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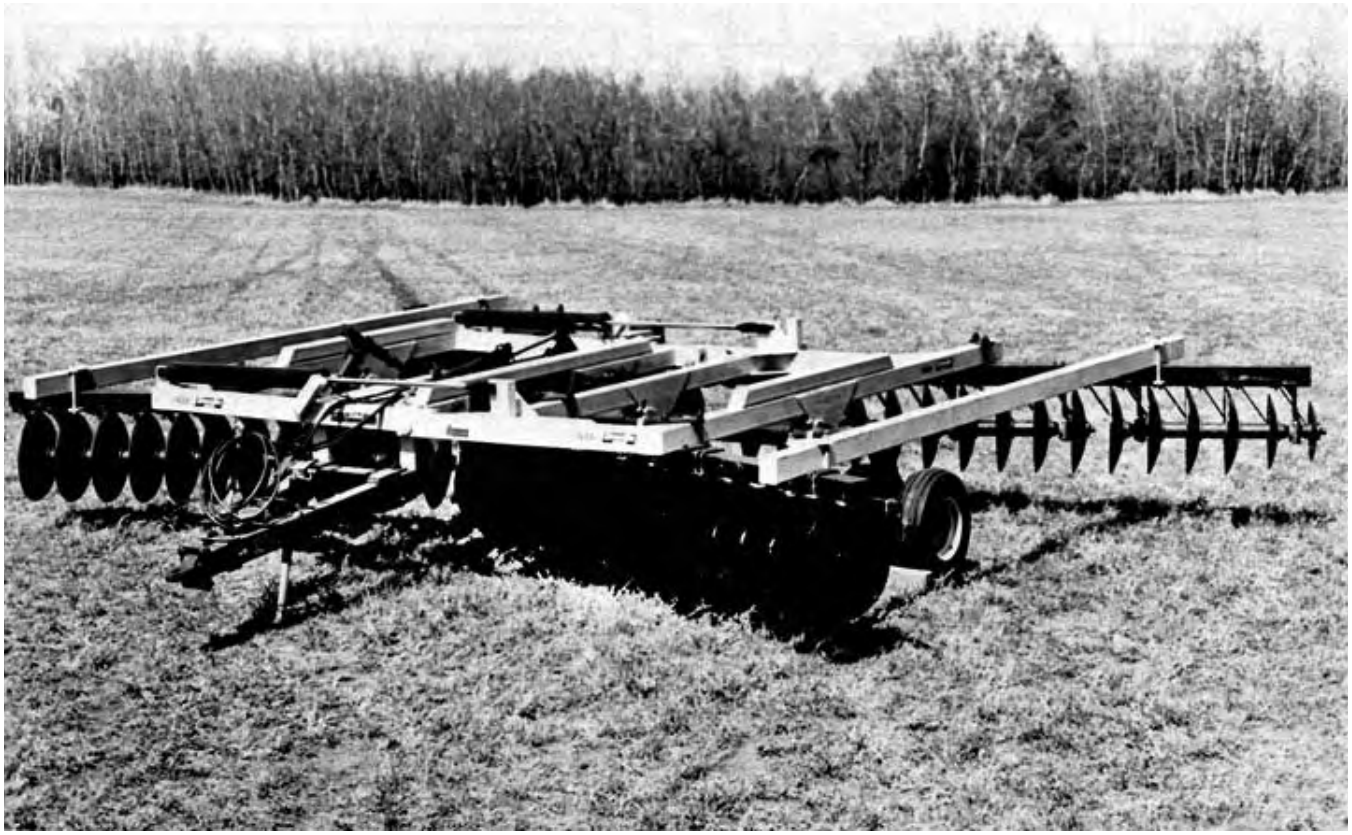

Ezee-On 1600 Double Offset Disk

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

EZEE-ON 1600 DOUBLE OFFSET DISK

MANUFACTURER AND DISTRIBUTOR:

Ezee-On Manufacturing Ltd.
Vegreville, Alberta
T0B 4L0

RETAIL PRICE:

$30,356.00 (March, 1983, f.o.b. Humboldt, 26.4 ft (8.0 m) unit at 22° disk angle with 26 in (660 mm) plain disks on 10.5 in (265 mm) spacing, optional extra gang hangers, and heavy duty bearings.)

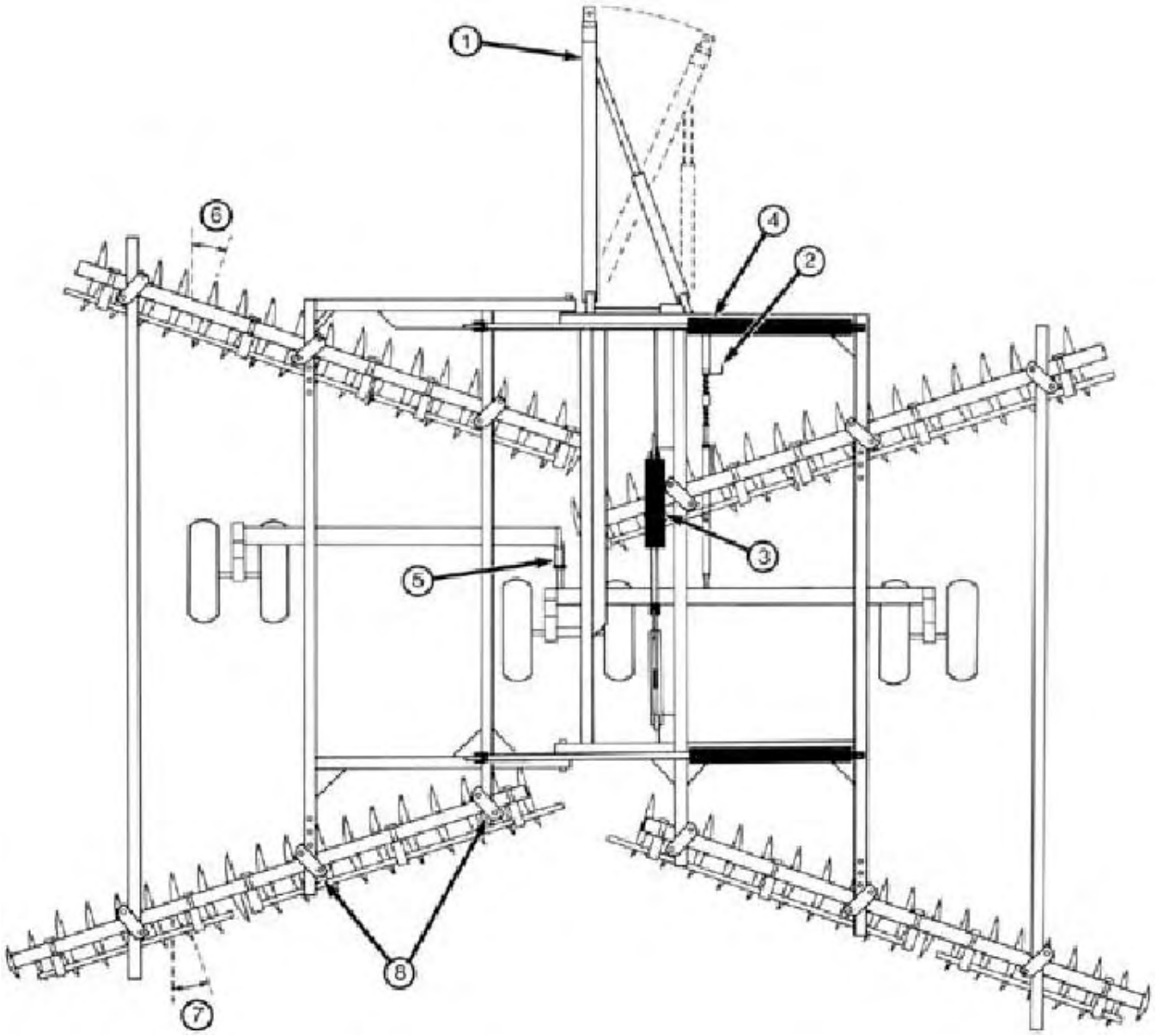

FIGURE 1. Ezee-On 1600 Double Offset Disk (1) Swinging Hitch, (2) Levelling Crank, (3) Depth Control Cylinder, (4) Wing Lift Cylinders, (5) Rockshaft Link, (6) Front Disk Angle, (7) Rear Disk Angle, (8) Gang Position and Disk Angle Adjustment.

SUMMARY AND CONCLUSIONS

Functional Performance: The overall functional performance of the Ezee-On 1600 double offset disk was good. Performance was reduced by plugging between the scrapers and bearing hangers in moist trash.

Quality of Work: Penetration was very good in all soils when the maximum disk angle was used. Depth of penetration was uniform in most conditions but was variable in hard dry soils.

Trash clearance was good in most conditions, however, some plugging occurred in moist fields and in fields with sod lumps. The Ezee-On 1600 buried 60 to 80% of the trash during one operation.

Furrow bottom ridging occurred only when the disk harrow skewed to one side when operating in hilly fields. Stability was improved by increasing the depth of the rear gangs.

Ease of Operation: Ease of placing the Ezee-On 1600 in transport was poor requiring more than five minutes. Swinging the hitch into transport was difficult unless a hydraulic cylinder was used. The Ezee-On 1600 was stable and towed well at normal tractor transport speeds. However, the 14.8 ft (4.5 m) height and the combined width of the tractor and the 17.2 ft (5.3 m) machine required caution in transport.

Ease of hitching to the Ezee-On 1600 was very good.

The disk harrow was easily maneuvered in the field.

Frame of Adjustment: Levelling the wing section was inconvenient as two men were required. Front-to-rear levelling was adequate and convenient. Tillage depth was easily set and maintained. The disk gang bolts required special tools for tightening.

Power Requirements: In most soils a tractor with 237 hp (176 kW) maximum power take-off rating will have sufficient

power to pull the 26.4 ft (8.0 m) wide Ezee-On 1600 at 5 mph (8 km/h) and 4 in (100 mm) depth with disk angles set at 22°.

Safety: The Ezee-On 1600 was equipped with a mechanical depth control lock for safe towing. A wing transport lock was not required as the wing rested firmly on the main section. A slow moving vehicle sign and hitch safety chain were not provided. Extreme care was needed when placing the disk harrow in transport as the wing reached a height of 17.5 ft (5.4 m), which is high enough to contact rural power lines. Rear visibility while transporting was unsatisfactory. The tires were adequately sized for safe transporting at normal tractor speeds.

Operator Manual: The operator manual was complete and clearly illustrated.

Mechanical History: A few mechanical problems occurred during the 125 hours of field operation. The front main section gang beam was bent when the disk harrow hit a large submerged rock.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to prevent trash build-up between the gang bearing hangers and the scrapers.
2. Modifying the scrapers to provide adequate cleaning of the disks and spools when operating in moist fields.
3. Increasing lateral adjustment range of the disk gangs.
4. Rerouting the hydraulic hoses to eliminate interference with the hitch jack handle.
5. Providing a tool to hold the disk gang while tightening the gang bolts.
6. Supplying a slow moving vehicle sign as standard equipment.
7. Using hydraulic hose fittings with adequate pressure ratings.
8. Providing instructions on wing lift cylinder hook-up to prevent bending of the cylinder rod.

Senior Engineer: G.E. Frehlich
Project Engineer: H.D. Kydd

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. We feel the present hangers give excellent strength and a slim line to minimize plugging, however, in certain conditions trash clearance is a problem. We are constantly considering improved hanger designs.
2. We have wide pan type scrapers available as an option for use in conditions when the flat 4 in (100 mm) scrapers are not adequate.
3. Lateral adjustment of gangs is restricted slightly when extra hangers are installed. In future production we will rearrange extra hangers to increase lateral adjustment.
4. In future production we will relocate the hose support or the hitch jack to allow more clearance between the hitch jack handle and the hoses.
5. We may make a tool available as an option. All export disk harrows are equipped with a tool; however, we presently do not supply it domestically to keep costs down.
6. Consideration is being given to supplying a slow moving vehicle sign as standard equipment.
7. Hydraulic hose fittings will be upgraded to adequate pressure ratings.
8. Additional instructions will be added to the manual, giving proper procedures to hook up the shaft end of wing lift cylinders.

GENERAL DESCRIPTION

The Ezee-On 1600 is an adjustable angle, two section, double offset, tandem disk harrow suitable for heavy primary tillage. It is available in widths ranging from 22 to 30.5 ft (6.7 to 9.3 m). The test machine was 26.4 ft (8.0 m) wide at a 22° disk angle. It was equipped with 26 in (660 mm) diameter disks spaced at 10.5 in (265 mm), and 18 in (450 mm) diameter furrow filler disks on the rear gangs.

The main section is supported by two sets of dual wheels and the wing section by one set of dual wheels. One hydraulic cylinder controls tillage depth, and two hydraulic cylinders connected in parallel, fold the wing into transport position. A tractor with three remote hydraulic circuits is needed to operate the Ezee-On 1600 if a hydraulic cylinder is used to swing the hitch into the transport position.

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

SCOPE OF TEST

The Ezee-On 1600 was operated in the field conditions shown in TABLE 1 for 125 hours while tilling about 1660 ac (673 ha). It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety, and suitability of the operator manual.

TABLE 1. Operating Conditions

Field Condition	Hours	Field Area	
		ac	ha
Soil Type			
- loam	45	620	251
- heavy clay	80	1040	422
Total	125	1660	673
Stony Phase			
- occasional stones	80	1036	420
- moderately stony	45	624	253
Total	125	1660	673
Surface Residue			
- stubble	36	531	215
- clover or alfalfa sod	60	794	322
- red clover (plow-down)	19	232	94
- native grass and brush	10	103	42
Total	125	1660	673

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was very good in all soil conditions. In hard dry soils and native grasses the maximum disk angle of 25° was required for adequate penetration.

Penetration across the disk harrow width was uniform in most conditions. In hard dry soils penetration was more uniform at greater disk angles. Front-to-rear depth uniformity was very good in most fields once the frame had been properly levelled. The three sets of dual wheels provided adequate flotation except in soft or wet areas.

The Ezee-On 1600 followed gently rolling field contours very well but large variations in depth occurred when passing over abrupt contour changes in rolling fields.

Plugging: Trash clearance was good in most conditions. Moist trash frequently collected between the scrapers and the gang bearing hangers (FIGURE 2) and caused plugging. It is recommended that the manufacturer consider modifications to prevent trash build-up between the gang bearing hangers and the scrapers.

FIGURE 2. Trash Build-up Between Scrapers and Gang Bearing Hangers.

In moist fields, soil collected on the spools and disks reducing trash clearance. It is recommended that the manufacturer consider modifying the scrapers to provide adequate cleaning of the disks and spools in moist fields.

Plugging also occurred at the center of the front gangs in fields

with sod lumps (FIGURE 3). Plugging occurred more frequently at greater disk angles. The manufacturer recommends notched disks or gang drive couplers to reduce plugging in sod.

FIGURE 3. Plugging at the Center of the Front Gangs.

Trash Burial: In most fields, 60 to 80% of the trash was buried during one operation (FIGURE 4). If dry, these fields would be susceptible to wind erosion.

FIGURE 4. Typical Trash Burial.

Field Surface: The Ezee-On 1600 left a uniform level surface in most fields. The standard furrow filling disks were effective. The hitch and rear gang position adjustments were adequate to prevent ridging or furrowing at the center.

In established sod, the sod strips left a rough field surface (FIGURE 5). A second operation was required to cut up these strips to obtain a smooth field surface.

FIGURE 5. Rough Field Surface in Sod.

Furrow Bottom Ridging: The Ezee-On 1600, with the 10.5 in (265 mm) spacing, had to be operated at least 4 in (100 mm) deep to completely disturb the soil surface. At shallower depths or smaller disk angles, unworked ridges remained. Unworked ridges also remained when the disk harrow skewed to one side, causing some of the rear disks to follow in the path of the front disks.

Stripping and the resulting weed misses occurred in the center (FIGURE 6) because of the wide space between the rear gangs. This stripping could be reduced by moving the front gangs farther apart and the rear gangs closer together, but the rear disk angle had to be reduced, to prevent ridging in the center. The range of these adjustments was limited by interference between frame members and gang hanger U-bolts. It is recommended that the manufacturer increase the lateral adjustment range of the disk gangs.

FIGURE 6. Weed Misses Caused by Stripping in the Center.

Skewing and Stability: The stability of the Ezee-On 1600 was good except in sharply undulating fields. Skewing occurred when a front corner of the disk harrow penetrated too deeply as it encountered a rise in the field surface. Stability could be improved by using the levelling crank to increase the depth of the rear gangs. However, if the rear gang depth was too great, a ridge was formed at the center.

EASE OF OPERATION AND ADJUSTMENT

Transporting: Ease of placing the Ezee-On 1600 into transport position (FIGURE 7) was poor. It usually took more than five minutes. Swinging the hitch into transport position was difficult unless a hydraulic cylinder was used. The transport lock for the depth control wheels had to be lifted into position before raising the disk harrow. A transport lock was not required for the wing as it rested firmly on the main section.

FIGURE 7. Transport Position.

Extreme caution was required when placing the Ezee-On 1600 into transport position as the wing reached 17.5 ft (5.4 m), which is high enough to contact energized power lines.

The Ezee-On 1600 towed well at normal tractor transport speeds with some front-to-rear rocking on rough roads. Disk-to-ground clearance of 7 in (180 mm) and a wheel tread of 6.6 ft (2.0 m) provided good ground clearance.

Rear visibility (FIGURE 8) during transport was unsatisfactory. The operator could not see traffic following the disk harrow.

Transport height was 14.8 ft (4.5 m) while transport width was 17.2 ft (5.3 m). The combined width of the disk harrow and a tractor with dual wheels was considerably wider, requiring extra care when transporting on public roads, through gates, and over bridges.

FIGURE 8. Rear Visibility During Transport.

Hitching: The hitch jack and rigid hitch link made one man hitching convenient. The hydraulic hoses interfered with the turning of the hitch jack handle. It is recommended that the manufacturer reroute the hydraulic hoses to eliminate this interference.

Maneuverability: On sharp turns, the tractor tire occasionally contacted the disk harrow frame, but the smooth frame prevented any tire damage.

Frame Levelling: Levelling the wing section was inconvenient. Two people were usually required to operate the tractor hydraulics and reposition the bolt in the adjustable rockshaft link.
Front-to-rear levelling was adequate and was easily done using the levelling crank.

Tillage Depth: Tillage depth was easily adjusted by moving the hydraulic stop valve on the depth control cylinder.

Gang Bolt Tightening: Periodic gang bolt tightening was necessary. Tightening gang bolts was very difficult requiring a large pipe wrench to hold the gang bolt while turning the nut with the socket provided. An extremely high torque of 3200 ft/lb (4320 Nm) was required. It is recommended that the manufacturer provide a tool to hold the disk gangs while tightening the gang bolts.

Disk Gang Adjustments: The disk angle and gang position were difficult to adjust and took three men about 30 minutes.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 9 shows average draft requirements for tandem disk harrows in primary tillage at a speed of 5 mph (8 km/h) at a 22° disk angle.

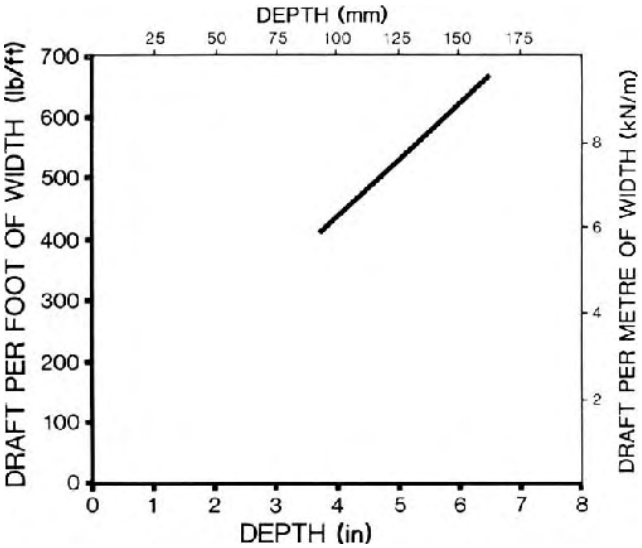

FIGURE 9. Average Draft Requirements for Disk Harrows at 5 mph (8 km/h) and 22° Disk Angle.

This figure gives average requirements based on tests of two makes of tandem disk harrows in one season and several different field conditions. Attempting to compare draft requirements of different makes of tillage machines is usually unrealistic. Draft requirements for the same machine 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 may affect draft more than variation in machine make, usually making it impossible to measure any significant draft differences between different makes.

In primary tillage, average draft at 5 mph (8 km/h) and a disk angle of 22°, varied from 430 lb/ft (6.3 kN/m) at 4 in (100 mm) depth to 627 lb/ft (9.1 kN/m) at 6 in (150 mm) depth. This corresponds to a total draft ranging from 11350 to 16550 lb (50.4 to 72.8 kN) for the 26.4 ft (8.0 m) test machine.

Increasing the disk angle by 4° increased draft by about 80 lb/ft (1.2 kN/m). For the 26.4 ft (8.0 m) test machine this represents a draft increase of 2100 lb (9.6 kN).

Tractor Size: TABLE 2 shows the tractor sizes needed to pull the 26.4 ft (8.0 m) Ezee-On 1600 in primary tillage. Tractor sizes have been adjusted to include tractive efficiency in loose soils and represent a tractor operating at 80% of maximum power on a level field. The sizes determined in the tables are the maximum power take-off rating as determined by the Nebraska tractor tests or as presented by the tractor manufacturer.

Tractor size may be determined from the above table by selecting the desired depth and speed. For example, in primary tillage, at 5 in (125 mm) depth and 5 mph (8 km/h) with disk angles set at 22°, a 290 hp (216 kW) would pull the 26.4 ft (8.0 m) Ezee-On 1600.

OPERATOR SAFETY

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

TABLE 2. Tractor Size: Maximum Power Take-Off Rating hp (kW) Required to pull the 26.4 ft (8.0 m) Ezee-On 1600 in Primary Tillage with Disk Angles set at 22°.

Depth		Speed					
in	mm	4 mph	6.4 km/h	5 mph	8 km/h	6 mph	9.7 km/h
4	100	182	135	237	176	296	221
5	125	225	166	290	216	360	269
6	150	270	201	344	257	425	317

Transport height of the 26.4 ft (8.0 m) wide test machine was 14.8 ft (4.5 m). Extreme care was needed when placing the disk harrow in transport position as the wing reached a height of 17.5 ft (5.4 m), which is high enough to contact rural 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 various types of public roads. If height limits are exceeded the operator must contact power and telephone utilities before moving.

A wing lock for transport was not required as the wing rested firmly on the main section. A depth control lock was provided.

A mounting bracket was provided for a slow moving vehicle sign but a sign was not supplied. It is recommended that a slow moving vehicle sign be supplied as standard equipment.

The Ezee-On 1600 was 17.2 ft (5.3 m) wide in transport. The combined width of the tractor and disk harrow was considerably wider, necessitating extra caution when transporting. Rear visibility while transporting was unsatisfactory.

The main section tires were adequately sized for transporting the disk harrow at normal tractor transport speeds.

OPERATOR MANUAL

The operator manual provided a complete parts list and information on assembly, adjustments, troubleshooting, maintenance, and safety. It was clearly written and illustrated.

DURABILITY RESULTS

TABLE 3 outlines the mechanical history of the Ezee-On 1600 during 125 hours of field operation while tilling about 1660 ac (673 ha). The intent of the test was evaluation of functional performance. The following mechanical problems occurred during the functional testing. An extended durability test was not conducted.

TABLE 3. Mechanical History

Item	Operating Hours	Equivalent Field Area	
		ac	(ha)
-One hydraulic fitting failed at	beginning of test		
-One wheel came loose breaking the hub during initial transport. The hub was replaced	beginning of test		
-A weld on the hitch jack mount failed and was rewelded	beginning of test		
-A wing lift cylinder rod bent and was replaced at	36	460	(186)
-A wheel bearing cup was lost and replaced at	60	850	(344)
-A front gang beam bent at	108	1480	(594)

DISCUSSION OF MECHANICAL HISTORY

Hydraulic Fittings: The common pipe fittings used on the Ezee-On 1600 are not adequately rated for tractor hydraulic system pressures. Serious damage or injury could occur if the fittings failed during operation. It is recommended that the manufacturer use hydraulic fittings and lines with adequate pressure ratings.

Wing Lift Cylinder: The wing lift cylinders were disconnected and retracted to permit sufficient flexing of the disk harrow in sharply undulating fields. A cylinder rod hooked on a frame bracket and bent while it was being extended for reconnecting. It is recommended that the manufacturer provide instructions on wing lift cylinder hook-up to prevent bending of the cylinder rod.

Gang Beam: The front gang beam on the main section, bent when several disks hit a large rock hidden below the soil surface. The manufacturer recommends using the optional stone flex bearing hangers for rocky conditions.

Disk Wear and Damage: Disk wear was minor during the 125 hours of operation. Many small nicks occurred when working in rocky conditions.

APPENDIX I
SPECIFICATIONS

MAKE: Ezee-On Double Offset Disk
MODEL: 1600
SERIAL NUMBER: 4730

OVERALL DIMENSIONS: (at 22° disk angle)

	FIELD POSITION	TRANSPORT POSITION
-- width	29 ft (8.8 m)	17.2 ft (5.3 m)
-- length	25.3 ft (7.7 m)	25.3 ft (7.7 m)
-- height	5.5 ft (1.7 m)	14.8 ft (4.5 m)
-- ground clearance	7 in (180 mm)	7 in (180 mm)

CUTTING WIDTH: 26 ft (7.9 m) at 25°
26.4 ft (8.0 m) at 22°
26.9 ft (8.2 m) at 18°
27.1 ft (8.3 m) at 14°

DISKS:
-- type: plain
-- number: 60 plus 2 furrow fillers
-- disk diameter: 26 in (660 mm)
-- disk thickness: 5/16 in (8 mm)
-- disk concavity: 3.5 in (92 mm)
-- disk spacing: 10.5 in (265 mm)
-- furrow filler diameter: 18 in (450 mm)
-- disk angle (adjustable): 14°, 18°, 22°, 25°

TIRES:
-- main section: 4, 11L x 15, 12-ply rating
-- wing: 2, 11L x 15, 12-ply rating

WEIGHT:	FIELD POSITION	TRANSPORT POSITION
-- left main section wheels	4806 lb (2180 kg)	5798 lb (2630 kg)
-- right main section wheels	4233 lb (1920 kg)	6724 lb (3050 kg)
-- wing wheels	4045 lb (1835 kg)	
-- hitch	496 lb (225 kg)	1058 lb (480 kg)
TOTAL	13580 lb (6160 kg)	13580 lb (6160 kg)

-- weight/unit width (at 20° disk angle) 514 lb/ft (770 kg/m)

LUBRICATION POINTS:
-- 4h: 24 gang bearings
-- daily: 6 wheels 8 rockshaft bearings
-- when necessary: 7 hitch, wing pivot, levelling crank

OPTIONAL EQUIPMENT
-- various disks, disk sizes and spacings
-- extra gang hangers
-- heavy duty bearings
-- stone flex hangers
-- gang drive couplers

APPENDIX II
MACHINE RATINGS

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

excellent	fair
very good	poor
good	unsatisfactory

APPENDIX III
CONVERSION TABLE

1 acre (ac)	= 0.4 hectare (ha)
1 mile/hour (mph)	= 1.7 kilometre/hour (km/h)
1 inch (in)	= 25 millimetre (mm)
1 foot (ft)	= 0.3 metre (m)
1 horsepower (hp)	= 0.7 kilowatt (kW)
1 pound mass (lb)	= 0.5 kilogram (kg)
1 pound force (lb)	= 0.004 kilonewton (kN)
1 pound force/foot (lb/ft)	= 0.014 kilonewton/metre (kN/m)

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