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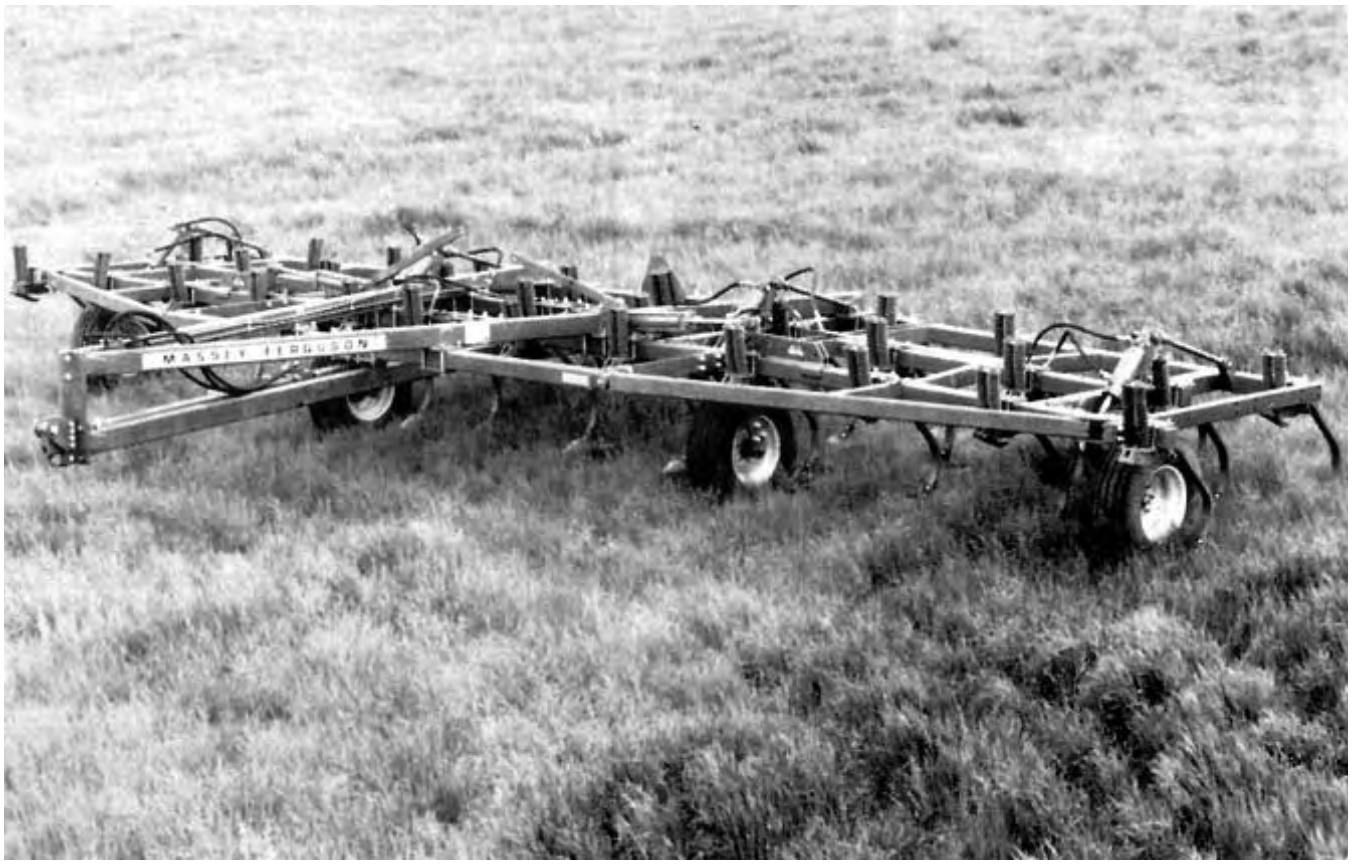
Evaluation Report 140



Massey-Ferguson 128 (10 m) Heavy Duty Cultivator

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

MASSEY-FERGUSON 128 HEAVY DUTY CULTIVATOR

MANUFACTURER:

Massey-Ferguson Industries Ltd.
915 King Street West
Toronto, Ontario
M6K 1E3

DISTRIBUTOR:

Massey-Ferguson Industries Ltd.
2615 Barlow Trail, S.E.
Calgary, Alberta
T2H 2J1

RETAIL PRICE:

$7855.00 (May, 1979, f.o.b. Lethbridge, 10 m width)

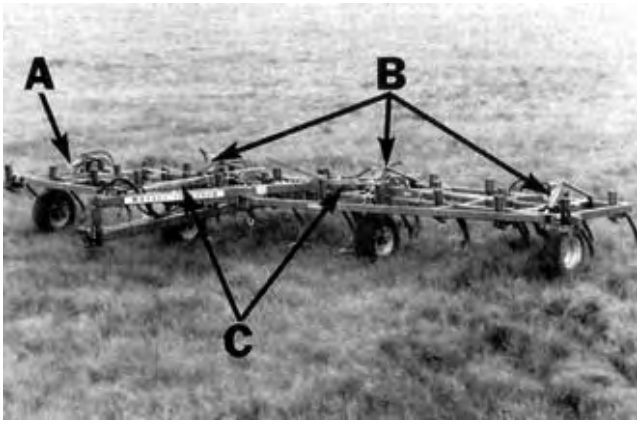


FIGURE 1. Massey-Ferguson 128: (A) Master Depth Cylinder, (B) Slave Depth Cylinders, (C) Wing Lift Cylinders.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Massey-Ferguson 128 heavy duty cultivator was good. Performance was reduced due to an inadequate hydraulic lift system and skewing about the hitch point.

The spring trip shanks could lift 300 mm (11.8 in) to clear stones. When equipped with sweeps having a 54 degree stem angle, the sweep pitch varied from 2 to 5 degrees over the full draft range normally experienced by heavy duty cultivators. When equipped with 50 degree sweeps the sweep pattern varied from 6 to 11 degrees. Shank cushioning spring preload was exceeded at drafts greater than 12.7 kN/m (870 lb/ft), occurring well above the range of normal primary tillage drafts.

Penetration was excellent in all soil conditions. The Massey-Ferguson 128 had a tendency to skew back and forth about the hitch point in light draft conditions. Skewing was never serious enough to affect weed kill. The Massey-Ferguson 128 followed the contour of rolling land very well. Weed kill in all conditions was very good as long as sweeps with adequate overlap were used. Furrow bottom and surface ridging were slight when equipped with 54 degree sweeps but increased considerably when using 50 degree sweeps. The Massey-Ferguson 128 was capable of clearing most trash but in loose, heavy trash, plugging occurred at the two centre shanks. Performance of the depth control hydraulic system was inadequate. In heavy draft conditions, the hydraulic system would not lift the cultivator out of the ground without first backing up.

The Massey-Ferguson 128 cultivator could be conveniently placed in transport position in less than five minutes. The 165 mm (6.5 in) sweep-to-ground clearance, in transport position, was adequate. Transport speeds in excess of 32 km/h (20 mph) caused the cultivator to sway due to negative hitch weight. High transport speeds were unsafe, as the tire loads in transport position exceeded the Tire and Rim Association's maximum rating by 30%.

Due to its large transport height and width, transporting on public roads had to be with extreme caution. The 10 m (33 ft) wide test machine had a transport height of 4 m (13.1 ft), permitting safe transport under power lines in the three prairie provinces. Transport height of the 12.5 m (41 ft) wide model of the Massey-Ferguson 128 is 5.3 m (17.3 ft) which is higher than minimum power line heights in all three provinces.

Adequate adjustments were provided for both lateral and fore-and-aft levelling. Tillage depth was uniform across the width of the cultivator as long as the centre frame and wing section hydraulic cylinders were kept synchronized and the cylinder anchor connectors were properly adjusted.

Average draft for the 10 m (33 ft) wide test machine, in light primary tillage, at 8 km/h (5 mph) varied from 17 kN (3820 lb) at 50 mm (2 in) depth to 37 kN (8320 lb) at 125 mm (5 in) depth. In heavy primary tillage at 8 km/h (5 mph), average draft varied from 18 kN (4050 lb) at 50 mm (2 in) to 65 kN (14,600 lb) at 125 mm (5 in).

In light primary tillage, at 10 km/h (6.2 mph) and 75 mm (3 in) depth a tractor with 120 kW (160 hp) maximum power take-off rating will have sufficient power reserve to operate the 10 m (33 ft) wide Massey-Ferguson 128. In heavy primary tillage at the same depth and speed a 147 kW (197 hp) tractor is needed.

The Massey-Ferguson 128 was equipped with transport locks and a slow moving vehicle sign to aid in transport safety. The operator's manual was clear, concise and well illustrated.

Some mechanical problems occurred during the 240 hours of field operation: Two shank attaching castings broke and many sweeps broke while working in very hard, packed soil. One wing lift cylinder developed a leak and the wing lift cylinder hydraulic tubing burst.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the cultivator hydraulics to permit raising the cultivator out of the ground in all conditions.
2. Modifications to eliminate hydraulic tubing failure.
3. Equipping the cultivator with tires that comply with the Tire and Rim Association load rating.
4. Providing some means of holding the hitch link in the horizontal position to facilitate one-man hitching.
5. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads.
6. 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: E. H. Wiens
Project Engineer: R. C. Papworth

THE MANUFACTURER STATES THAT:

With regard to recommendation number:

1. The lifting ability of the Massey-Ferguson 128 is dependent on the tractor's hydraulic system pressure. Massey-Ferguson's field tests indicated satisfactory lifting ability when the cultivator is used with tractors having 2000 psi hydraulic system pressure.
2. Hydraulic line failure will be investigated.
3. Maximum recommended transport speed of the MF 128 is 10 mph as outlined in the operator's manual. The tires furnished with the cultivator are appropriate for such use.
4. Hitch link improvement will be investigated.
5. Massey-Ferguson's hydraulic couplers are to current A.S.A.E. standard S-366. As industry standards are revised or adopted, Massey-Ferguson will give full consideration to compliance.
6. All current production Massey-Ferguson shanks and sweeps comply with A.S.A.E. standard S-255-1.

GENERAL DESCRIPTION

The Massey-Ferguson 128 is a trailing, flexible, three-section heavy duty cultivator suitable for medium and heavy primary tillage operations. It is available in six widths, ranging from 9.5 to 12.5 m. The test machine was a 10 m model, with a 3.9 m centre frame and two 3.05 m wings. It was equipped with 33 spring-trip shanks, laterally spaced at 305 mm, arranged in three rows.

The centre frame is carried on two wheels, while each wing is supported by a single wheel. Four hydraulic cylinders, connected

in series, control the tillage depth. The master cylinder is located on the right wing, while two slave cylinders are located on the centre section and one on the left wing. The wings fold into upright transport position with two hydraulic cylinders connected in parallel. A tractor with dual remote hydraulic controls is needed to operate the Massey-Ferguson 128.

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

SCOPE OF TEST

The Massey-Ferguson 128 was operated in the field conditions shown in TABLE 1 for 240 hours, while cultivating about 1560 ha. 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		
- sand	62	403
- loam	93	605
- clay	85	552
TOTAL	240	1560
Stony Phase		
- stone free	40	260
- occasional stones	140	910
- moderately stony	40	260
- very stony	20	130
TOTAL	240	1560

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.

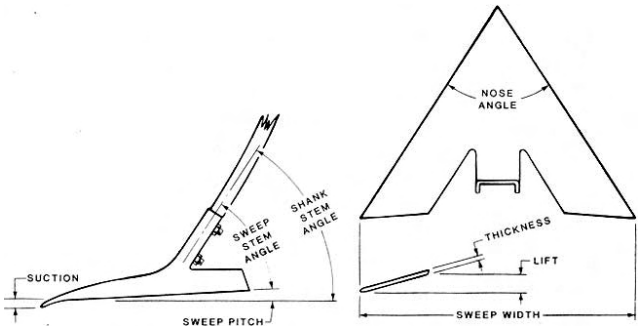


FIGURE 2. Shank and Sweep Terminology.

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

The Massey Ferguson 128 was equipped with spring trip shank holders. Tripping force was adjustable. During most of the test, the Massey-Ferguson 128 was used with 406 mm wide Massey-Ferguson sweeps with a 54 degree stem angle, giving a no-load sweep pitch of 2 degrees. Although 54 degree sweeps were recommended by the manufacturer, the cultivator was supplied for test, equipped with 406 mm wide Massey-Ferguson 50 degree sweeps, giving a no-load sweep pitch of 6 degrees. The 50 degree sweeps were used for 115 hours.

FIGURE 3 shows pitch characteristics of the Massey-Ferguson 128 shank assembly. 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 trip spring preload, followed by shank tripping. Sweep pitch varied 5 degrees over the full range of draft normally occurring in primary tillage. When equipped with the recommended 54 degree sweeps, sweep pitch varied from 2 to 7 degrees over this draft range while with 50 degree sweeps, sweep pitch varied from 6 to 11 degrees. Trip spring preload was exceeded at drafts greater than 12.7 kN/m, occurring well beyond the normal draft range, indicating that the Massey-Ferguson 128 was well suited for heavy primary tillage.

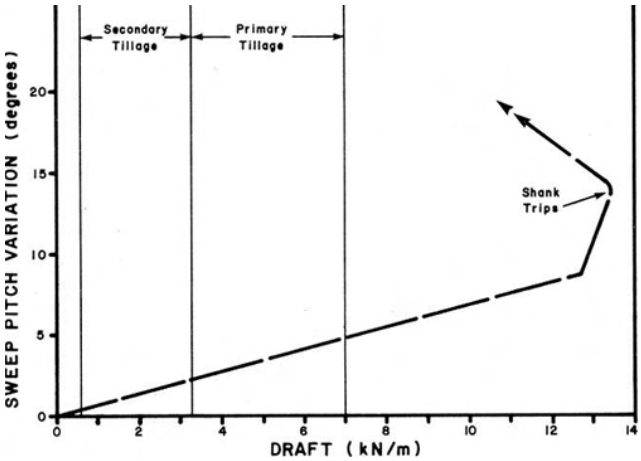


FIGURE 3. Sweep Pitch Variation Over a Normal Range of Draft (305 mm Shank Spacing).

FIGURE 4 shows the lifting pattern when shanks encounter stones or field obstructions. Maximum lift height was 300 mm. The shank trip assembly performed well throughout the test. Two shank attaching castings broke when operating in extremely hard packed fields.

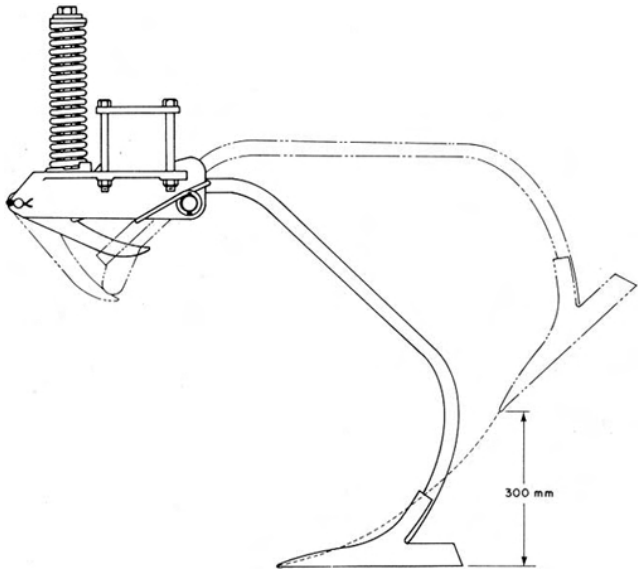


FIGURE 4. Shank Lifting Pattern.

Penetration: Penetration was excellent in all conditions when equipped with either 54 or 50 degree sweeps. Since sweep pitch was excessive with the 50 degree sweeps and penetration was similar, this substantiates the manufacturer's recommendation for using 54 degree sweeps.

Penetration was uniform across the cultivator width providing the frame was properly levelled. Although no flotation problems occurred during the test, the centre wheels carried considerably more weight than the wing wheels and sinking of the centre section could be expected in very soft, wet fields. The wheels were positioned so that each centre section wheel supported about 36% of the cultivator weight while each wing wheel supported about 14%. In addition, each centre section wheel supported about 35% of the total tillage

suction force while each wing wheel supported about 15%. For good flotation, and to obtain uniform tillage depth across the cultivator width, it is desirable to have wheels sized and positioned so that each 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 relatively level with insignificant twisting of the wings. The Massey-Ferguson 128 followed gently rolling field contours very well, maintaining quite uniform depth across its width. All sections were narrow enough to result in even penetration. As with most wing cultivators, large variation in tillage depth occurred in fields with abrupt contour changes.

Plugging: Trash clearance was very good. The Massey-Ferguson 128 was capable of clearing medium to heavy trash. Some plugging occurred in loose, heavy trash, between the two centre shanks (FIGURE 5) which were spaced at only 610 mm. An alternate shank arrangement, to provide more clearance between these shanks, by moving one shank to the front cross member, was available. This alternate shank arrangement was not evaluated.

FIGURE 5. Plugging at Two Centre Shanks.

Shank shape also contributed to plugging in some conditions. Weeds hair-pinned on the shanks, causing a build up which did not clear as well as on conventional semi-circular shanks.

Trash Burial and Field Surface: With 54 degree sweeps, at 75 mm tillage depth the Massey-Ferguson left most stubble standing upright at speeds below 6 km/h (FIGURE 6). The amount of trash buried increased at speeds above 6 km/h and at depths greater than 75 mm. More trash was buried with the 50 degree sweeps.

Surface ridging with 54 degree sweeps was from 25 to 50 mm while with 50 degree sweeps, surface ridging increased to about 125 mm. Surface ridging was most apparent in sandy soils at slower speeds.

FIGURE 6. Trash Burial with 54 Degree Sweeps at 75 mm Depth and 6 km/h.

Furrow Bottom Ridging: With 54 degree sweeps, furrow bottom ridging varied from 12 to 25 mm. In very hard soils, furrow bottom ridging was more severe due to the increased sweep pitch at higher drafts (FIGURE 3).

Skewing and Stability: The Massey-Ferguson 128 had a tendency to skew back-and-forth, about the hitch point, especially in light draft conditions. Skewing never was severe enough to affect weed kill. The shank pattern was symmetrical and did not impose any side forces on the cultivator during normal tillage. When equipped with 406 mm sweeps, weeds would be missed if the cultivator skewed more than 3.5 degrees (FIGURE 7).

Weed Kill: Weed kill was very good when equipped with 406 mm sweeps. The standard sweep spacing of 305 mm resulted in 101 mm sweep overlap. Considerable sweep wear could occur before weeds were missed. When sweeps had worn to 330 mm,

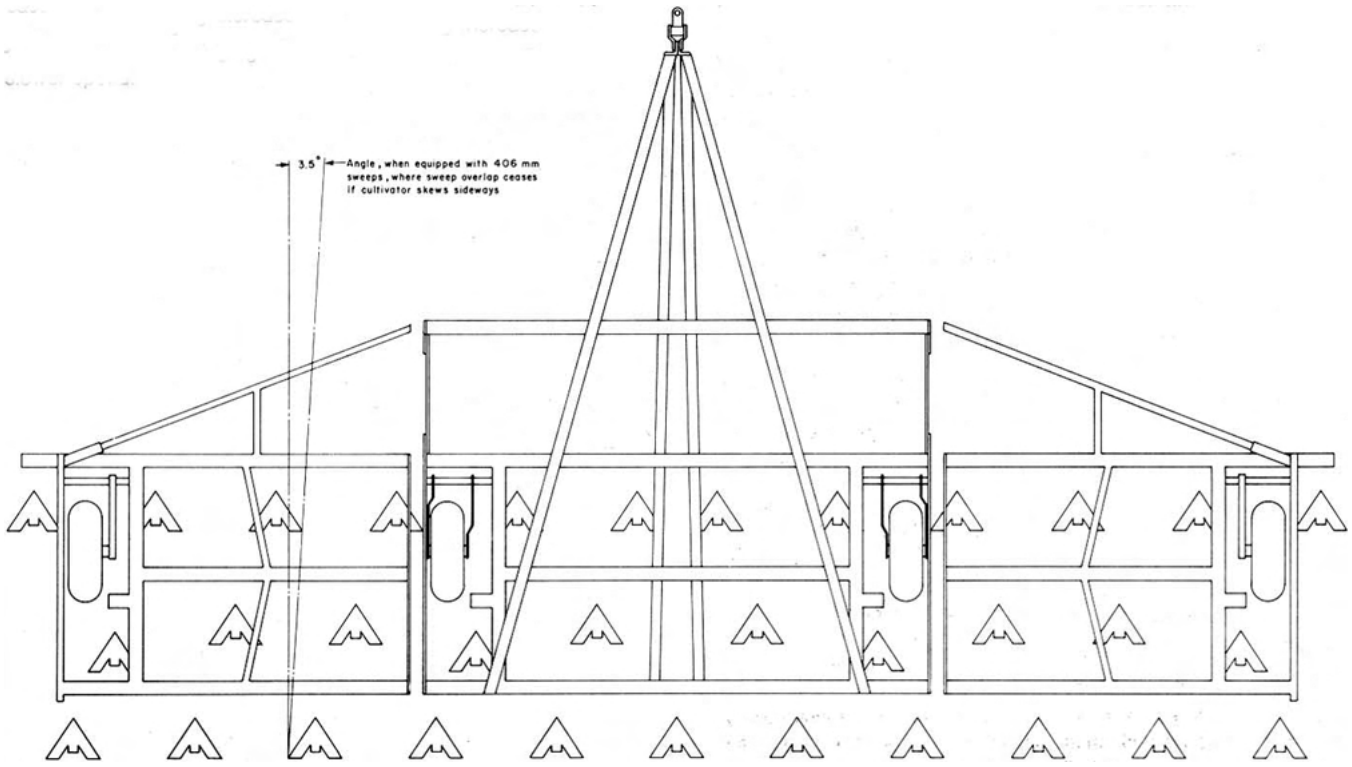


FIGURE 7. Sweep Pattern (305 mm Shank Spacing).

some of the larger weeds would work their way between the sweeps.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Massey-Ferguson 128 was easily placed in transport position (FIGURE 8) using the hydraulic wing lift system supplied as standard equipment. Two pins, which had to be inserted by hand, were provided to lock the wings during transport. Raising or lowering, which depended on the tractor hydraulic system, took one man less than five minutes. Mechanical locks were provided to lock up the two depth control cylinders on the main frame.

Transport width was 6.1 m while transport height was 4 m. Extreme care was needed when transporting on public roads, through gates, over bridges and beneath power or telephone lines. The negative hitch weight of 110 kg caused the cultivator to sway at transport speeds above 32 km/h. If a farm truck is used to transport the cultivator, sufficient weight should be added to the truck to compensate for the negative hitch weight.

Sweep to ground clearance during transport was 165 mm, while transport wheel tread was 3.5 m. This usually provided ample ground clearance.

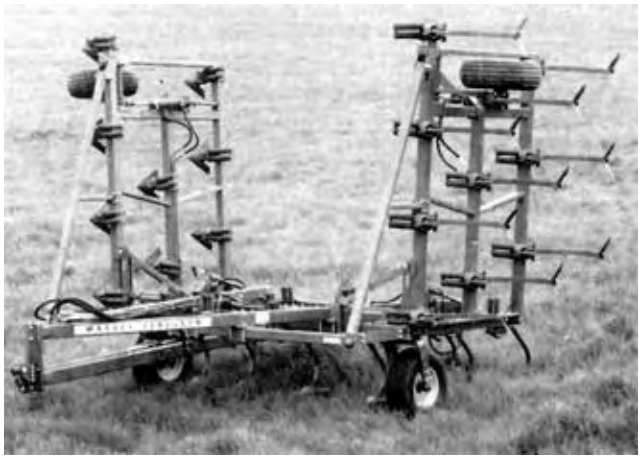


FIGURE 8. Transport Position.

Hitching: Due to the negative hitch weight, the hitch jack on the Massey-Ferguson 128 was mounted at the rear of the cultivator. The jack permitted easy hitching. The hitch link swivelled downward when not hitched to a tractor (FIGURE 9). One-man hitching would have been greatly facilitated if the clevis remained horizontal.

The hitch height could be adjusted 254 mm in ten increments by removing four bolts. This range was adequate to allow fore-and-aft cultivator frame levelling with all tractors used during testing.

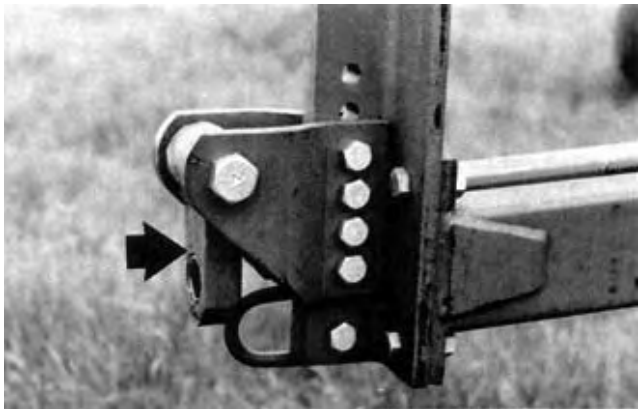


FIGURE 9. Hitch Link in Vertical Position.

Frame Levelling: Adequate lateral levelling adjustments were provided for both the centre and wing sections. The centre and wing sections were levelled with a threaded adjustment at the anchor end of each depth control cylinder.

Depth of Tillage: Tillage depth is controlled with four hydraulic cylinders, one attached to each wheel. The master cylinder, mounted on the right wing wheel, is connected in series to the three slave cylinders. As is common with series hydraulic systems, to maintain the centre and wing frames at the same height, periodic synchronization of the cylinders, by completely extending them to fully raised position, was necessary.

The hydraulic depth control stop collar on the master cylinder, provided convenient depth adjustment. Uniform tillage depth across the cultivator could usually be obtained with the tractor hydraulics, without using the depth control stop collar.

At extreme depths or high draft conditions, the hydraulic system was inadequate to raise the cultivator out of the ground. In these conditions, the sweeps sometimes had to be freed by backing the cultivator before they could be lifted out of the ground. This resulted in some sweep and shank damage. It is recommended the depth control system be modified to permit raising the cultivator out of the ground in all conditions.

Sweep Installation: It took one man about one and one-half hours to remove and replace the 33 sweeps on the Massey-Ferguson 128. The sweeps were initially installed with sweep bolts which protruded 10 mm beyond their nuts. As a result, in stony soil, the bolt ends burred, making removal difficult. This problem was corrected by using sweep bolts that had the ends completely covered by the nuts to prevent thread damage during tillage.

When using 406 mm sweeps, the two sweeps on the front wing cross member, adjacent to the main frame wheels, had to have one wing cut off (FIGURE 10) to prevent tire interference and damage. This was inconvenient since an acetylene torch was needed when changing sweeps.

FIGURE 10. Sweep Wing Cut-off to Prevent Tire Damage.

Shank Installation: A shank holder could be replaced, without removing the complete shank holder assembly from the frame, in about 20 minutes.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 11 shows draft requirements for heavy duty cultivators in typical primary tillage at a speed of 8 km/h. This figure gives average requirements based on tests of 10 makes of heavy duty cultivators in 40 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 draft per metre of width, at 8 km/h, varied from 1.7 kN at 50 mm depth to 3.7 kN at 125 mm depth. For the 10 m wide Massey-Ferguson 128, this corresponds to a total draft ranging from 17 to 37 kN. In heavy primary tillage, average draft per meter of width, at 8 km/h, varied from 1.8 kN at 50 mm depth to 6.5 kN at 125 mm depth, corresponding to a total draft from about 18 to 65 kN for the 10 m wide test machine.

Increasing speed by 1 km/h, increased draft by about 90 N per metre of width. For the 10 m wide test machine, this represents a draft increase of about 0.9 kN for a 1 km/h speed increase.

TABLES 2 and 3 shows tractor sizes needed to operate the 10 m wide Massey-Ferguson 128 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 Massey-Ferguson 128 in the stated conditions.

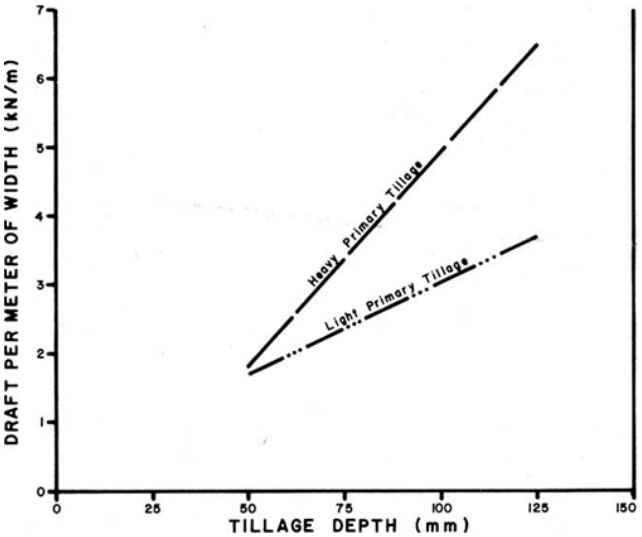


FIGURE 11. Average Draft Requirements for Heavy Duty Cultivators at 8 km/h.

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 depth and 10 km/h, a 120 kW tractor is needed to operate the Massey-Ferguson 128 cultivator. In heavy primary tillage, at the same depth and speed, a 147 kW tractor is needed.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 10 m Wide Massey-Ferguson 128 in Light Primary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
50	52	63	75	88	102	116
75	75	89	104	120	137	155
100	97	115	133	153	173	194
125	120	140	162	185	208	233

TABLE 3. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 10 m Wide Massey-Ferguson 128 in Heavy Primary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
50	49	59	70	82	94	108
75	94	111	129	147	166	186
100	140	163	187	212	238	264
125	185	215	246	277	308	342

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 lines in farm yards maybe as low as 4.6 m.

Transport height of the 10 m wide test machine was 4.0 m, permitting safe transport under prairie power lines. On the other hand, transport height of the 12.5 m wide model of the Massey-Ferguson 128 is 5.3 m, which is high enough for contact with many 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 public roads. If height limits are exceeded, the operator must contact power and telephone utilities before moving.

The Massey-Ferguson 128 was 6.1 m wide in transport position. This necessitated caution when towing on public roads, over bridges and through gates. The Massey-Ferguson 128 was equipped with a slow moving vehicle sign.

Mechanical stops were provided to lock both centre frame lift cylinders in transport position. Pins were also provided to lock the wings in transport position.

The Massey-Ferguson 128 towed well at speeds up to 32 km/h. At higher transport speeds, swaying resulted due to the negative hitch weight. In transport position, the entire weight of the cultivator was supported by the two main frame wheels and individual tire loads exceeded the Tire and Rim Association's maximum rating by 30%. This tire overload was considered unsafe and hazardous, especially at high transport speeds. It is recommended that the cultivator be equipped with tires having suitable load ratings.

The operator's manual clearly outlined safety precautions.

STANDARDIZATION

Hydraulics: During the test, considerable difficulty was encountered due to differences in hydraulic couplers on various tractors. The difficulty was in 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 was very good, containing 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 Massey-Ferguson 128 during 240 hours of field operation while tilling about 1560 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.

TABLE 4. Mechanical History.

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA (ha)
Sweeps and Shanks		
- Complete sets of worn sweeps were replaced at	115, 166	748, 1080
- Shank attaching castings broke and were replaced at	148, 220	962, 1430
- Many sweeps broke	throughout the test	
-The shank holders in the front row showed considerable wear at	End of test	
Frame		
-Stop bolts on the wing lift bracket were installed at	67	436
Hydraulics		
-Flow restrictors on the wing lift hydraulic line were installed at	95	618
-The right wing lift cylinder developed a l eak and was repaired at	115	748
-The hydraulic tubing to one wing lift cylinder burstand was replaced with hose at	230	1495

DISCUSSION OF MECHANICAL PROBLEMS

SWEEPS AND SHANKS

Shanks: Two shank attaching castings broke during the test (FIGURE 12) when the cultivator was working in very hard, packed soil for about 60 hours. The front row of shank holders showed signs of hinge point wear at the end of the test, with about 15 mm of lateral shank movement at the sweep tip. Sweeps: Many sweep wings broke off throughout the test (FIGURE 13). Breaking of the sweep wings may have been initiated by bending of the wings when backing up to enable the hydraulic system to lift the cultivator.

Sweep Wear: As is common with most cultivators rapid, non-uniform wear occurred on the sweeps which followed the cultivator and tractor wheel tracks. The front row of sweeps also wore faster than the rear row. Complete sweep sets needed replacement twice in 240 hours. Sweep wear rate depends on the type and abrasiveness of the soil. Great variation can be expected.

FIGURE 12. Broken Shank Attaching Casting.

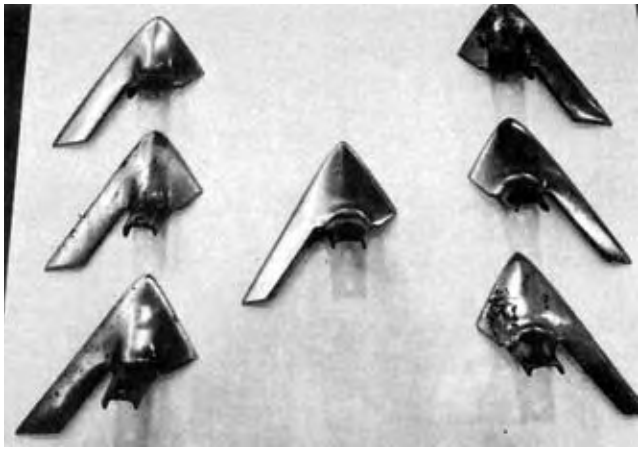


FIGURE 13. Broken Sweeps.

FRAME

Wing Lift Bracket: The stop bolts on the wing lift brackets had not been installed at assembly, causing the hitch member to misalign to the extent that the wing transport pins could not be inserted. Installation of the stop bolts alleviated this problem.

HYDRAULICS

Flow Restrictors: Flow restrictors in the wing lift hydraulic line had not been installed at assembly, allowing the wing sections to fall to the ground instead of being gently lowered. Installation of flow restrictors solved this problem.

Hydraulic Tubing: The hydraulic tubing to one of the wing lift cylinders burst and was replaced with hydraulic hose. It is recommended that modifications be made to eliminate possible hydraulic tubing failure.

APPENDIX I

SPECIFICATIONS

MAKE: Massey-Ferguson Heavy Duty Cultivator
MODEL: 128 (10 m size)
SERIAL NUMBER: 2037002638
MANUFACTURER: Massey Ferguson Industries Ltd.
915 King Street West
Toronto, Ontario
M6K 1E3

	FIELD POSITION	TRANSPORT POSITION
DIMENSIONS:		
-width	10,185 mm	6120 mm
-length	5740 mm	5740 mm
-height	1360 mm	3940 mm
-maximum ground clearance	165 mm	165 mm
-wheel tread	8970 mm	3450 mm

SHANKS:	
-number	33
-lateral spacing	305 mm
-trash clearance (frame to sweep tip)	693 mm
-number of shank rows	3
-distance between rows	864 mm
-shank cross-section	25 x 50 mm
-shank stem angle	56°
-sweep hole spacing	57 mm
-sweep bolt size1	1 mm
HITCH:	
-vertical adjustment range	254 mm
DEPTH CONTROL:	hydraulic
FRAME:	
-cross section	102 mm square tubing
TIRES:	
-centre section	2, 11Lx 15, 8 ply
-wings	2, 11Lx 15, 8 ply
NUMBER OF LUBRICATION POINTS:	8 wheel pivot bearings - 10 hour service 33 spring trip shanks - 10 hour service 4 wheel bearings - annual service
HYDRAULIC CYLINDERS:	
-depth control,	
-right wing, master	1, 108 x 254 mm
-right centre section, slave	1, 102 x 254 mm
-left centre section, slave	1. 95 x 254 mm
-left wing, slave	1, 89 x 254 mm
-wing lift cylinder	2, 100 x 406 mm

WEIGHTS:	FIELD POSITION	TRANSPORT POSITION
-right wing wheel	504 kg	
-right centre wheel	1191 kg	1710 kg
-left centre wheel	1191 kg	1710 kg
-left wing wheel	504 kg	
- hitch	-80 kg	-110 kg
Total	3310 kg	3310kg

OPTIONAL EQUIPMENT:
-six width options from 9.5 to 12.5 m
-spring cushion shank

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 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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