilonewton (kN)	= 220 pounds force (lb)
1 kilonewton/metre (kN/m)	= 70 pounds force/foot (lb/ft)
1 kilopascal (kPa)	= 0,2 pounds force/square inch (psi)

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