

Evaluation Report

473



Morris MP-912 Heavy Duty Cultivator

A Co-operative Program Between



MORRIS MP-912 HEAVY DUTY CULTIVATOR

MANUFACTURER AND DISTRIBUTOR:

Morris Rod-Weeder Co. Ltd.
 85 York Road
 Yorkton, Saskatchewan
 S3N 2X2
 (306) 783-8585

RETAIL PRICE:

\$24,200.00 [February, 1986, f.o.b. Humboldt, 32.8 ft (10 m) width, with optional harrows and McKay sweeps].

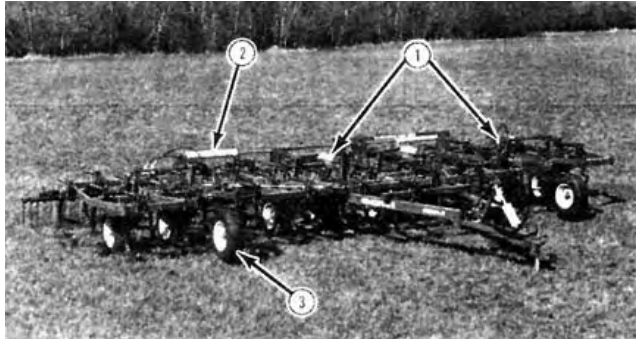


FIGURE 1. Morris MP 912: (1) Depth Control Cylinders, (2) Wing Lift Cylinder, (3) Stabilizer Wheel.

SUMMARY AND CONCLUSIONS

Quality of Work: The Morris MP-912 was suitable for all secondary and primary tillage when equipped with 14 in (356 mm) sweeps. The spring trip shanks lifted 10.2 in (260 mm) to clear stones. When equipped with 50 degree sweeps, sweep pitch ranged from 5 to 7 degrees over the normal range of tillage. Shank trip spring preload was exceeded at drafts greater than 1205 lb/ft (17.6 kN/m). This is well above the range of normal primary tillage drafts.

Penetration was excellent in all field conditions. Shanks held the sweeps level, resulting in an even furrow bottom.

Trash clearance was very good. The field surface left by the Morris MP-912 was good provided fine harrows were used. The harrows left bunches typical of all mounted harrows on the field surface in heavy trash.

Weed kill was good except in heavy trash where the harrows were less effective.

Ease of Operation and Adjustment: Ease of hitching to the Morris MP-912 was very good. The rigid hitch link and hitch jack made one man hitching easy. Ease of transporting the Morris MP-912 was very good. It could be placed into transport in less than 5 minutes. The Morris MP-912 had a very narrow transport width. All transport locks were located at the front and could be inserted without climbing onto the cultivator frame. Maneuverability was very good.

Ease of levelling the Morris MP-912 was very good. Lateral levelling adjustments were provided for each wheel set. Adjustment was provided for front-to-back frame levelling. Ease of setting the tillage depth was very good. A depth stop valve connected into the hydraulic circuit controlled tillage depth. Ease of adjusting the optional mounted harrows was good. Ease of installing sweeps and shanks was good. It took about 10 minutes to install a new shank.

Safety: The Morris MP-912 was equipped with centre frame and wing transport locks. Transport height of the Morris MP912 permitted safe transport under most power lines. The test machine had a very narrow transport width. A slow moving vehicle sign was not provided. In transport, the tires were not overloaded.

Operator's Manual: The operator's manual included instructions on setup, lubrication, maintenance, and safety. It provided a complete parts listing and set of operating instructions.

Mechanical History: The depth stop valve failed and one tire had to be replaced after being cut by an adjacent sweep. Several other minor mechanical problems occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing a longer hitch jack.
2. Modifications to eliminate the need to manually position the centre frame transport lock before lifting the machine into transport.
3. Supplying a wrench for lateral levelling of the cultivator frame.
4. Modifications to allow easy adjustment of the harrow fine angle.
5. Supplying a slow moving vehicle sign.
6. Modifications to prevent tire damage from sweeps.

Senior Engineer: G.E. Frehlich

Project Engineer: H.D. Kydd

Project Technologist: M.J. Bennett

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A new longer hitch jack has been specified.
2. The wing transport rest has been modified to eliminate this problem.
3. This point is presently under consideration.
4. This point is presently under consideration.
5. We presently supply a slow moving vehicle sign bracket. The sign itself is supplied by the dealer upon request.
6. A number of alternatives are being considered and will be implemented upon completing an evaluation.

GENERAL DESCRIPTION

The Morris MP-912 heavy duty cultivator is a trailing, three section cultivator suitable for primary and secondary tillage operations. It is available in widths from 19 ft (5.6 m) to 41 ft (12.5 m). The test machine is 32.8 ft (10.0 m) wide with a centre frame of 11.0 ft (3.3 m) and wing sections of 12.3 ft (3.7 m). It has 43 spring trip shanks arranged in four rows and spaced at 9 in (230 mm) intervals.

The centre frame is supported by two tandem wheel sets while each wing frame is supported by one tandem wheel set and one stabilizer wheel. 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 Morris MP-912 cultivator. The test machine is equipped with optional three row fine harrows.

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

SCOPE OF TEST

The Morris MP-912 was operated in the field conditions shown in TABLE 1 for 100 hours while cultivating about 1579 ac (639 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	
		ac	ha
Soil Type			
- sand	4	70	28
- light loam	24	340	138
- loam	43	654	265
- clay	29	515	208
TOTAL	100	1579	639
Stony Phase			
- stone free	35	709	287
- occasional stones	49	580	235
- moderately stony	11	270	89
- very stony	4	70	28
TOTAL	100	1579	639

RESULTS AND DISCUSSION

QUALITY OF WORK

Shank Characteristics: Many manufacturers use different shank and sweep stem angles (FIGURE 2) when designing their cultivators. To achieve and maintain penetration, sweeps and

shanks must be matched to obtain sufficient sweep pitch. Usually, manufacturers recommend sweeps with a stem angle of 0 to 5 degrees less than the shank stem angle, to provide a slightly positive no-load sweep pitch.

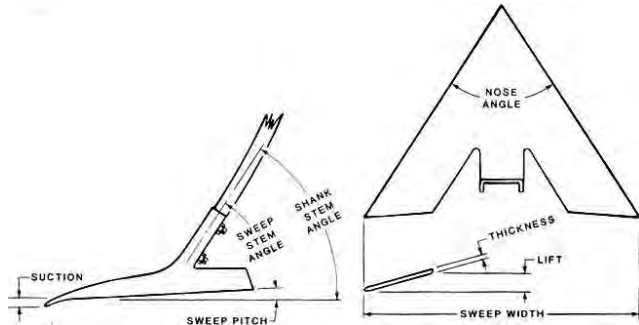


FIGURE 2. Shank and Sweep Terminology

Sweep pitch increases in proportion to draft due to shank flexing. Depending on shank stiffness and cushion spring preload, sweep pitch 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, rapid sweep tip wear, and increased draft. Shanks which maintain a low, relatively constant sweep pitch over the normal range of tillage forces, are desirable.

The Morris MP-912 cultivator was equipped with 43 spring trip shank mechanisms spaced at 9 in (230mm). Spring tension was specified by the manufacturer. The Morris MP-912 was equipped with 14 in (356 mm) McKay sweeps, having a 50 degree stem angle. This gave a no-load sweep pitch of 5 degrees.

FIGURE 3 shows the sweep pitch characteristics of the shank assemblies on the Morris MP-912. The lower slope line results from shank flexing, while the upper curve represents forces that occur during the trip cycle. Over the normal tillage draft range, sweep pitch varied only 2 degrees. With the 50 degree sweeps, this represents a working sweep pitch range from 5 to 7 degrees. Trip spring preload was exceeded at a draft of 1205 lb/ft (17.6 kN/m). This shows that the Morris MP-912 cultivator was suitable for all secondary and primary tillage when equipped with 14 in (356 mm) sweeps.

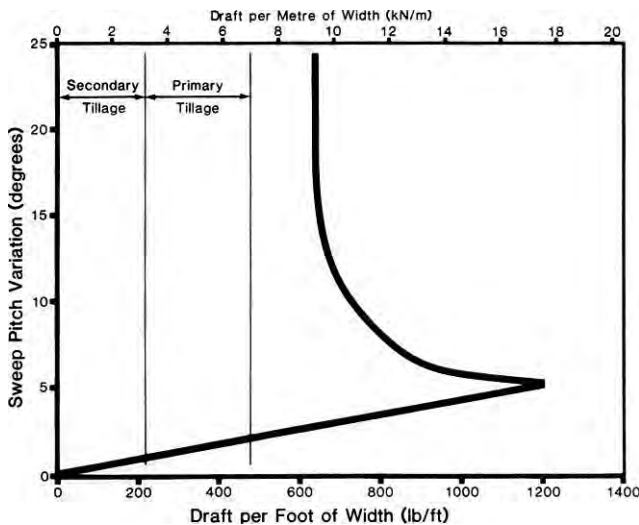


FIGURE 3. Sweep Pitch Over a Normal Draft Range [9 in (230 mm) Shank Spacing]

FIGURE 4 shows the lifting pattern when shanks encountered stones or field obstructions. Maximum lift height was 10.2 in (260 mm) when equipped with McKay sweeps.

Penetration: Penetration was excellent in all field conditions. In all primary and secondary tillage, the spring trip shanks held the sweeps level resulting in an even furrow bottom.

Uniformity of the tillage depth was very good across the cultivator width when properly levelled. The frame remained level in secondary and primary tillage. The front stabilizer wheels minimized twisting of the wing frames. As with most rigid hitch cultivators, large variations in tillage depth occurred in fields with abrupt contour changes.

Trash Clearance: The Morris MP-912 was very good at clearing large amounts of trash. A sweep to frame clearance of 27.5 in (700 mm) and a 9 in (230 mm) shank spacing allowed large amounts of dry or damp trash to pass through the cultivator.

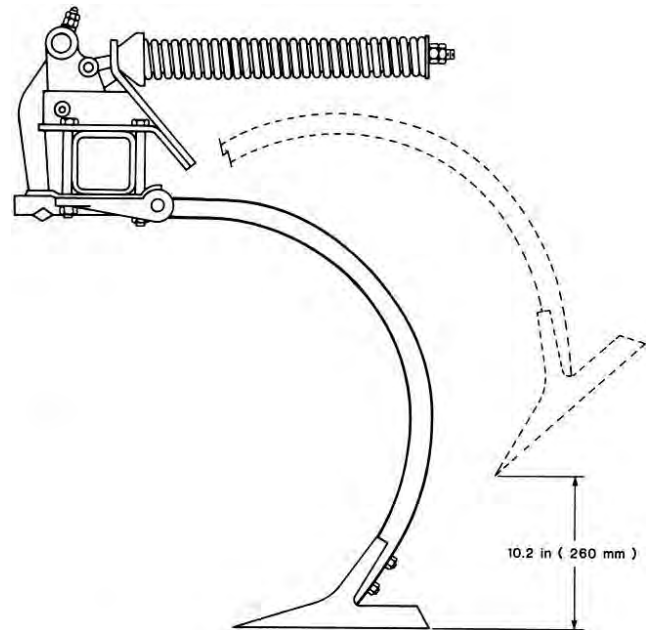


FIGURE 4. Shank Lifting Pattern

Trash Burial and Field Surface: In moderate trash conditions, the harrows were effective in distributing the trash evenly when properly adjusted. In heavy trash, the harrows left bunches on the field surface (FIGURE 5), typical of all mounted harrows. In light trash, the harrows were effective in levelling the ridges left by the cultivator to produce a uniform seedbed (FIGURE 6).



FIGURE 5. Typical Field Surface in Heavy Trash Conditions



FIGURE 6. Typical Seedbed Preparation

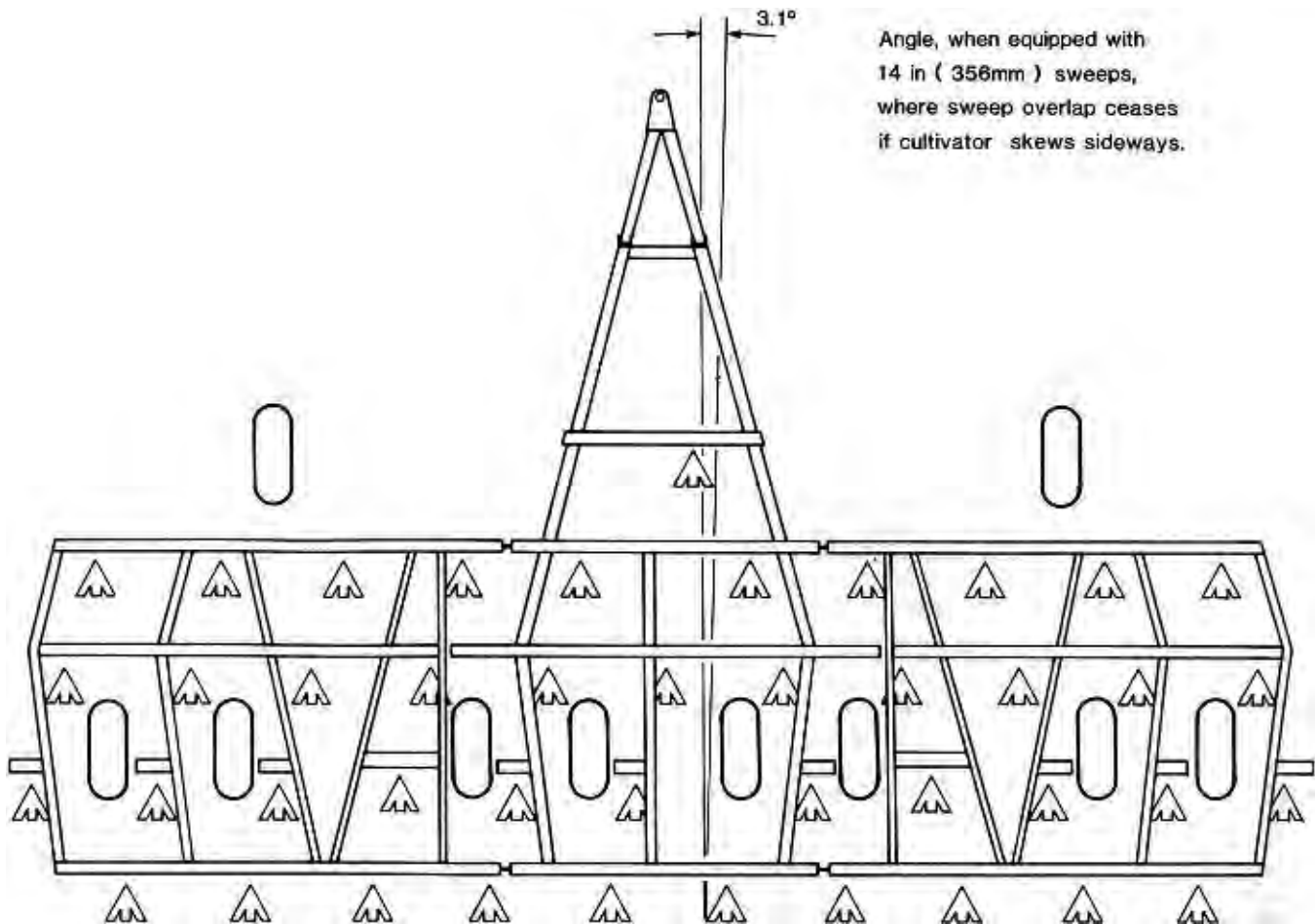


FIGURE 7. Sweep Pattern [9 in (230 mm) Shark Spacing]

Skewing and Stability: The Morris MP-912 was very stable and did not skew sideways in typical field conditions. The sweep pattern (FIGURE 7) was symmetrical and did not impose any side forces on the cultivator during tillage. Skewing was minimal even on hillsides or where soil hardness varied across the machine width. With 14 in (356 mm) sweeps, the cultivator had to skew more than 3.1 degrees for weed misses to occur.

Weed Kill: Weed kill was good with the 14 in (356 mm) sweeps and 9 in (230 mm) shank spacing. The finishing harrows were effective in exposing weeds in light trash conditions. The harrows were less effective in heavy trash conditions.

EASE OF OPERATION AND ADJUSTMENT

Hitching: Ease of hitching to the Morris MP-912 was good. The hitch jack and rigid hitch link made one man hitching easy. Hitch weight was positive in transport and field position with mounted harrows. The hitch jack was stable but too short for hitching to the test tractor without using a block. It is recommended that the manufacturer consider providing a longer hitch jack.

Transporting: Ease of transporting the Morris MP-912 was very good. It was easily placed in transport position by one person in less than 5 minutes (FIGURE 8). Locks were provided for the wings and the centre frame wheels. All transport locks were situated at the front of the machine and could be inserted without climbing onto the cultivator frame. The harrows could be individually locked in a raised position for greater ground clearance during transport.

Transport width of the test machine was 12.8 ft (3.9 m) while transport height was 15.3 ft (4.7 m). Normal care was needed when transporting on public roads, through gates, over bridges, and beneath power lines.

The Morris MP-912 towed well without sway or bounce at normal transport speed. A sweep-to-ground clearance of 7.5 in (190 mm) was sufficient. Caution was required when transporting over rough or rolling fields or through ditches due to the narrow 9.5 ft (2.9 m) wheel tread.

The transport locks on the centre frame section often fell for

ward during field operation (FIGURE 9). The locks then had to be pushed back behind the wing support before the cultivator was raised for transport. Once raised for transport, the operator could then position the transport locks. This was very inconvenient. It is recommended that the manufacturer consider modifications to eliminate this problem.



FIGURE 8. Transport Position

Maneuverability: Maneuverability of the Morris MP-912 was very good. The rear wheels of the 4 wheel drive test tractor did not contact the hitch. On the test machine, there were enough sweeps beyond the outer wheels to allow moderate overlap without running the wheel on cultivated soil. Running all wheels on untilled soil helps maintain flotation and a uniform tillage depth.

Frame Levelling: Ease of levelling the frame was very good. Each set of wheels could be adjusted separately for lateral levelling of the frame but this required a 1-1/2 in wrench. Few farmers carry wrenches this size and one was not supplied with the machine. It is

recommended that the manufacturer consider supplying one.

Front to back levelling was accomplished by adjusting the ratchet jack on the A-frame hitch member (FIGURE 10). In addition, the hydraulic cylinder on the hitch raised and lowered the main hitch as the depth was changed. This automatically kept the cultivator frame level.

Depth Adjustment: Ease of setting tillage depth was very good. Tillage depth was controlled by four hydraulic cylinders connected in series. A hydraulic stop valve (FIGURE 10) stopped oil flow when the proper depth was reached.

To ensure uniform tillage depth, hydraulic cylinders should be synchronized periodically by completely extending them to a fully raised position.

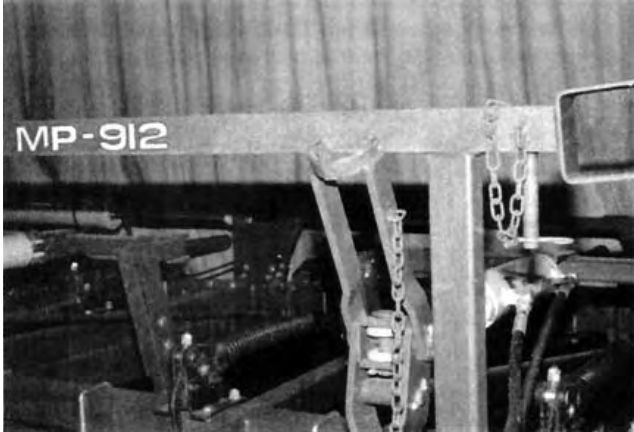


FIGURE 9. Transport Locks in Front of the Wing Support

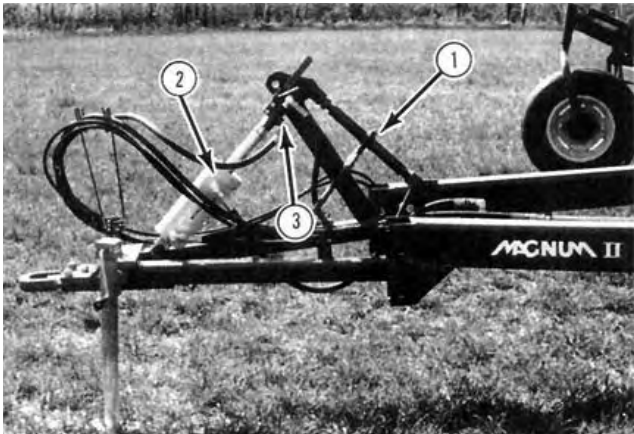


FIGURE 10. Levelling and Depth Stop Components: (1) Front-to back Levelling Adjustment, (2) Main Frame Levelling Cylinder, (3) Depth Stop Valve

Harrow Adjustment: Ease of adjusting the optional tine harrows was good. The harrow frame could be levelled by loosening two U-bolts. The tine angle could be adjusted to six different positions. Adjustments for harrow depth, tine angle, and harrow spring preload were sufficient for most conditions. When changing the harrow tine angle, the adjustment levers were sometimes difficult to position because of interference with the harrow row connecting bar (FIGURE 11). It is recommended that the manufacturer consider modifications to allow easier adjustment of the harrow tine angle.

Sweep and Shank Installation: It took one person about 2-1/2 hours to replace the 47 sweeps on the Morris MP-912. No thread damage occurred to the sweep bolts.

Shank replacement was good. It took at least 10 minutes to install a new shank.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 12 shows draft requirements for cultivators in typical primary and secondary tillage at a speed of 5 mph (8 km/h). This figure gives average requirements based on tests of 27 cultivators and 53 different field conditions. Attempting to compare draft requirements of different makes of cultivators is usually 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.

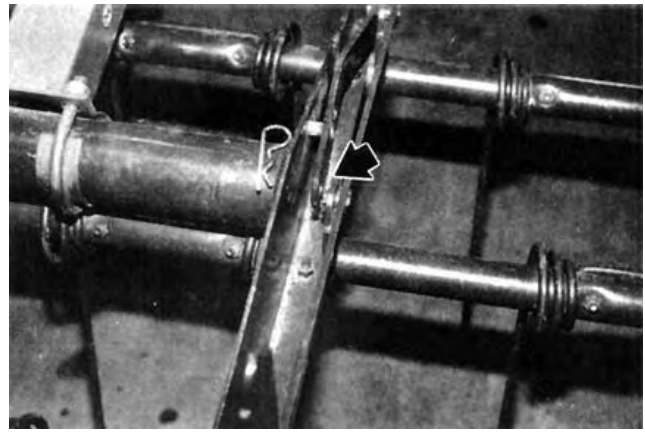


FIGURE 11. Interference Between Tine Angle Adjustment Bar and Harrow Frame

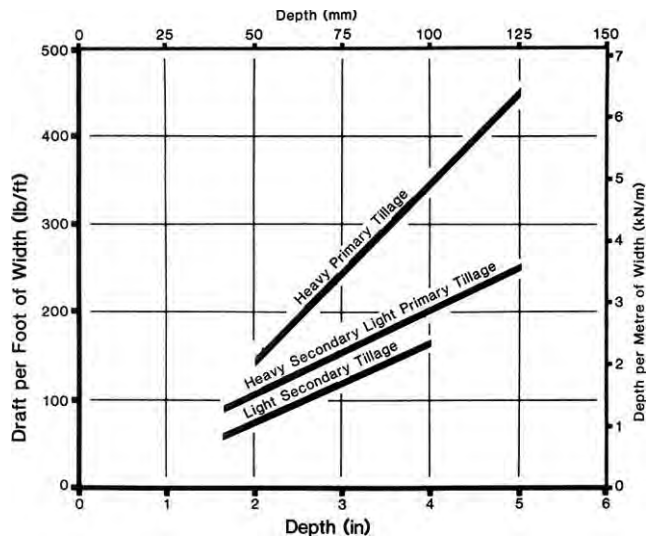


FIGURE 12. Average Draft Requirements for Intermediate Cultivators at 5 mph (8 km/h)

Usually variations in soil conditions affect draft much more than variations in machine make, making it impossible to measure any significant draft differences between makes of cultivators. However, in recent years, with the advent of air seeders, cultivators such as the Morris MP-912 have been designed for heavy primary tillage, but have shank spacings less than the 12 in (305 mm) spacings normally used for heavy duty cultivators.

Tests in the past two years have shown that cultivators with the narrower shank spacings will have higher draft requirements than the same size conventional heavy duty cultivator. The draft and power requirements shown here for primary tillage are based on the conventional 12 in (305 mm) spacing. Cultivators with narrower shank spacing may have considerably higher draft when operating at the same depth and speed.

In light secondary tillage, such as seedbed preparation and herbicide incorporation, average draft at 5 mph (8 km/h) varied from 55 lb/ft (0.8 kN/m) at 1.6 in (40 mm) depth to 150 lb/ft (2.2 kN/m) at 4 in (100 mm) depth. For the 32.8 ft (10 m) wide test machine, this corresponds to a total draft ranging from 1804 to 4920 lb (8.0 to 21.9 kN).

In heavy secondary or light primary tillage, average draft varied from 90 lb/ft (1.3 kN/m) at 1.6 (40 mm) depth to 250 lb/ft (3.7 kN/m) at 5 in (125 mm) corresponding to a total draft ranging from 2952 to 8200 lb (13.1 to 36.5 kN) for the 32.8 ft (10 m) wide test machine.

In heavy primary tillage, average draft at 5 mph (8 km/h) varied from 132 lb/ft (1.9 kN/m) at 2 in (50 mm) to 444 lb/ft (6.5 kN/m) at 5 in (125 mm) depth corresponding to a total draft from 4330 to 14,560 lb to (19 to 65 kN) for the 32.8 ft (10m) wide test machine.

Increasing speed by 1.0 mph increased draft by 10.5 lb/ft (95 N/m draft increase for each 1.0 km/h speed increase). This represents a total draft increase of 344 lb for a 1.0 mph speed increase (0.95 kN for a 1.0 km/h speed increase) for the test machine in

primary tillage.

Tractor Size: TABLES 2, 3 and 4 show tractor size required to pull the 32.8 ft (10 m) wide Morris MP-912 in light secondary, in heavy secondary or light primary tillage, and in heavy primary tillage with 14 in (356 mm) sweeps.

TABLE 2. Tractor Size: Maximum Power Take Off Rating hp (kW) Required to Pull the 32.8 ft (10 m) Morris MP-912 in Light Secondary Tillage

DEPTH in (mm)		SPEED mph (km/h)					
in	(mm)	5	(8.0)	6	(9.7)	7	(11.3)
2	(50)	51	38	71	53	82	61
3	(75)	81	61	110	82	125	93
4	(100)	112	84	147	110	165	123

TABLE 3. Tractor Size: Maximum Power Take Off Rating hp (kW) Required to Pull the 3.28 ft (10 m) Morris MP-912 in Heavy Secondary Tillage or Light Primary Tillage

DEPTH in (mm)		SPEED mph (km/h)					
in	(mm)	5	(8.0)	6	(9.7)	7	(11.3)
2	(50)	84	63	115	86	135	101
3	(75)	119	89	154	115	184	138
4	(100)	153	115	195	146	234	175
5	(125)	188	141	238	178	278	208

TABLE 4. Tractor Size: Maximum Power Take Off Rating hp (kW) Required to Pull the 3.28 ft (10 m) Morris MP-912 in Heavy Primary Tillage

DEPTH in (mm)		SPEED mph (km/h)					
in	(mm)	4	(6.4)	5	(8.0)	5	(9.7)
2	(50)	62	46	86	64	112	84
3	(75)	115	86	152	114	194	145
4	(100)	170	127	219	164	275	206
5	(125)	223	167	286	214	356	266

The power requirements shown for heavy primary tillage are based on draft requirements for heavy duty cultivators with 12 in (305 mm) shank spacings. Tractor size for the Morris MP-912 with a 9 in (230 mm) shank spacing may be considerably higher than shown.

Tractors 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.

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example, in light secondary tillage at 3 in (75 mm) depth and 6 mph (9.7 km/h) a 110 hp (82 kW) tractor is needed to operate the Morris MP-912. In heavy secondary or light primary tillage at the same depth and speed, a 154 hp (115 kW) tractor is required. In heavy primary tillage at the same depth and speed, a 194 hp (145 kW) tractor is required.

OPERATOR SAFETY

Extreme caution is needed when transporting most folding cultivators to avoid contacting power lines. Minimum power line heights over farmland or secondary roads vary in the three prairie provinces. In Alberta and Manitoba, lines over roads may be as low as 16 ft (4.8 m). In Saskatchewan, they may be as low as 17 ft (5.2 m). In all three provinces, lines in farmyards may be as low as 15 ft (4.6 m).

Transport height of the 32.8 ft (10 m) wide three section Morris MP-912 was 15.3 ft (4.7 m) permitting safe transport under most prairie power lines. The legal responsibility for safe passage under utility lines rests with the machinery 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 only 12.8 ft (3.9 m) wide in transport position and required normal caution when transporting. A slow moving vehicle sign was not supplied. It is recommended that the manufacturer consider supplying one.

Transport locks for the centre frame section and the wings were provided. The locks could be positioned without climbing on to the cultivator frame. The rigid hitch link and hitch jack allowed safe

hitching by one person.

The load on the centre section tires did not exceed The Tire and Rim Association maximum load rating even when in transport with mounted harrows.

OPERATOR'S MANUAL

The operator's manual was excellent. It supplied instructions on set up, lubrication, maintenance, and safety. There was a complete list of operating instructions. It also provided a complete parts listing. It was well written and clearly illustrated.

MECHANICAL HISTORY

TABLE 4 outlines the mechanical history of the Morris MP-912 during 100 hours while cultivating about 1579 ac (639 ha).

The intent of the test was evaluation of functional performance. The following mechanical problems occurred during functional testing. An extended durability test was not conducted.

Depth Stop Valve: During testing, an O-ring in the depth stop valve was damaged, allowing oil to flow past the valve. This caused inconsistent depth control. The valve was replaced, and the problem was eliminated.

Tire Clearance: Clearance between the tires and some of the sweeps was as small as 1.5 in (38 mm) when 14 inch sweeps were used. This resulted in many cuts in the tires and one flat tire during testing. The outside tips of the sweeps closest to the tires were cut off to prevent further tire damage. The use of 12 inch sweeps may also have prevented tire damage. It is recommended that the manufacturer consider modifications to prevent tire damage.

TABLE 4. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA	
		ac	(ha)
-The depth stop valve failed and was replaced at	85	1340	(542)
- A sweep cut a tire causing a flat . The tire was replaced and the sweep wings close to the tires were cut off at	92	1452	(587)

APPENDIX

SPECIFICATIONS

MAKE: Morris
MODEL: MP 912
SERIAL NO.: 4005
MANUFACTURER: Morris Rodweeder Co Ltd
 85 York Road
 Yorkton, Saskatchewan
 S3N 2X2

OVERALL DIMENSIONS:	FIELD POSITION	TRANSPORT POSITION
-width	32.8 ft (100 m)	12.8 ft (39 m)
-length with mounted harrows	19.5 ft (6.0 m)	19.5 ft (60 m)
-height	5.2 ft (1.6 m)	15.3 ft (47 m)
-maximum ground clearance	7.5 in (190 mm)	7.5 in (190 mm)
-wheel tread	27.6 ft (8.4 m)	95 ft (29 m)

SHANKS:

-number	43
-spacing	9 in (230 mm)
-trash clearance (frame to sweep tip)	275 in (700 mm)
-number of shank rows	4
-centre section	4
-wings	4
-distance between rows	32 in (812 mm)
-shank cross section	1.25 x 2 in (31 x 50 mm)
-shank stem angle	55 degrees
-sweep hole spacing	225 in (56 mm)
-sweep bolt size	1/2 x 2 in

HITCH:

-vertical adjustment range	about 18 in (457 mm) infinite
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DEPTH CONTROL:

series hydraulic

FRAME:

-cross section	4 in (100 mm) square tubing
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TIRES:

-centre section	4, 9 5 L x 15, 8 ply
-wing sections	4, 95 L x 15, 6 ply
-stabilizer wheels	2, 9 5 L x 15, 6 ply

NUMBER OF LUBRICATION POINTS

-grease fittings	69
-wheel bearings	10

HYDRAULIC CYLINDERS:

-depth control	5, 3.5 x 12 in (89 x 305 mm)
-wing lift	2, 4.5 x 28 in (114 x 711 mm)

WEIGHTS:

(WITHOUT HARROWS)

	FIELD POSITION	TRANSPORT POSITION
-right wheels	2275 lb (1032 kg)	
-right centre wheels	2558 lb (1160 kg)	4653 lb (2110 kg)
-left centre wheels	2504 lb (1136 kg)	4625 lb (2098 kg)
-left wheels	2221 lb (1007 kg)	
-hitch	470 lb (213 kg)	750 lb (340 kg)
TOTAL	10028 lb (4548 kg)	10028 lb (4548 kg)

WEIGHTS:

(WITH MOUNTED HARROWS)

	FIELD POSITION	TRANSPORT POSITION
-right wheels	2565 lb (1163 kg)	
-right centre wheels	2885 lb (1309 kg)	5340 lb (2422 kg)
-left centre wheels	2825 lb (1281 kg)	5295 lb (2402 kg)
-left wheels	2505 lb (1163 kg)	
-hitch	240 lb (109 kg)	385 lb (174 kg)
TOTAL	11020 lb (4998 kg)	11020 lb (4998 kg)

OPTIONAL EQUIPMENT INCLUDED:

- mounted finishing
- harrows (three row)

OPTIONAL EQUIPMENT AVAILABLE:

- rigid shanks
- mounted finishing harrows
- 12 width options from 19 ft (5.8 m) to 41 ft (12.5 m)

APPENDIX II

MACHINE RATINGS

The following rating scale is used in Machinery Institute Evaluation Reports:

excellent	fair
very good	poor
good	unsatisfactory

SUMMARY CHART

MORRIS MP-912 HEAVY DUTY CULTIVATOR

RETAIL PRICE	\$24,200.00 [February, 1986, f.o.b. Humboldt, 32.8 ft (10 m) width, with optional harrows and McKay sweeps].
QUALITY OF WORK	
Shank Characteristics	
-trip clearance	10.2 in (260 mm)
-spring preload	Exceeded at 1205 lb/ft (17.6 kN/m), suitable for primary tillage
-working sweep pitch	5 to 7 degrees over normal tillage range
Penetration	
-ability	Excellent ; level furrow bottom in secondary and primary tillage
-uniformity	Very Good
Trash Clearance	Very Good
Trash Burial and Field Surface	Good ; harrows left bunches in heavy trash
Weed Kill	Good
EASE OF OPERATION AND ADJUSTMENT	
Hitching	Good ; hitch jack was too short
Transporting	Very Good ; locks were easily installed, narrow transport width
Maneuverability	Very Good
Frame Levelling	Very Good
Depth Adjustment	Very Good ; easy to adjust
Harrow Adjustment	Good
Sweep and Shank Installation	Good ; took about 10 minutes to replace a shank
POWER REQUIREMENTS	
Light Secondary Tillage	110 hp (82 kW) at 3 in (75 mm) depth and 6 mph (9.7 km/h)
Heavy Secondary or Light Primary Tillage	154 hp (115 kW) at 3 in (75 mm) depth and 6 mph (9.7 km/h)
Heavy Primary Tillage	194 hp (145 kW) at 3 in (75 mm) depth and 6 mph (9.7 km/h)
OPERATOR SAFETY	Operator did not have to climb on cultivator frame to position locks, very narrow transport width
OPERATOR'S MANUAL	Excellent ; well written and clearly illustrated, complete operating instructions and parts manual
MECHANICAL HISTORY	Depth stop valve failed, tires damaged by sweeps, no shanks bent during testing



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