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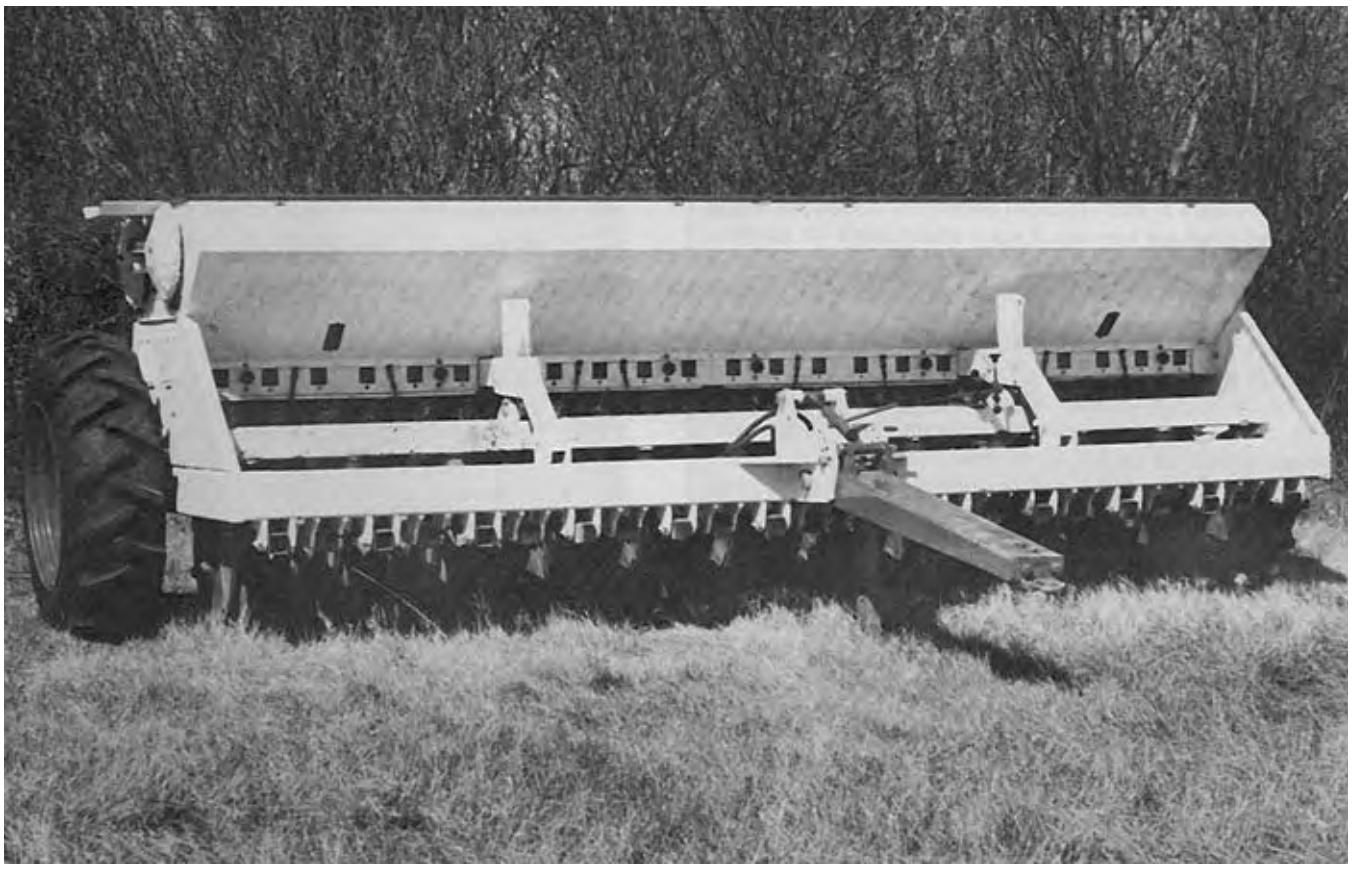
Evaluation Report 148



Melroe 702-3D Grain and Fertilizer Drill

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

MELROE 702 GRAIN AND FERTILIZER DRILL

MANUFACTURER:

P. B. Bettinson and Company Limited
Holbeach, Lincolnshire,
England, PE12 7LS

DISTRIBUTOR:

Westward Parts Services Ltd.
P.O. Box 1907
Regina, Saskatchewan
S4P 3E1

RETAIL PRICE:

$14,100.00 (January, 1979, f.o.b. Humboldt with 23 triple disk openers on 178 mm spacing, interior disk scrapers and hectare meters.)

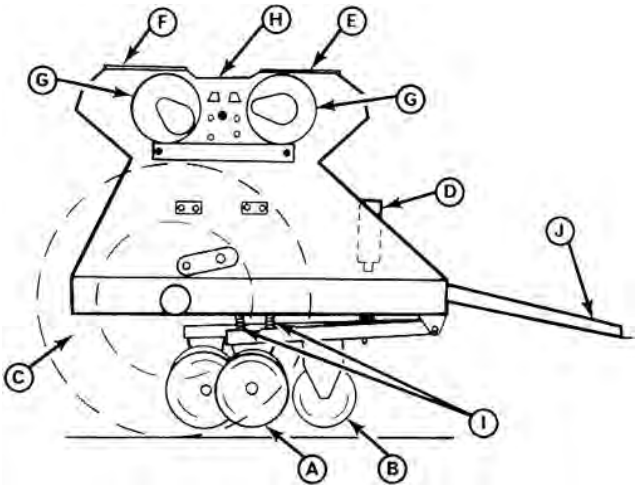


FIGURE 1. Schematic of Melroe 702: (A) Double Disk Openers, (B) Single Disk Cutting Coulters, (C) End Wheels, (D) Hydraulic Lift, (E) Grain Box Opening, (F) Fertilizer Box Opening, (G) Fertilizer and Grain Drive Gear Cassettes, (H) Walkway, (I) Fertilizer and Grain Delivery Tubes, (J) Hitch.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Melroe 702 grain drill was fair. Penetration was good when seeding into a prepared seedbed or directly into stubble or pastureland. The ability of the Melroe to cut through residue was good when equipped with the large 305 mm (12 in) diameter cutting coulters. Plugging occurred readily when using the 254 mm (10 in) diameter cutting coulters in soft, trashy fields. In soft soils, straw was pushed to the bottom of the furrow and in hard soils, large quantities of trash reduced penetration. Seed placement and seed coverage were fair. Packer wheels were not available and in some moist fields the seed was left uncovered and in dry fields moisture loss from the loose soil was substantial. Lodging of rocks between openers was a frequent problem in stony fields. The double disk scrapers were inadequate for operation in wet clay soils.

The accuracy of the seed metering system was very good in barley, wheat, oats and rapeseed. The minimum seeding rate in rapeseed was 4.3 kg/ha (3.8 lb/ac). The variation in seeding rates among seed runs was insignificant when seeding large seeds such as wheat, oats and barley or small seeds such as mustard and rapeseed. The seeding rates in all crops were unaffected by field roughness, field slope, ground speed or level of grain in the grain box.

Overall performance of the fertilizer attachment was good. Variation of the application rates among runs was slightly above the suggested limit, but the application rate was not affected by field roughness, field slope, ground speed or level of fertilizer in the fertilizer box.

A separate grass seed attachment was not available for the Melroe 702. Small grass seeds such as alfalfa could be seeded through the main box with the low range grain drive. Large light seeds, such as bromegrass could not be seeded through the main box as they bridged over the feed rolls. These seeds usually require an agitator to prevent bridging. An agitator was not available for the Melroe 702.

Both the seed and fertilizer rates were easy to change. The seed and fertilizer boxes were convenient to fill from the high central walkway provided a “filling auger” was used. The fertilizer box was easy to clean but was not adequately sealed to prevent water entering in heavy rains. Two lubrication fittings required greasing.

About 42.0 kW (56 hp) of tractor power should be available for each 4.1 m (13.4 ft) section of drill. An 84 kW (112 hp) tractor should have sufficient power reserve to operate a two drill hookup at 8.0 km/hr (5 mph) in most soils.

The operator’s manual was good. It contained detailed instructions on adjustment, repair and maintenance. The Melroe 702 was safe to operate if normal safety precautions were followed.

Failure of the buffer cables occurred frequently. No other serious mechanical problems occurred during testing.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the interior double disk scrapers and providing exterior disk scrapers to improve performance in wet soils.
2. Increasing the transport clearance of the openers and providing a transport safety lock.
3. Modifications to reduce buffer cable failure.
4. Installing rock deflectors to prevent lodging of stones between adjacent openers.
5. Supplying a slow moving vehicle sign.
6. Modifying the hitch angle adjustment to facilitate setting of the cutting coulter depth.

Chief Engineer - E. 0. Nyborg
Senior Engineer - L. G. Smith
Project Engineer - G. E. Frehlich

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. It is our understanding that the Bettinson Company does offer an outside scraper for the double disks. We are checking this.
2. Melroe feels that the Bettinson drill has adequate ground clearance at the present and the hydraulic lock supplied with the drill is sufficient for a transport lock.
3. We are not aware that we have had cable problems on the drill but we will check into this problem.
4. We do not have a solution for this problem at this time.
5. Any drills ordered from Bettinson in the future will be equipped with a slow moving vehicle sign.
6. The hitch adjustment will be checked into. In our tests it seemed adequate.

GENERAL DESCRIPTION

The Melroe 702 is a 4.1 m grain drill designed for no-till, minimum till and conventional seeding. It is equipped with 23 double disk openers spaced 178 mm apart in two rows and preceded by single disk cutting coulters. Seeding depth and opener force are controlled by two hydraulic cylinders. The grain box has a capacity of 930 L grain and the fertilizer box has a capacity of 950 kg fertilizer.

Seed and fertilizer are metered by sponge rollers rotating against small glass windows. Flexible rubber hoses separately deliver the seed and fertilizer to the openers. Grass seed is sown through the main grain box at the low range settings. Packer wheels or other means of closing the opener furrow are not provided. The test machine was equipped with interior double disk scrapers.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Melroe 702 was operated in the conditions shown in TABLE 1 for 152 hours while seeding about 292 ha. It was evaluated for quality of work, ease of operation, ease of adjustment, power requirements, operator safety and suitability of the operator’s

manual. In addition, the seed and fertilizer systems were tested and calibrated in the laboratory.

TABLE 1. Operating Conditions

Crop	Soil	Stone Conditions	Field Area ha	Hours
Oats on summerfallow	Oxbow loam	moderately stony	10	5
Wheat on stubble	Weyburn loam	occasional stones to moderately stony	30	18
Rapeseed on stubble	Weyburn loam	occasional stones	9	4
Wheat on stubble	Echo loam	occasional stones	9	4
Wheat on stubble	Hatton fine sandy loam	stone free	9	4
Wheat on stubble	Fox valley silty loam	stone free	9	4
Wheat on stubble	Fox valley silty loam	occasional stones	11	5
Wheat on stubble	Echo loam	occasional stones	7	4
Wheat on stubble	Regina heavy clay	occasional stones	12	5
Wheat on stubble	Regina heavy clay	stone free	9	5
Grass mixture on pastureland	Oxbow loam	occasional stones	3	4
Wheat on summerfallow	Oxbow loam	occasional stones	4	2
Rye on stubble	Estevan loam	occasional stones	68	35
Wheat on stubble	Trossacha heavy clay	occasional stones	102	53
Total			292	152

RESULTS AND DISCUSSIONS

QUALITY OF WORK

Penetration: The drilling of seeds directly into stubble or pastureland in a no-till planting operation requires an opener that will cut through heavy surface trash, penetrate dry compacted soils and produce a minimum amount of soil disturbance. Excessive soil disturbance promotes weed growth and the loss of soil moisture.

The Melroe 702 was equipped with double disk openers preceded by single disk cutting coulters (FIGURE 2). The original 250 mm diameter cutting coulters were replaced by larger 305 mm diameter coulters with a sharper cutting edge. The functional performance of these two coulters was compared.

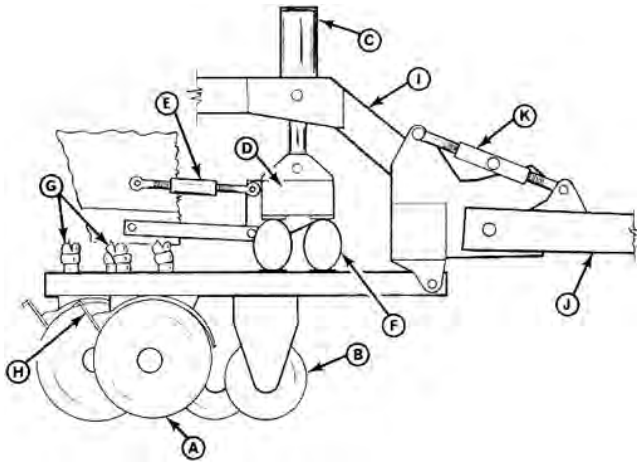


FIGURE 2. Triple Disk Opener: (A) Double Disks, (B) Cutting Coulter, (C) Hydraulic Cylinder, (D) Pressure Beam, (E) Adjustable Parallel Linkage, (F) Rubber Buffers, (G) Seed and Fertilizer Delivery Tubes, (H) Double Disk Scrapers, (I) Main Frame, (J) Hitch, (K) Hitch Angle Adjustment.

Penetration of the openers was very good when seeding directly into moist stubble fields and good when seeding directly into dry stubble fields and pastureland. In the hard soils it was necessary to add ballast to the rear drill frame (FIGURE 3). A total of 600 kg weight was added to provide the required opener force and to prevent the end wheels from lifting off the ground. The seed and fertilizer application systems were ground driven making it necessary for the wheels to maintain ground contact. The sharper edge on the larger cutting coulter resulted in better opener penetration.

The ability of the triple disk opener to cut through surface residue was good in firm soils and fair in soft moist soils. The straw was pushed into the furrow bottom without being cut when operating in soft, moist soils. Extremely heavy surface residue prevented proper opener penetration regardless of soil conditions. The sharper cutting edges of the 305 mm diameter cutting coulters resulted in better trash cutting than the smaller coulters. It is very important for proper penetration and seed placement that the straw and chaff be evenly spread before seeding.

The force on the openers and the opener depth were controlled with two hydraulic cylinders. The cylinders raised and lowered the pressure beam that transferred the force through rubber buffers (FIGURE 2) to the two rows of openers. The operating depth of the back row of openers could be increased with respect to the front row of openers by changing the angle of the pressure beam. The front cutting coulters could be operated deeper or shallower than the double disks by adjusting the hitch angle. Individual depth adjustment of the openers travelling in the tractor wheel tracks was not possible. In average conditions the front cutting coulter was adjusted to penetrate 16 mm deeper than the double disk opener. In softer soil conditions it was necessary to operate the cutting coulter at a shallower depth than the double disk to maintain proper rotation of the double disk opener. Failure to do this resulted in skips and non-uniform seeding.

FIGURE 3. Concrete Ballast Blocks Added to Drill Frame.

The downward force on each opener could be adjusted from 0 to over 2940 N providing the machine was sufficiently ballasted. The maximum average force with grain and fertilizer boxes full and the machine loaded with 600 kg of ballast was 1760 N per opener. This force was sufficient for all conditions encountered during the tests.

FIGURE 4. Soil Surface after Seeding Directly into Stubble. (Top: heavy trash cover; Bottom: light trash cover.)

Seed Placement: The basic rules for the conventional seeding of cereal and oilseed crops also apply to the direct drilling of these crops into stubble. The seed is ideally placed when it is in moist soil on a firm seedbed 20 to 50 mm from the soil surface with the

soil packed tightly about the seed for optimum moisture contact and minimum soil drying.

FIGURE 5. Soil Surface after Seeding into Summerfallow.

In very heavy trash, seed placement was poor. Failure of the openers to cut through the surface residue resulted in the seed being placed either in the residue or on the soil surface. In lighter trash conditions and in softer soil the trash was pushed to the bottom of the furrow without being cut (FIGURE 6). The seed was then placed on this trash and covered with a mixture of trash and soil. This reduced the contact between the seed and the soil that is necessary for good germination. Seed placement was fair in fields with evenly spread surface residue.

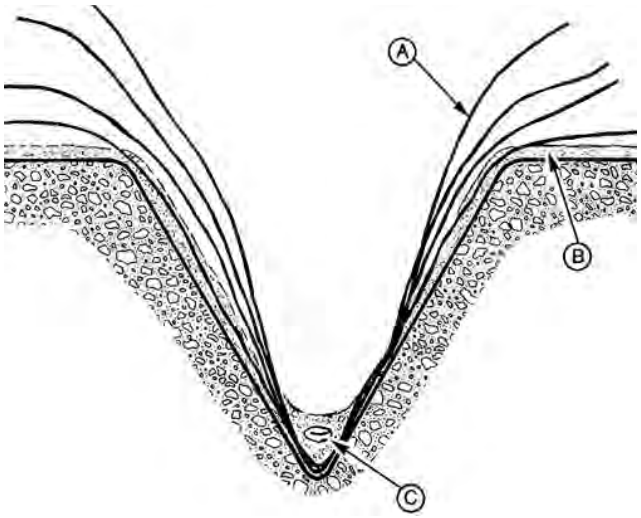


FIGURE 6. Schematic Representation of Poor Seed Placement Due to Poor Trash Cutting. (A) Uncut Straw, (B) Chaff, (C) Seed.

The triple disk opener penetrated well but seeded at an uneven depth. Because of the wide variation of soil hardness in any one field, there was a large variation in the opener force. In hard areas, the rubber buffers between the openers and pressure beam were compressed and the seed placed nearer the surface. In soft areas the buffers relaxed and the seed was placed deeper. The coefficient of variation[1] can be used to indicate the uniformity of the seeding depth. The higher the CV the less uniform is the seeding depth. The lower the C V the more uniform is the seeding depth. A CV value of 30% represents fairly uniform seeding. The coefficient of variation when seeding wheat into a level stubble field at 8.0 km/h at an average 32.2 mm depth was 52.0%. This value is high and indicates poor control of the seeding depth.

The average seeding depth was significantly affected by a change in ground speed. The average seeding depth increased from 32.2 mm to 49.8 mm as the operating speed decreased from 8.0 km/h to 4.8 km/h. Seed placement when renovating dry pastureland was fair as the triple disk opener penetrated well in hard compacted soil.

The Melroe could be successfully used for seeding conventionally into a prepared seedbed without requiring machine alterations.

Soil Compaction: Press wheels or packer wheels were not available as optional equipment. When seeding directly into stubble or pastureland the only seed cover resulted from the crumbling of the furrow walls. In wet fields there was very little furrow wall crumbling and the seed was left relatively uncovered at the furrow bottom. In dry fields, especially with prepared seedbeds, seed coverage was good, but the soil was loosely packed about the seed resulting in poor seed contact with the soil and loss of soil moisture.

In several situations the seed had to be placed fairly deep so the furrow walls would crumble to provide the necessary seed cover. A heavy rain immediately after seeding completely closed the furrow resulting in very deep seed placement and poor emergence.

Packer or harrow units could be attached to the rear of the drill to provide better seed coverage when seeding into a prepared seedbed. Use of harrows when seeding directly into stubble causes excessive soil disturbance and promotes weed growth. One of the important principles of a no-till operation is to minimize soil disturbance to reduce the germination of weeds and loss of soil moisture.

The wide pitch of the double disk opener produced considerable soil disturbance (FIGURE 7), especially at higher operating speeds.

FIGURE 7. Soil Disturbance by Double Disk Openers.

Seed Emergence: In general, the crops seeded directly into stubble or conventionally into a prepared seedbed, germinated well and emerged evenly if adequate moisture was present (FIGURES 8 and 9). In the dry fields, complete emergence occurred only after rain.

Seed emergence in heavy trash areas ranged from fair to poor as the trash prevented proper opener penetration. Emergence in the renovated pastureland was poor due to the dry soil conditions and the competition from the existing growth. Proper pasture renovation requires that the existing growth be removed in 150 mm wide strips using a chemical defoliant with the new seed placed in the centre of these strips.

Metering Accuracy: The grain and fertilizer systems (FIGURE 11) were calibrated in the laboratory using a standard procedure[2] and compared with the manufacturer's calibration.

Since the actual application rates for certain settings depend on factors such as size, density and moisture content of seeds and fertilizer particles, it is not possible for a manufacturer to present charts to include all the variations of seed and fertilizer used. Research has shown, however, that small variations in seed or fertilizer application rates will not significantly affect grain crop yields.

Seed Metering System: The accuracy of the seed metering system on the Melroe 702 in wheat, barley and rapeseed was very good. Differences between the actual seeding rate and the manufacturer's calibration charts were probably due to differences

[1]The coefficient of variation is the standard deviation of the seeding depths expressed as a percent of the mean seeding depth.

[2]PAMI T776-R79, Detailed Test Procedures for Grain Drills

in the seed densities. Since seed densities were not stated in the operator's manual actual rates should be checked by the operator. TABLE 2 shows the calibration for seeding oats through the grain box using the high range sprocket drive. A calibration chart for oats was not included in the operator's manual.

FIGURE 8. Emergence of Wheat Drilled Directly into Wheat Stubble (Top: 25 Days after Seeding; Bottom: 45 Days after Seeding.) Moisture Conditions are Average.

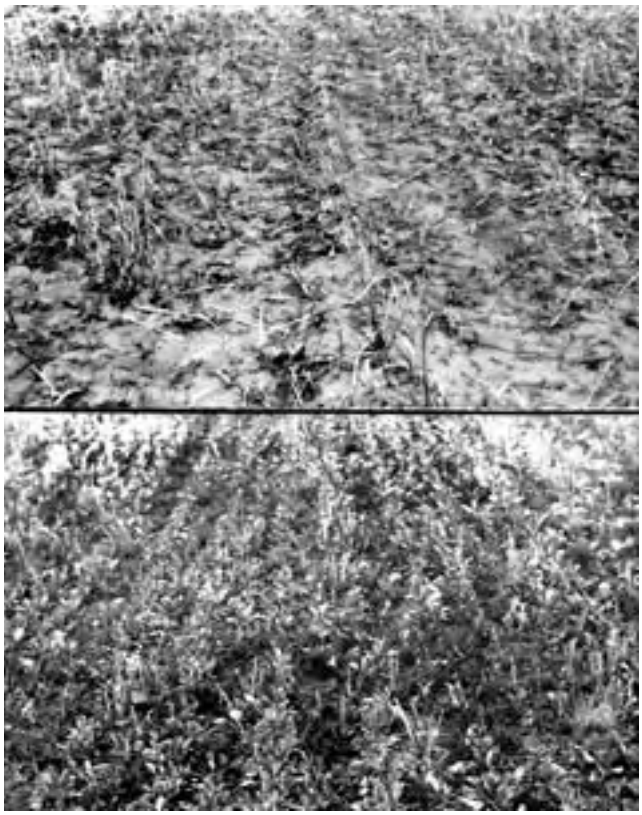


FIGURE 9. Emergence of Rapeseed Drilled Directly into Wheat Stubble (Top: 21 Days after Seeding; Bottom: 41 Days after Seeding.) Moisture Conditions are Average.

FIGURE 10. Poor Wheat Emergence 41 Days after Seeding into Excessive Trash.

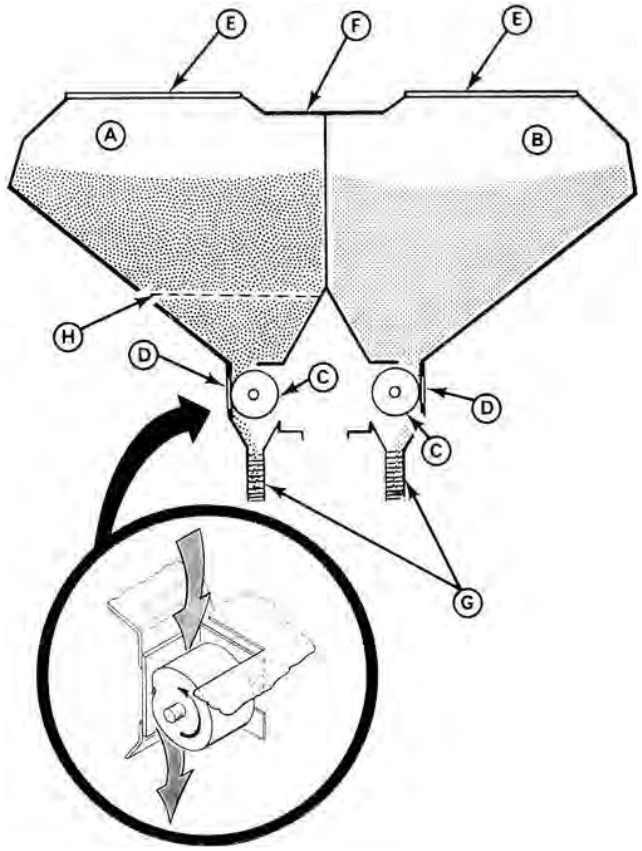


FIGURE 11. Seed and Fertilizer Metering Systems: (A) Fertilizer Box, (B) Grain Box, (C) Sponge Rollers, (D) Small Glass Windows, (E) Grain and Fertilizer Box Lids, (F) Walkway (G) Grain and Fertilizer Delivery Tubes. (H) Fertilizer Screen.

TABLE 2. Oats Calibration -- High Range Settings

Cassette Setting Number	Oats (kg/ha) PAMI
1	12.3
5	16.8
10	20.1
15	23.9
20	29.0
25	26.4
30	41.9
35	47.7
40	58.0
45	62.3
50	76.0
55	84.8
60	94.9

Field roughness, level of seed in the grain box, variation in field slope or ground speed did not affect the seeding rate for either large or small seeds.

The coefficient of variation (CV) can also be used to describe the variation of application rates among individual seed cups. An accepted variation for grain or fertilizer application is a CV value not greater than 15%. If the CV is less than 15%, seeding is acceptable whereas if the CV is much greater than 15%, the variation among

individual seed cups is excessive.

For wheat, oats and barley, seeding was very uniform. For example, when seeding wheat at 82.5 kg/ha the CV was only 5.5%. Seeding rapeseed was also very uniform. When seeding rapeseed at a rate of 11.0 kg/ha the CV was only 6.5%.

Fertilizer Metering System: TABLE 3 shows PAMI calibration results for 11-48-0 fertilizer with a density of 928 kg/m³. Comparisons with the manufacturer's calibrations in the same table indicate a significant difference between the two calibrations. This difference is probably due to the varying size and density of the fertilizer used in the two calibrations. The density of the fertilizer used in the manufacturer's calibrations was not indicated in the operator's manual.

TABLE 3. Fertilizer Calibration -- High Range Settings

Cassette Setting Number	Fertilizer (kg/ha)	
	PAMI	Manufacturer
1	26.0	37.0
5	39.0	53.9
10	47.5	65.1
15	56.3	85.3
20	69.0	106.6
25	85.0	132.4
30	99.5	160.4
35	113.4	187.4
40	129.4	233.4
45	140.4	272.7
50	164.9	333.2
55	193.7	408.4
60	231.0	512.8

The variation in the fertilizing rate from one run to another was high. For example, when distributing 11-48-0 fertilizer at a rate of 60.9 kg/ha, the coefficient of variation among individual feed cups was 19.1%. This was slightly above the suggested 15% limit.

The fertilizer application rate was not significantly affected by the level of fertilizer in the box, ground speed or field vibrations. As shown in FIGURE 12, the application rate was not significantly affected by field slope. The application rate remained relatively unchanged when seeding up a 15° slope or down a 15° slope.

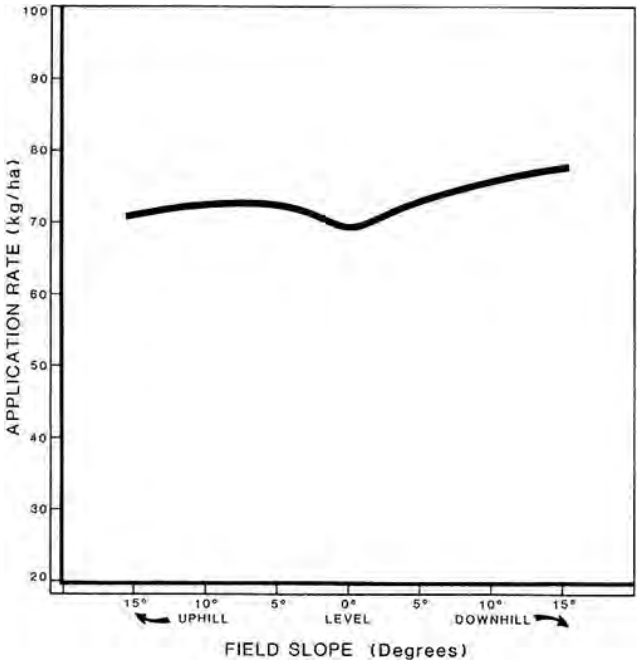


FIGURE 12. Variation in Fertilizer Application Rate with Change in Field Slope while Applying 11-48-0 Fertilizer at the Number 28 Setting.

Grass Seeding: A grass seeding attachment was not available as optional equipment for the Melroe 702. The large light seeds such as bromegrass were seeded through the grain box by mixing the seed with heavier material such as cracked grain or fertilizer. Failure to mix the seed with heavier material resulted in bridging of the seed over the seed cups. A grain agitator was not available to aid in the seeding of light grasses through the grain box.

Small grass seeds such as alfalfa and small grains such as rapeseed were also seeded through the grain box using the low range sprocket drive. The accuracy and the uniformity with which small seeds could be seeded through the grain box was very good. TABLE 4 shows the calibration for seeding alfalfa through the grain box using the low range sprocket drive and the calibration for seeding ryegrass using the high range sprocket drive. Calibration charts for alfalfa and ryegrass were not included in the operator's manual.

TABLE 4. Ryegrass Calibration -- High Range Settings and Alfalfa Calibration Low Range Settings

Cassette Setting Number	Grass (kg/ha) PAMI	Alfalfa (kg/ha) PAMI
1	4.7	7.3
5	6.9	9.6
9	7.9	10.8
13	9.5	12.5
17	10.7	13.8
21	12.9	16.3
25	15.7	19.1
29	17.8	21.3
33	21.2	24.8
37	26.2	30.9
39	33.0	38.9
Densities: Russian Wild Ryegrass -- 296 kg/m³ Rambler Alfalfa -- 838 kg/m³		

EASE OF OPERATION

Wet Fields: Excessive mud buildup on the single disk cutting coulters and the double disk openers caused plugging when operating in wet clay soils (FIGURE 13). Plugging occurred even more readily in heavy trash as the straw was pushed ahead of the openers.

FIGURE 13. Plugging of the Melroe When Operating in Wet Clay Soils.

Scrapers were not available to prevent mud buildup on the outside surfaces of the disks (FIGURE 14). The interior double disk scrapers were not spring loaded or self-adjusting and did not prevent mud buildup between the double disks and the casting. The scrapers did not maintain contact with the inside surface of the disks once the disks had warped from usage. It is recommended that the manufacturer modify the interior disk scrapers and provide exterior disk scrapers to improve operation in wet fields.

FIGURE 14. Mud Buildup on the Cutting Coulters and Double Disks.

Stony Fields: Wedging of small 170 to 200 mm diameter rocks between adjacent openers was a common occurrence in stony fields. A metal bar was frequently required to remove the rocks. It is recommended that rock deflectors be added to improve operation in stony fields.

The compression of the rubber buffers permitted the front and back rows of openers to lift a maximum of 200 mm to clear rocks and other obstructions. The opener force increased to 3500 N as the buffers compressed to the maximum. Average opener force during normal operation varied from 450 to 1150 N.

Trashy Fields: Heavy surface residue caused poor opener penetration, poor seed placement and plugging. Plugging occurred when trash (FIGURE 15) was pushed ahead by the original 250 mm diameter cutting coulters rather than being cut. This problem was alleviated by replacing the original coulters with the larger 305 mm diameter cutting coulters as supplied by the manufacturer.

FIGURE 15. Heavy Surface Residue Encountered during Field Testing.

Filling: The Melroe 702 was equipped with reversible lids on the grain and fertilizer boxes and a 235 mm wide central walkway. A removable metal screen in the bottom of the fertilizer box prevented lumps from entering the sponge roller feeds. The grain box had a capacity of 930 L grain and the fertilizer box had a capacity of 950 kg fertilizer.

Filling from the centre platform was difficult unless a small auger was used. A platform was not provided to permit filling from the rear of the drill. Access to the central walkway was inconvenient and at times dangerous. A metal step was fabricated to permit safer and easier access to the central platform (FIGURE 16).

Small glass windows in the drill box aided detection of a low grain level and the small glass feed windows permitted the operator to observe the seed as it was being metered.

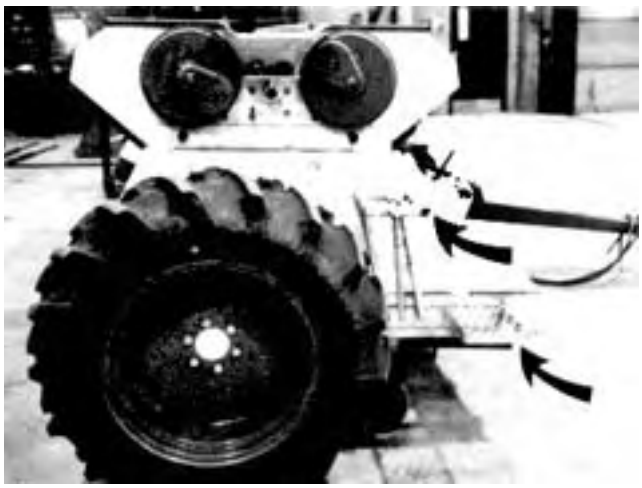


FIGURE 16. Metal Steps Added to Improve Accessibility to the Central Platform.

Moisture: The grain and fertilizer boxes were adequately sealed to prevent leakage into the box in light rains, but small amounts of water entered during heavy rains. If the drill is forced to stand out in the rain, the fertilizer shaft must be checked before operation to ensure that it is free to rotate and that the fertilizer has not caked.

Cleaning: Both the grain and fertilizer boxes could be cleaned either with a vacuum cleaner or by removing the sponge feed rollers. Removing the sponge rollers was difficult and time consuming. The sponge rollers should be removed at the end of the season and placed in clean dry storage away from rodents.

Hectaremeters: The Melroe 702 was equipped with two hectaremeters. The continuous reading, non-resettable meter indicated the total number of hectares seeded by the machine. The resettable hectaremeter recorded the nearest tenth hectare to a maximum of 1000 hectares and was used to measure the size of a particular field.

FIGURE 17. Sponge Rollers being Removed.

Transporting: The Melroe 702 was not equipped with a separate transporting system and could only be transported in field position. The overall width of the machine was 5.0 m, which permitted easy travel down most country roads. The machine trailed well and rode smoothly at speeds up to 25 km/h provided grain and fertilizer boxes were empty. Speeds in excess of this are not recommended. The limited ground clearance of the openers frequently resulted in dragging of the disks on rounded country roads (FIGURE 18). Also, the openers could not be mechanically locked in a raised position for transport. It is recommended that a mechanical lock be provided and the opener ground clearance be increased to prevent excessive disk wear during transport.

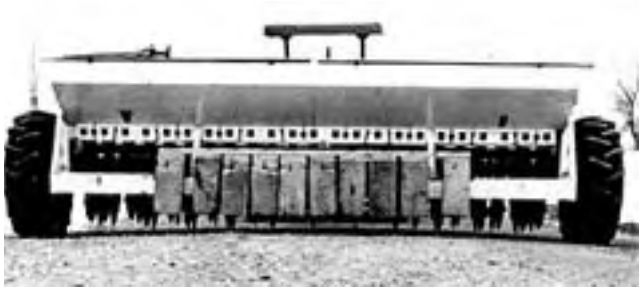


FIGURE 18. Limited Opener Clearance When Transporting.

Marker: A marker was not available for the Melroe grain drill. When operating in tall stubble or dusty conditions it was very difficult to see the edge of the previous pass.

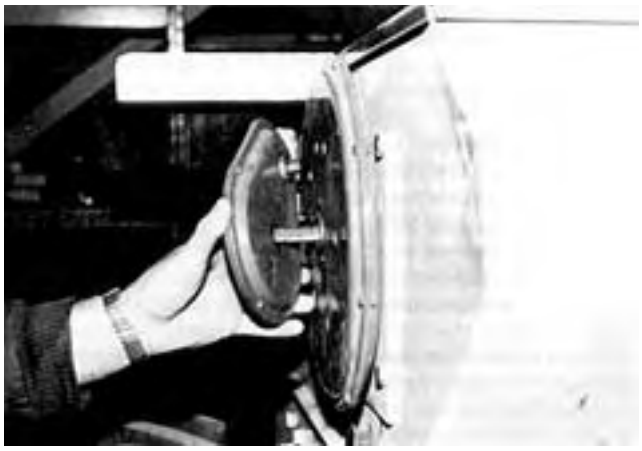
EASE OF ADJUSTMENT

Lubrication: Only one pressure grease fitting on each of the end wheels required greasing once a month. Other lubrication included the oiling of gears, drive chains and the cassette mounting hubs.

Seeding and Fertilizing Rates: The seeding and fertilizing rates were adjusted in an identical manner. The desired working range (high or low) was obtained by loosening the chain tightener, transferring the chain to the desired sprockets and then resetting the chain tightener. The desired seeding or fertilizing rates were then selected by the proper positioning of the multi-geared cassettes. The alignment of the smaller cassette with the hexagonal connector shaft was difficult (FIGURE 19) and required practice and patience.

It was very important that the hub upon which the large cassette was placed be kept oiled and free of dirt and rust to ensure easy

cassette removal.
FIGURE 19. Difficult Alignment of the Smaller Cassette and Connector Shaft.



Depth: There were three separate opener depth adjustments. The entire triple disk opener could be raised and lowered from the tractor with the two hydraulic cylinders. The maximum depth could be set by adjusting the depth adjustment bolt shown in FIGURE 20. The bolt activated a hydraulic shut-off valve to maintain the cylinder position. The shut-off valve leaked oil continuously during the tests. The two cylinders controlling the depth occasionally needed bleeding to remove air from the system and to keep the pressure beam level.

The front cutting coulter could be set deeper or shallower than its double disk opener by changing the hitch angle. The hitch angle was adjusted by turning the handle of the screw jack connected to the hitch and the main frame of the drill (FIGURE 20). It was extremely difficult to adjust the screw jack unless most or all of the weight was removed from the hitch. It is recommended that the manufacturer modify the hitch to provide easier hitch angle adjustment.

The front row of openers could be adjusted to operate deeper or shallower than the back row of openers by adjusting the length of the parallel linkages that connect the pressure beam to the main frame. The resulting twist of the beam changed the position of the front row of openers relative to the back row of openers. The adjustment was simple and easy (FIGURE 20).

POWER REQUIREMENTS

Maximum draft, with 600 kg of ballast and filled grain and fertilizer boxes on level fields with average soil moisture was about 11,000 N while average draft was about 7750 N. When considering variations in soil and field conditions about 42 kW of tractor power should be available for each 4.1 m section of drill. An 84 kW tractor should have sufficient power reserve to operate a two drill hookup at 8.0 km/h in most soils.

OPERATOR SAFETY

The Melroe 702 grain drill was safe to operate if normal safety precautions were observed.

The drill was not equipped with a slow moving vehicle sign. Provincial highway regulations require displaying a slow moving vehicle sign when transporting machinery on public highways. It is recommended that the manufacturer supply a slow moving vehicle sign as standard equipment.

A step was not available to provide easy access to the central walkway. Also, the openers could not be mechanically locked in a raised position when transporting or working beneath the machine. All moving parts were adequately shielded.

OPERATOR'S MANUAL

The operator's manual was simple, concise and well illustrated, presenting useful information on the operation and maintenance of the machine. The operator's manual did not include metric calibration charts for the grain and fertilizer box or the densities of the grain and fertilizer used in the manufacturer's calibrations.

DURABILITY RESULTS

The Melroe 702 was operated for 152 hours while seeding about 292 ha. The intent of the test was an evaluation of functional performance and an extended durability evaluation was not conducted. TABLE 5 outlines the mechanical problems that did occur during the functional testing.

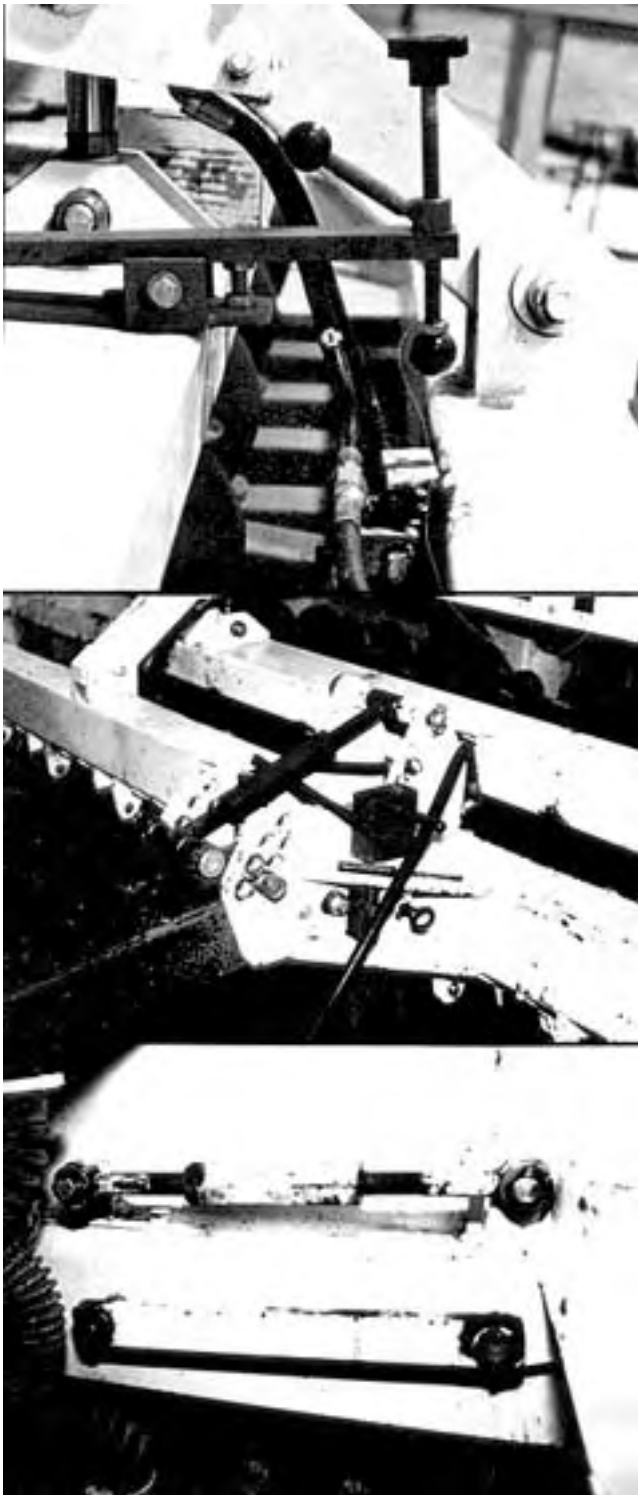


FIGURE 20. Depth Adjustments: (Top: Depth Adjustment Bolt; Middle: Hitch Angle Adjustment; Bottom: Parallel Linkage Adjustment).

DISCUSSIONS OF MECHANICAL PROBLEMS

Hitch: The ball swivel on the hitch yoke had worn excessively and the ball broke loose from the socket at 92 hours. The ball was welded to the socket to remedy the problem.

Buffer Cables: The buffer cables that raise the openers broke due to the heavy weight of the openers. This occurred most frequently when transporting from one field to another. The openers bounced up and down eventually snapping the cables. The repair of these cables was difficult and time consuming as ends had to be machined and silver-soldered onto the new cable. It is recommended

that the manufacturer modify the opener lift system to reduce buffer cable failures.

TABLE 5. Mechanical History

Item	Operating Hours	Field Area ha
-A hydraulic hose to the slave cylinder burst and was replaced at	88	170
-The ball swivel broke loose from the hitch yoke and was welded solid at	92	180
-A buffer cable broke and was replaced at	95, 98, 102, 126, 132, 148	184, 191, 200, 254, 266,301
-A cassette retainer clip came off and was replaced at	107	211
-The ball attached to the depth adjusting screw broke at	107	211
-A rubber buffer was torn and replaced at	123	243
-The fertilizer lid support bracket broke and was rewelded at	141	287

APPENDIX I
SPECIFICATIONS

MAKE:	Melro Grain and Fertilizer Drill
MODEL:	702-7158
SERIAL NO:	MBU-10022
OVERALL DIMENSIONS:	
-- height	1595 mm
-- length	3340 mm
-- width	4950 mm
-- effective seeding width	4090 mm
-- transport ground clearance	80 mm
SEED METERING SYSTEM:	
-- type	soft sponge roller pressing against glass window
-- drive	gear and chain from end wheel through gear cassette
-- adjustment	changing speed of rotating sponge roller by changing sprocket sizes and adjusting multi-speed gear cassette
-- transfer to openers	convoluted rubber hose
FERTILIZER METERING SYSTEM:	
-- type	soft sponge roller pressing against glass window
-- drive	gear and chain from end wheel through a gear cassette
-- adjustment	changing speed of rotating sponge roller by changing sprocket sizes and adjusting multi-speed gear cassette
-- transfer to openers	convoluted rubber hose
OPENERS:	
-- type	triple disk (single disk cutting coulter followed by double disk opener)
-- size	250 mm cutting coulter; 305 mm cutting coulter is optional 355 mm double disks
-- distance between coulter and double disk	340 mm
-- number of openers	23
-- opener spacing	178 mm
-- number of rows	2
-- distance between rows	220 mm
END WHEELS:	
-- number	2
-- tire size	12.4 x 24, 6-ply
GRAIN AND FERTILIZER BOX CAPACITIES:	
-- grain box capacity	930 L
-- fertilizer box capacity	950 kg

WEIGHT: (without ballast)	boxes full	boxes empty
-- weight on end wheels	3396 kg	2054 kg
-- weight on hitch	502 kg	368 kg
total weight	3898 kg	2422 kg

NUMBER OF CHAIN DRIVES:	8
NUMBER OF LUBRICATION POINTS:	2
NUMBER OF HYDRAULIC LIFTS:	1
NUMBER OF SEALED BEARINGS:	88

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/hr)	= 0.62 miles/hour (mph)
1 metre (m) = 1000 millimetres (mm)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.20 pounds (lb)
1 newton (N)	= 0.22 pounds force (lb)
1 litre (L)	= 0.028 bushels (bu)
1 kilogram/hectare (kg/ha)	= 0.9 pounds/acre (lb/ac)
1 kilogram/cubic metre (kg/m^3)	= 0.08 pounds/bushel (lb/bu)

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