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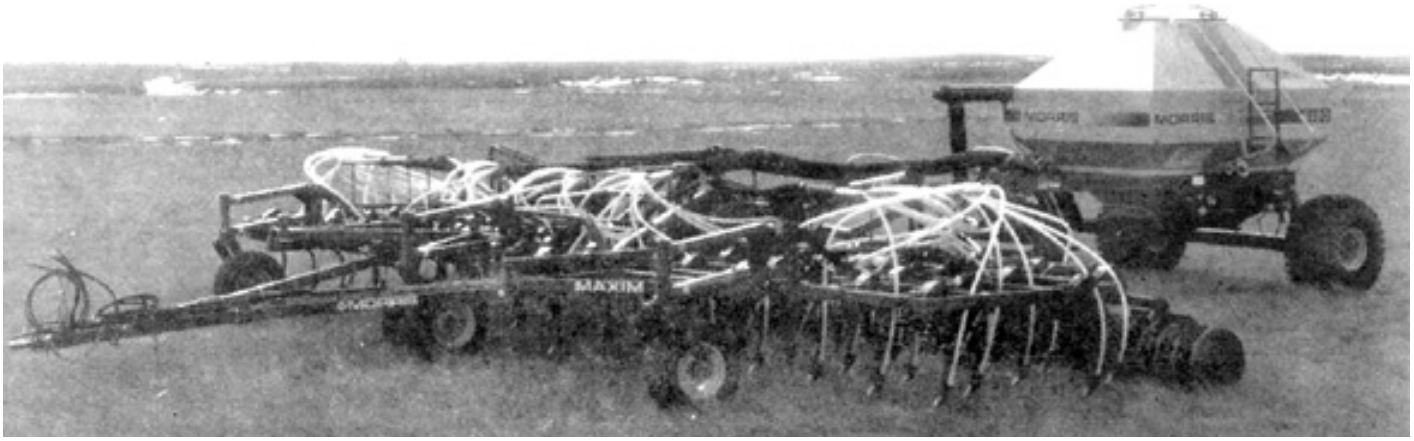

Morris Maxim Air Drill

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

MORRIS MAXIM AIR DRILL

MANUFACTURER AND DISTRIBUTOR:

Morris Industries Ltd.
85 York Road
Yorkton, Saskatchewan S3N 2X2
Phone: (306) 783-8585

RETAIL PRICE:

$47,345.00 (March, 1994 f.o.b. Lethbridge, Alberta) for 39 ft (11.9 m) wide drill complete with 63 edge-on shanks spaced at 7.5 in (191 mm), 2 in (51 mm) steel packers and rock deflectors.

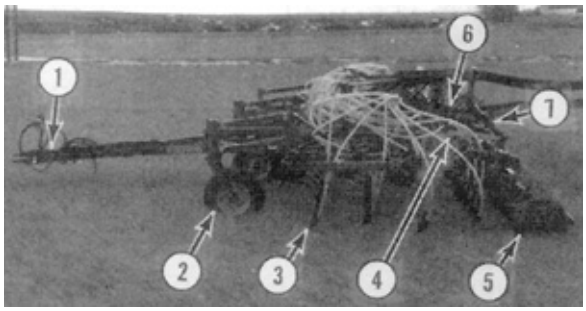

FIGURE 1. Morris Maxim Air Drill: (1) Floating Hitch, (2) Gauge Wheel, (3) Edge-on Shanks, (4) Long Turnbuckle, (5) Press Wheels, (6) Short Turnbuckle and (7) Hydraulic Depth Control Cylinder.

SUMMARY

QUALITY OF WORK

Penetration of the Morris Maxim air drill with edge-on shanks was very good. The openers were able to maintain proper depth in fields which contained areas of hard soil. Four mounting positions were possible for the opener and seed boot assembly. The 390 lb (1.7 kN) shank trip force minimized tripping of the shank assembly.

Seed and fertilizer placement was very good. The seed and fertilizer were placed together in the furrows. The band width of the rows averaged 1.8 in (46 mm). Seed and fertilizer depth remained uniform when seeding in either tilled or untilled soil.

Soil finishing was very good. The majority of the straw was left on the soil surface with some remaining upright when working in untilled soil conditions. The packing force was adequate for the soils and conditions encountered during the test.

Residue clearance was very good. The four rows of hoe openers allowed good residue flow. Variation in opener spacing caused occasional plugging in the main frame.

Operation in stony conditions was very good. Maximum lift height of the edge-on shank was 10 in (254 mm). Rocks 5 to 6 in (127 to 152 mm) in diameter occasionally jammed between the press wheels.

EASE OF OPERATION AND ADJUSTMENT

Ease of performing routine maintenance on the Morris Maxim air drill was very good. The 36 grease fittings were serviced by one person in 20 minutes. Replacing the hoe point openers required four hours and changing the position of the openers and seed boots required two hours.

Ease of transporting was very good. Caution was required when transporting because of the width and height of the unit. The drill towed well at speeds up to 20 mph (32 km/h). A sweep-to-ground clearance of 6.5 m (165 mm) allowed for safe transportation.

Ease of levelling the frame was good. Turnbuckles levelled each drill frame section. Shims on the press wheel pivot brackets levelled the unit laterally.

Ease of setting the seeding depth was very good. The seeding depth was controlled by four hydraulic cylinders. Stroke control collars on each cylinder were manually set to change the seed depth. Keeping the cylinders phased helped maintain uniform seeding depth.

POWER REQUIREMENTS

Overall tractor size needed to pull the 39 ft (11.9 m) test unit at normal seeding depths and at 5 mph (8 km/h) varied from 143 to 236 PTO hp (107 to 176 PTO kW).

OPERATOR SAFETY

The Morris Maxim air drill was safe to operate when normai safety precautions were observed. A stow moving vehicle sign, safety reflectors and hitch safety chain were provided as standard equipment.

OPERATOR'S MANUAL

The operator's manual was very good. A separate assembly manual was also provided. The manuals were clearly wdtten, with photographs and illustrations for explanations.

MECHANICAL HISTORY

Interference occurred between the right wing and main frame press wheel gangs when unfolding the unit. The right wing truss support member cracked and four wing depth control hydraulic lines were damaged dudng the test.

RECOMMENDATIONS

The Alberta Farm Machinery Research Centre (AFMRC) recommends the manufacturer:

1. Supply a marking system as optional equipment.
2. Improve the clearance between the press wheel gangs to ensure proper clearance when unfolding the unit.
3. Improve the routing of the wing-depth control hydraulic lines.

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MANUFACTURER'S REPLIES TO RECOMMENDATIONS

The manufacturer states that with regards to recommendation number:

1. Currently Haukass Manufacturing from Mortlach, Saskatchewan can supply markers for all sizes of Maxim air drills that Morris Industries manufacturer.
2. Additional clearance has been implemented on new production machines.
3. A protective sleeve has been retrofitted to prevent chaffing of the hydraulic hoses. All production machines have been retrofitted with this upgrade.

ADDITIONAL MANUFACTURER'S REPLIES:

1. The hard surfaced point mentioned in the report is no longer offered and has been replaced by the chrome tipped point.
2. Regarding the cracked wing lift truss support, the wing lift support design has been changed to prevent this type of failure occurring.

GENERAL DESCRIPTION

The Morris Maxim air drill is a trailing, floating hitch seeder suitable for primary and secondary seeding operations. The four row drill comes with three or five frames and 7.5, 10 or 12 in (191,254, or 305 mm) opener spacing. The air drill frame is supported by front gauge wheels and rear press wheel gangs. The drill can be operated with any air delivery system. Four different operating widths are available from 29 to 49 ft (8.8 to 14.9 m). The seed and fertilizer are placed in the furrow made by the opener and packed by individual gang press wheels.

The seeding depth is controlled by four hydraulic cylinders mounted between the air drill and press wheel gang frames. The cylinders are equipped with stroke control collars which adjust the depth for each section. Two hydraulic cylinders are used on the main frame. Turnbuckles level the air drill. The gauge wheels are dual on the main frame and single on the wings.

The drill is available with either adjustable edge-on shanks or 47 degree cultivator style shanks.

The main frame and wing frames are connected together by the hitch frame and wing lift trusses. The trusses allow each frame to move independently. The wings fold into transport by two hydraulic cylinders connected in parallel. The hydraulic cylinders for the main frame transport wheels are connected to the wing hydraulics with a counter balance and sequence valve. The valves determine the order the wings and transport wheels are raised or lowered.

The test machine was a 39 ft (11.9 m), three section unit with 63 edge-on shanks spaced at 7.5 in (191 mm). The steel packers were 2 in (51 mm) wide with rock deflectors. The Morris Maxim air drill was used with a Morris 6180 air seeder during the test. Optional equipment on the test included the hard surfaced openers and chrome tipped point openers. FIGURE 1 shows the location of major components. Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Morris Maxim air drill was operated in field conditions shown in TABLE 1 for 105 hours while seeding 2147 ac (869 ha). The unit was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

The machine evaluated by the AFMRC was configured as described in the General Description, FIGURE 1, and Specifications section in APPENDIX I of this report. The manufacturer may have built different configurations of this machine before and after AFMRC tests. Therefore, when using this report, be sure to first check that the machine under consideration is the same as the one reported here. If differences exist, assistance can be obtained from AFMRC or the manufacturer to determine changes in performance.

TABLE 1. Operating Conditions.

MATERIAL	SOIL TYPE AND CONDITION	STONE CONDITIONS	FIELD ac	AREA ha	HOURS
Spring Wheat	Sandy Clay Loam *	Stone Free	178	72	12
Spring Wheat	Loam *	Stone Free	500	202	22
Spring Wheat	Loam *	Moderate	190	77	9
Spring Wheat	Silt Loam *	Stone Free	229	93	11
Barley	Silt Loam **	Occasional	341	138	15
Rye	Silt Loam **	Occasional	109	44	9
Winter Wheat	Silt Loam **	Stone Free	420	170	20
Winter Wheat	Silt Loam *	Stone Free	180	73	8
TOTALS			2,147	869	105

* Primary

** Secondary

RESULTS AND DISCUSSION QUALITY OF WORK

Penetration: Penetration of the Morris Maxim air drill with the edge-on shanks was very good. Penetration was similar for both the hard surfaced and chrome tipped point opener. The openers were able to maintain proper depth in fields which contained areas of hard soil.

Uniform penetration across the width of the drill required proper levelling of the unit. The gauge wheels and packers provided adequate support for the drill. The independent frame sections enabled the drill to maintain proper penetration when working in moderately rolling to rolling field conditions. Sharp gullies or hills resulted in uneven penetration.

The edge-on opener assembly (FIGURE 2) consisted of a compression spring, frame mount, shank, seed boot and hoe point opener. Two notches on the edge-on shank and three holes on both the opener and seed boot allowed for four mounting positions. FIGURE 3 shows the sweep pitch characteristics of the Morris edge-on shank with the chrome tipped point opener. The 390 lb (1.7 kN) shank trip force minimized tripping of the shank assembly during field testing.

Seed and Fertilizer Placement: Seed and fertilizer placement of the Morris Maxim air drill was very good. The seed and fertilizer were placed together in the furrows. The Maxim air drill was equipped with a square seed boot located directly behind the hoe opener. The band width of the rows averaged 1.8 in (46 mm). Seed and fertilizer depth was uniform when seeding in either tilled or untilled soil. Most seeds were placed within 0.5 in (13 mm) of the average seed depth of 2.1 in (53 mm).

The Morris Maxim air drill was stable and did not skew sideways in typical field conditions.

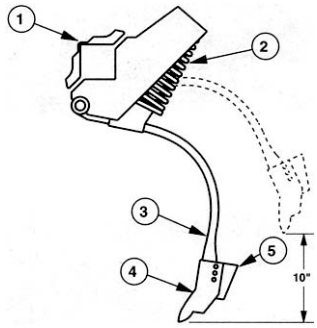


FIGURE 2. Edge-on Shank Assembly: (1) Frame Mount, (2) Compression Spring, (3) Edge-on Shank, (4) Opener and (5) Seed Boot.

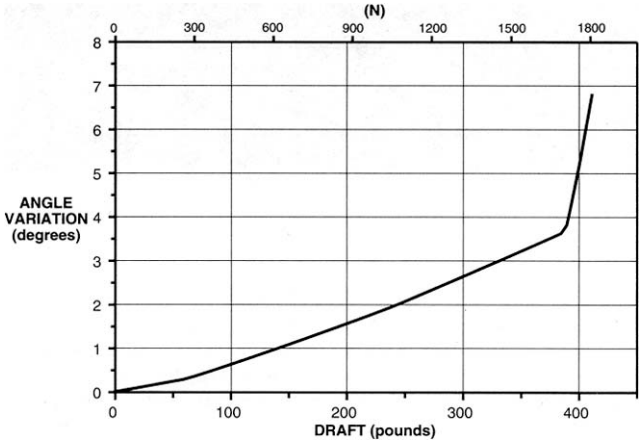


FIGURE 3. Sweep pitch characteristics for Morris edge-on shank.

Soil Finishing: Soil finishing of the Morris Maxim air drill was very good. FIGURE 4 shows the soil surface after seeding into an untilled wheat stubble field. The majority of the straw was left on the surface with some remaining upright. FIGURE 5 shows the soil sur-

face after seeding into a previously tilled field. Ridge depths from the press wheels ranged from 1.4 to 2.4 in (35 to 61 mm), depending on soil conditions. The packing force was adequate for the soils and conditions encountered during the test.

Residue Clearance: Residue clearance of the Morris Maxim air drill was very good. The four rows of hoe openers on 30 in (762 mm) lateral spacing allowed for good residue flow. Variation in lateral opener spacing (APPENDIX III) on the main frame caused occasional plugging in fields with high amounts of straw, high standing stubble or weed infestation.

Stony Conditions: Operation of the Morris Maxim air drill in stony conditions was very good. Maximum lift height of the edge-on shank was 10 in (254 mm). Rocks 5 to 6 in (127 to 152 mm) in diameter would occasionally jam between press wheels causing the press wheel gang to skid. The press wheel section was raised off the ground and turned by hand to remove the rock.

Marking System: No marking system was supplied with the Maxim air drill. In certain seeding conditions the use of a marker was necessary. The AFMRC recommends the manufacturer supply a marking system as optional equipment.

FIGURE 4. Soil surface after seeding into an untilled wheat stubble field.

FIGURE 5. Soil surface after seeding into a tilled field.

EASE OF OPERATION AND ADJUSTMENT

Maintenance: Ease of performing routine maintenance was very good. Grease fittings were provided for the gauge wheel castor pivots, lower pivot arms and the press wheel gangs. The lower pivot arms were greased every 10 hours. The castor pivots were greased every 100 hours and the press wheel bearings every 50 hours. The wheel hubs required servicing every 500 hours or annually. The manufacturer recommended the press wheel assemblies be checked for tightness after 5 and 15 hours and then periodically. One person required 20 minutes to service the 36 grease fittings.

One person required four hours to replace the hoe point openers. To change the position of the openers and seed boots required two hours. The replacement of a shank assembly required 10 minutes.

Transporting: Ease of transporting the Maxim air drill was good. The unit was placed into transport position (FIGURE 6) in 10 minutes. A transport rest lock secured the wing front and a transport lock strap secured the rear of the wing. The wing gravity locks prevented the wings from swaying during transport. Wing stabilizer chains connected to the floating hitch prevented the unit from tipping backwards during transport. Securing the wings in transport position on uneven ground was difficult. One wing frame did not rest against the wing transport rest lock. The operator had to manually push the wing against the rest lock to secure the wing in transport position.

Gravity locks were provided for the transport wheels. A transport lock at the main gauge wheel prevented movement of the main frame during transport. The main gauge wheels were also pinned to prevent castering.

Transport width of the test machine was 22.4 ft (6.8 m) and transport height was 16.6 ft (5.1 m). Care was needed when transporting on public roads, through gates, over bridges and beneath power lines.

Sufficient clearance between the tractor's rear tires and the air drill allowed sharp turns in both field and transport position.

The Maxim air drill towed well without sway or bounce at a tractor speed of 20 mph (32 km/h). A sweep-to-ground clearance of 6.5 in (165 mm) allowed for safe transportation.

FIGURE 6. Transport position.

Frame Levelling: Ease of levelling the frame was good. Adjusting the shims on the press wheel pivot brackets levelled the unit laterally. Initial level settings were supplied for the short and long turnbuckles (FIGURE 7). Final adjustments were done in the field. The drill was lowered hydraulically until the rear row openers on the main frame were at the required depth. The rear row openers on the wings were set to the main frame rear row depth by adjusting the short turnbuckles on the wings. The long turnbuckles levelled the unit front to back.

Depth Adjustment: Ease of setting the seeding depth was very good. The seeding depth was controlled by four hydraulic cylinders connected in series. Two hydraulic cylinders (flow divider cylinders) were located between the main frame cylinder support tower and press wheel gang frame. One hydraulic cylinder was located between each wing frame and press wheel gang frame. A stroke control collar (FIGURE 7) was located on each hydraulic cylinder. Adjusting the length of each collar evenly changed the depth of the air drill. Optional depth spacers were provided for shallow seeding depths.

The depth control cylinders were rephased by maintaining hydraulic pressure for four seconds with the air drill in a raised position. Keeping the cylinders phased helped maintain uniform seeding depth.

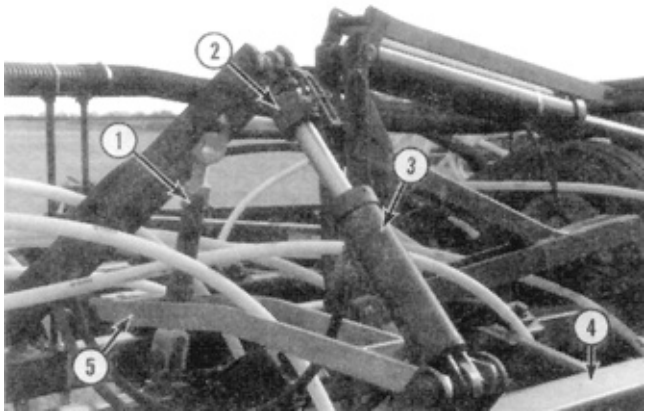


FIGURE 7. Depth and Level Adjustments: (1) Short Turnbuckle, (2) Stroke Control Collar, (3) Depth Control Cylinder, (4) Press Wheel Gang Frame and (5) Long Turnbuckle.

POWER REQUIREMENTS

Draft Characteristics: Draft (drawbar pull) requirements depended on previous field preparation, soil texture, soil moisture content and ground speed.

Average draft for the 39 ft (11.9 m) drill tested in clay loam soil ranged from 7952 to 10788 lb (35.4 to 48 kN) at a normal seeding depth and at 5 mph (8 km/h).

Average draft of the Morris 6180 air seeder used during the test when full of wheat ranged from 706 to 1146 lb (3.1 to 5.1 kN).

Tractor Size: FIGURE 8 shows the power take-off horsepower requirements per foot of drill width for varying seed depths at 5 mph (8 km/h). Requirements varied from 1.4 hp/ft (3.4 kW/m) at a 0.5 in (13 mm) seed depth to 8.9 hp/ft (21.8 kW/m) at a 3.5 in (89 mm) seed depth. The overall tractor size needed to pull the 39 ft (11.9 m) test unit at normal seeding depths and at 5 mi/h (8 km/h) varied from 143 PTO hp (107 PTO kW) to 236 PTO hp (176 PTO kW). Additional power needed to pull the Morris 6180 tank full of wheat ranged from 17 to 28 PTO hp (13 to 21 PTO kW).

These tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80 percent of maximum power take-off rating as determined by the Nebraska tractor tests or as presented by the tractor manufacturer. The tractor sizes given will have ample power reserves to operate in the stated conditions.

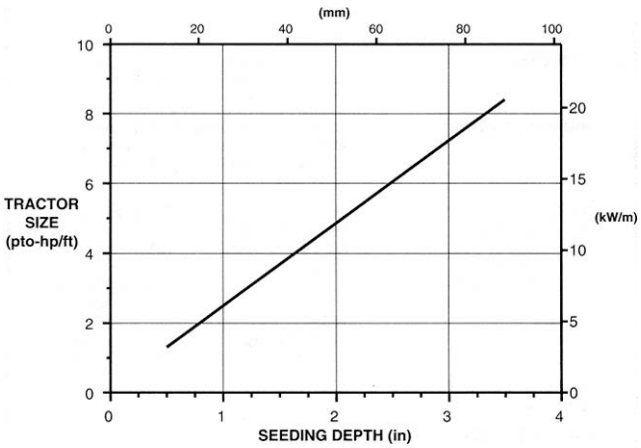


FIGURE 8. Average horsepower requirements at 5 mi/h (8 km/h).

OPERATOR SAFETY

The Morris Maxim air drill was safe to operate when normal safety precautions were observed. The test unit was 22.4 ft (6.8 m) wide in transport, which required caution when towing on public roads, over bridges and through gates. A slow moving vehicle sign, safety reflectors and hitch safety chain were provided as standard equipment. The counter balance valve and sequence valve ensured safe and proper operation of the transport hydraulic system.

The manufacturer recommended the transport speed of the air drill not exceed 20 mph (32 km/h). Tire loads did not exceed the maximum load ratings for transport speeds up to 20 mph (32 km/h).

OPERATOR'S MANUAL

The operator's manual was very good. The manual for the Morris Maxim air drill contained useful information on safety, specifications, operation, maintenance and trouble shooting. A separate assembly manual was provided. A parts list manual was not included.

MECHANICAL HISTORY

The Morris Maxim air drill was operated for 105 hours while seeding 2147 ac (869 ha). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted. TABLE 2 outlines the mechanical problems that did occur during the functional testing.

TABLE 2. Mechanical History.

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA ac	ha
Wing press wheel gang caught on main frame press wheel gang when unfolding		Throughout the Test	
Replaced lost main gauge wheel transport lock pin	53	719	291
Replaced hard surface openers with chrome tipped openers	78	1,547	626
Welded crack on right wing lift truss support	78	1,547	626
Noticed damaged wing depth control hydraulic lines		End of Test	

DISCUSSION OF MECHANICAL PROBLEMS

Press Wheel Gang: When unfolding the unit into field position the right wing inside press wheel gang would not clear the press wheel gang on the main section (FIGURE 9). The wing press wheel gang did not come free from the main-press wheel gang as the unit moved forward. To free the wing press wheel gang the wing was slightly raised into transport and then lowered. The AFMRC recommends the manufacturer improve the clearance between the press wheel gangs to ensure properclearance when unfolding the unit.

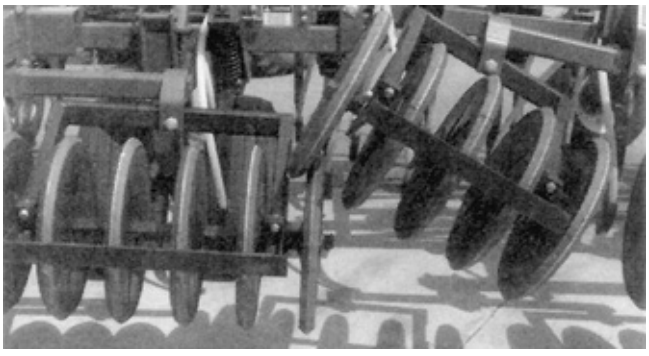


FIGURE 9. Interference between wing and main frame press wheel gangs.

Cracked Wing Lift Truss Support: The right wing truss support (FIGURE 10) cracked near the hydraulic cylinder connection. The crack in the support was welded and no further problems occurred.

Hoe Point Wear: The hard surface opener was replaced after 1547 ac (626 ha) or 25 ac (10 ha) per point. FIGURE 11 shows the average wear of the chrome tipped opener after 600 ac (243 ha) or 9.5 ac (3.8 ha) per point. Cost of the replacement hard surfaced and chrome tipped points were $9.00 and $17.00 each, respectively.

Damaged Wing Depth Control Hydraulic Lines: The hydraulic lines were routed through the wing lift trusses (FIGURE 12). As the wings were placed in and out of transport the hydraulic lines rubbed on the wing lift truss. Continuous scraping would eventually cause the hydraulic lines to fail. The AFMRC recommends the manufacturer improve the routing of the wing depth control hydraulic lines.

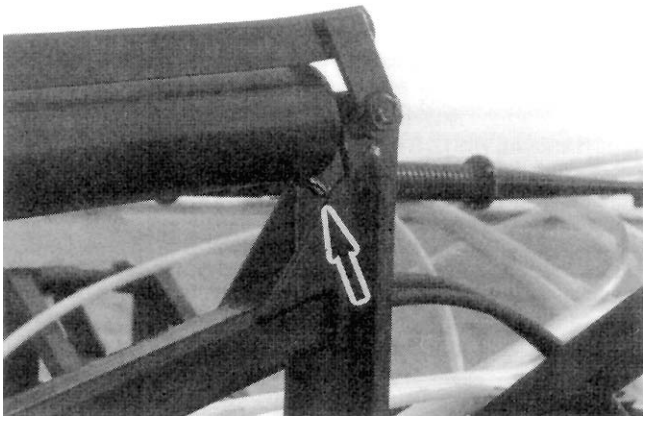


FIGURE 10. Cracked wing lift truss support.

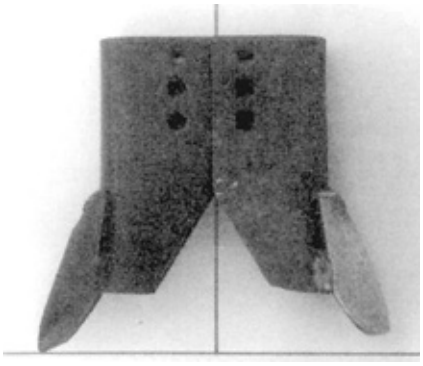


FIGURE 11. Point wear of chrome tipped points.

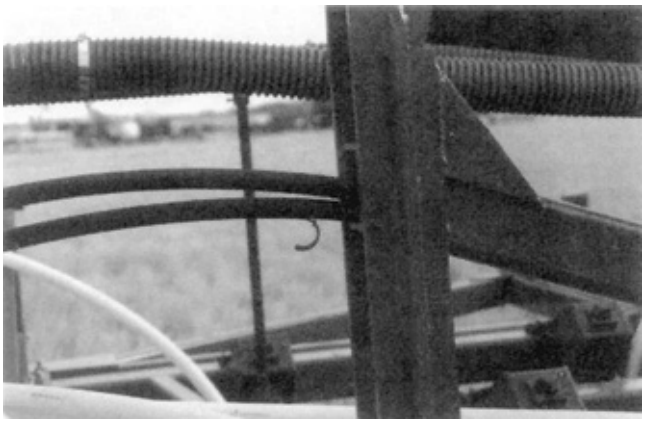


FIGURE 12. Damaged wing depth control hydraulic lines.

APPENDIX I

SPECIFICATIONS

MAKE:	Morris	
MODEL:	Maxim Air Drill, 39AD	
SERIAL NUMBER:	3900003936	
MANUFACTURER:	Morris Industries Ltd. 85 York Road Yorkton, Saskatchewan S3N 2X2 Phone: (306) 783-8585	
DIMENSIONS:	**Field Position**	**Transport Position**
- height	5.9 ft (1.8 m)	16.6 ft (5.1 m)
- length	25.6 ft (7.8 m)	24.8 ft (7.6 m)
- width	39.4 ft (12.0 m)	22.4 ft (6.8 m)
- effective seeding width	38.8 ft (11.8 m)	
- transport ground clearance		
- packers		16.5 in (419 mm)
- shanks		6.5 in (165 mm)
- wheel tread		11.4 ft (3.5 m)
OPENERS:		
- type	edge-on opener	
- point	Chrome Tipped Point and Hard Surfaced Opener	
- point width	1.6 in (41 mm)	
- number	63	
- spacing	7.5 in (191 mm)	
- vertical clearance	27 in (686 mm) (frame to point)	
- number of rows	four	
- distance between rows	24 in (610 mm) (centre to centre)	
- shank cross section	2 x 1 in (51 x 25 mm)	
- opener bolt size	5/16 x 2.25 in carriage bolt	
PRESS WHEELS:		
- type	V-shaped steel	
- diameter	23 in (584 mm)	
- width	2 in (51 mm)	
- number	63 (four sets of five on each wing, three sets of six and one set of seven on the main section)	
- spacing	7.5 in (191 mm)	
HITCH:	floating	
DEPTH CONTROL:	stroke control collars 1 in (25 mm) optional spacers	
FRAME:		
- number of sections	three	
- cross sections	4 in (102 mm) square tubing	
GAUGE WHEELS:		
- number	four, one wheel on each wing frame, two wheels on main frame	
- tire size	11L - 15, 6 ply wing wheels 9.5L - 15FI, 6 ply main wheels	
TRANSPORT WHEELS:		
- number	four	
- type	two sets of duals	
- tire size	11 - 15 LT, 8 ply	
LEVELLING:	shims on press wheel assemblies for lateral, short and long turnbuckles on each frame section.	
TRANSPORT LOCK:	gravity locks for transport wheels and wings, main gauge wheel transport lock and transport rest lock and lock strap for each wing.	
WEIGHTS:	**Field Position**	**Transoort Position**
- left gauge wheel	1640 lb (744 kg)	
- main gauge wheels	3480 lb (1579 kg)	1840 lb (835 kg)
- right gauge wheel	1600 lb (726 kg)	
- left transport wheels		7420 lb (3367 kg)
- right transport wheels		7490 lb (3398 kg)
- packers	10030 lb (4551 kg)	
- hitch	280 lb (127 kg)	280 lb (127 kg)
TOTAL	17030 lb (7727 kg)	17030 lb (7727 kg)
NUMBER OF LUBRICATION POINTS:	36	
NUMBER OF HYDRAULIC CYLINDERS:	four (depth control), two (transport), two (wing lift)	
OPTIONS INCLUDED ON TEST MACHINE:	- 39 ft-(11.9 m) width - 7.5 in (191 mm) spacing - 2 in (51 mm) steel press wheels - edge-on shanks - press wheel rock deflectors	
OTHER AVAILABLE OPTIONS:	- 29, 34 and 49 ft (8.8, 10.4 and 14.9 m) widths - 10 and 12 in (254 and 305 mm) shank spacing - 2 in (51 mm) rubber packers (7.5 in spacing) - 3.5 in (89 mm) steel or rubber packers (10 and 12 in spacing)	

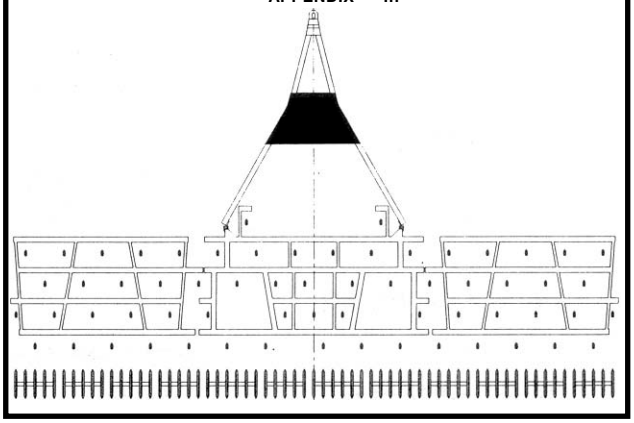
APPENDIX II

MACHINERY RATINGS

The following rating scale is used in Alberta Farm Machinery Research Centre Evaluation Reports.

- Excellent
- Very Good
- Good
- Fair
- Poor
- Unsatisfactory

APPENDIX III



SUMMARY CHART

MORRIS MAXIM AIR DRILL

RETAIL PRICE:	$47,345.00 (March, 1994, f.o.b. Lethbridge, Alberta) for 39 ft (11.9 m) wide drill complete with 63 edge-on shanks spaced at 7.5 in (191 mm), 2 in (51 mm) steel packers and rock deflectors.
QUALITY OF WORK:	
- Penetration	**very good;** openers penetrated hard soils
- Seed and Fertilizer Placement	**very good;** uniform seed depth in tilled or untilled soil
- Soil Finishing	**very good;** left majority of straw on surface in primary conditions
- Trash Clearance	**very good;** occasional plugging in the main frame section
- Stony Conditions	**very good;** rocks occasionally jammed between press wheels
EASE OF OPERATION AND ADJUSTMENT:	
- Maintenance	**very good;** replacing the openers required 4 hours and changing the mounting position 2 hours
- Transporting	**good;** difficult to place in transport position on uneven ground
- Frame Levelling	**good;** initial levelling was time consuming
- Depth Adjustment	**very good;** stroke control collars manually set to change depth
POWER REQUIREMENTS:	varied from 143 PTO hp (107 PTO kW) to 236 PTO hp (176 kW)
OPERATOR SAFETY:	**safe;** safety reflectors and chain provided
OPERATOR'S MANUAL:	**very good;** clearly written
MECHANICAL HISTORY:	interference between wing and main frame press wheel gangs when unfolding

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