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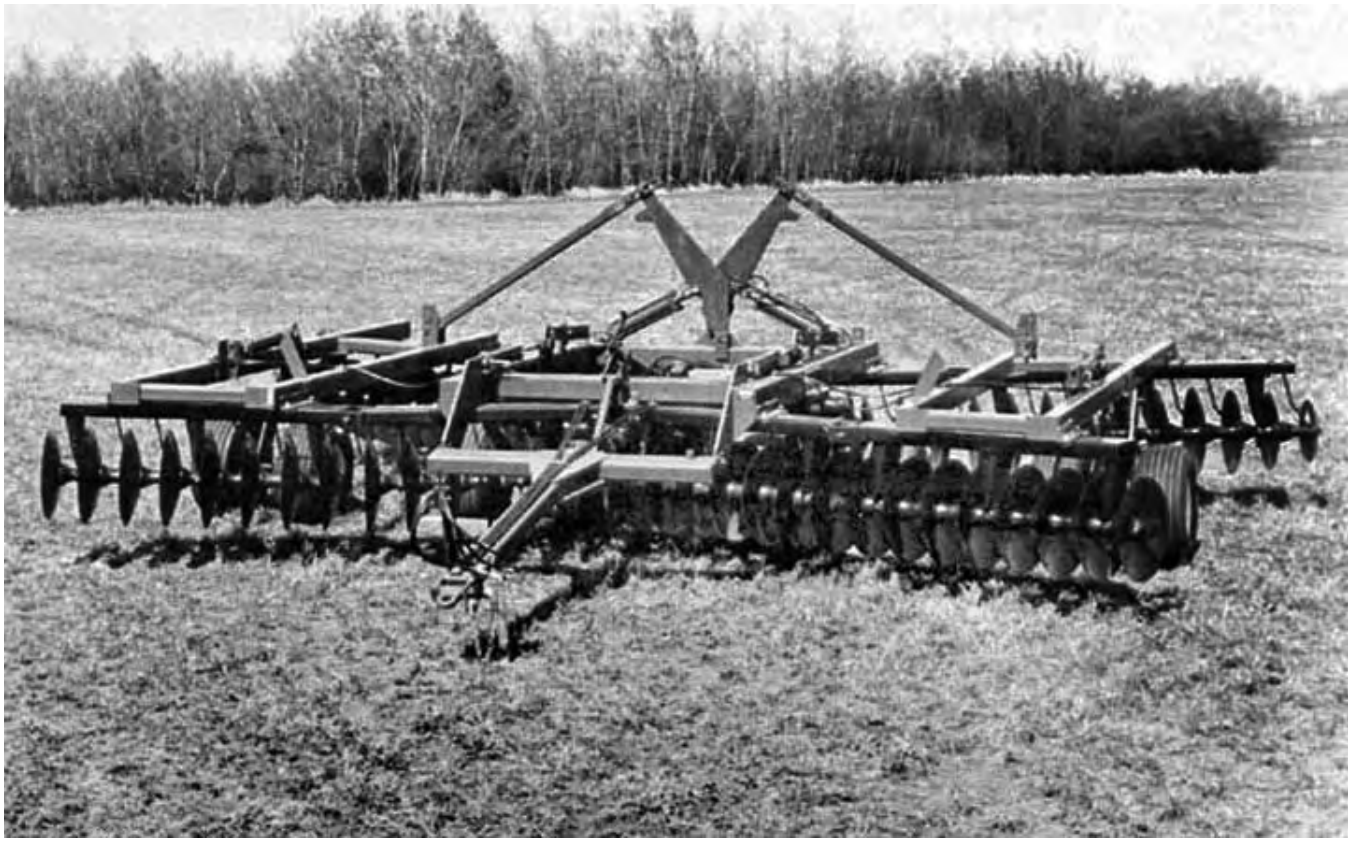

International Harvester 596 Tandem Disk Harrow

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

INTERNATIONAL HARVESTER 596 TANDEM DISK HARROW

MANUFACTURER:

International Harvester Company of Canada Limited
208 Hillyard Street
Hamilton, Ontario
Canada

RETAIL PRICE:

$33,455.00 (March, 1983, f.o.b. Humboldt, 25.1 ft (7.7 m) unit with 26 in (660 mm) plain disks on 10.5 in (265 mm) spacing, optional center shank, plain furrow filler disks, and furrow filler scrapers.)

DISTRIBUTOR:

International Harvester Company of Canada Limited
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Saskatoon, Saskatchewan
S7H 0W5

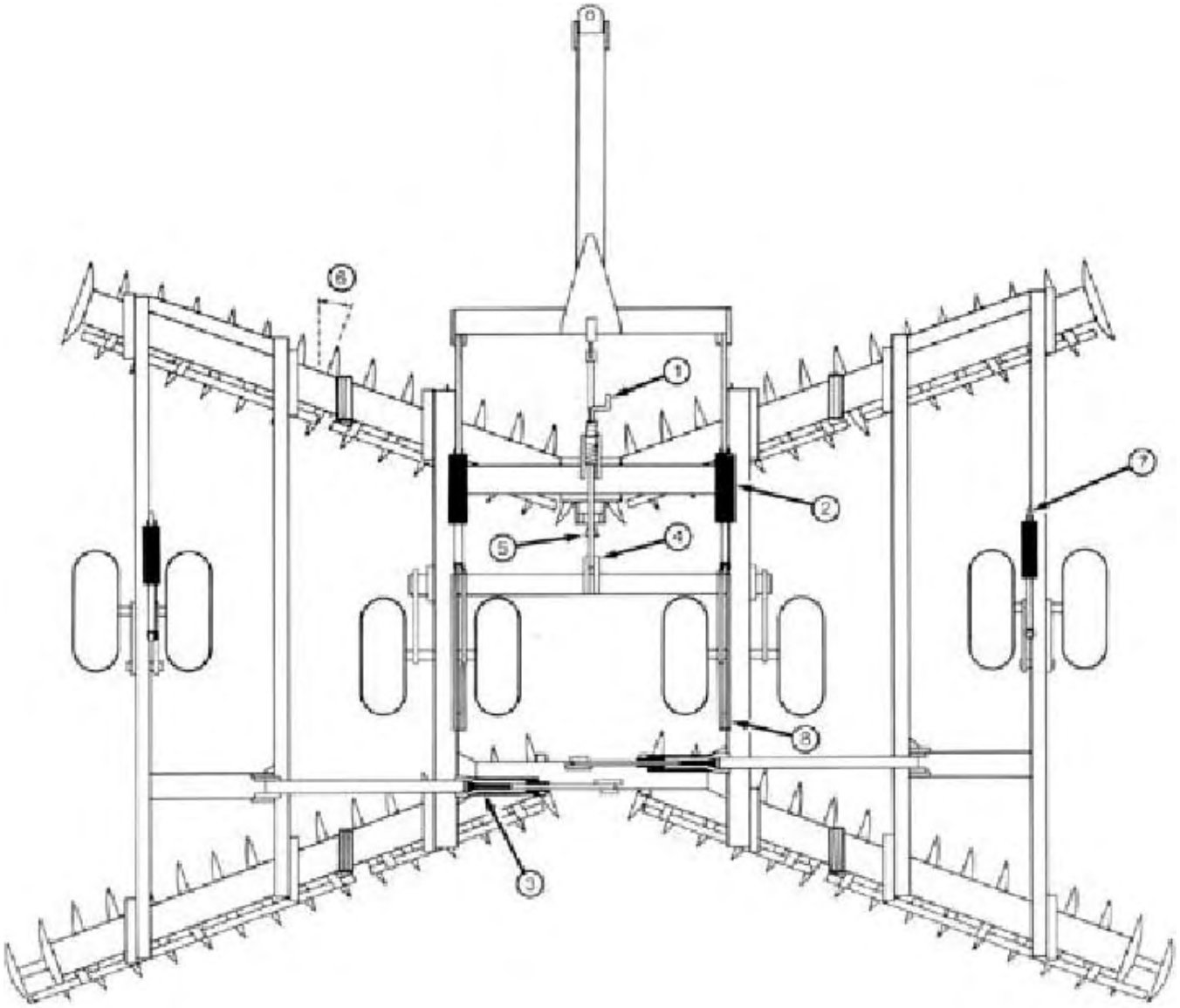

FIGURE 1. International Harvester 596 Tandem Disk Harrow (1) Levelling Crank, (2) Depth Control Cylinders, (3) Wing Lift Cylinders, (4) Frame Level Adjustment, (5) Center Shank, (6) Disk Angle, (7) Wing Depth Adjustment, (8) Transport Bars.

SUMMARY AND CONCLUSIONS

Functional Performance: The overall functional performance of the International Harvester 596 tandem disk harrow was very good. Performance was reduced by inadequate penetration in hard dry native grasses.

Quality of Work: Penetration was good in most soils but was inadequate in dry native grasses. Depth of penetration was uniform in most conditions.

Trash clearance was very good and 60 to 80% of the trash was buried 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 International 596 into transport was good requiring one man less than two minutes. The International 596 was stable and towed well at normal tractor transport speeds. The test machine was 15.3 ft (4.7 m) wide and 11.4 ft (3.5 m) high in transport, which is well below most prairie power lines.

Ease of hitching to the International 596 was very good.

The tires on tractors with dual wheels caught on the hitch members when turning sharp corners.

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

Power Requirements: In most soils, a tractor with 203 hp (151 kW) maximum power take-off rating will have sufficient power reserve to pull the 25.1 ft (7.7 m) wide International 596 tandem disk harrow at 5 mph (8 km/h) and 4 in (100 mm) depth.

Safety: The International 596 was equipped with mechanical depth control and wing transport locks for safe towing. A slow moving vehicle sign was not provided. A hitch safety chain was provided. Rear visibility while transporting was very good. The tires were adequately sized for safe transporting at normal tractor speeds.

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

Mechanical History: A few mechanical problems occurred during the 144 hours of field operation. Poor weld quality resulted in one wing wheel support weld failure. One hydraulic hose failed.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing scrapers on the outside front disks for operating in moist fields.
2. Lengthening the hydraulic hoses to permit easy connecting to most tractor hydraulic outlets.
3. Modifications to prevent tractor tire damage when making sharp turns with tractors equipped with dual wheels.
4. Providing suitable tools for tightening the gang bolts.
5. Connecting the transport bars together to prevent the bars from swinging down and injuring the operator when setting the depth or inserting the transport locks.
6. Supplying a slow moving vehicle sign as standard equipment.
7. Providing a positive lock on the gang bolt nuts to prevent loosening.
8. Improving weld quality.
9. Rerouting the hydraulic hoses to prevent them from being damaged by the wheels, wing lift arms, and transport bars.
10. Modifications to improve gang bearing lubrication and prevent premature bearing failure.

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

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Scrapers for outside front disks are not supplied as they are not required in the majority of conditions and would only be beneficial in very sticky, moist soil.
2. The hydraulic hoses supplied extend approximately 30 in (760 mm) past the hitch pin, which we feel is adequate for most tractors.
3. We feel the present hitch design is adequate as it permits 90° turns if the outside of the tractor tires are less than 151 in (3.85 m) apart and the drawbar pin is at the recommended ASAE location.
4. We no longer supply arbour bolt tools.
5. Two pins are provided with each set of transport bars. One is used to keep the bars together and the other is used for depth setting. The operator manual will be changed to clarify this point.
6. Slow moving vehicle signs are not supplied with the disk harrow, however, they are readily available at most dealers. We do supply sign mounts as standard equipment.
7. A positive lock is considered undesirable as it discourages retightening of the arbour bolts which is required several times especially on a new disk harrow.
8. No other similar failures have been experienced, however, manufacturing has been advised of the reported weld failure.
9. We feel the routing is adequate as it was done in cooperation with the hose manufacturer.
10. Gang bearings have been altered to increase their impact resistance life. Further investigation into bearing lubrication will be conducted and modifications considered where warranted.

GENERAL DESCRIPTION

The International Harvester 596 is a fixed angle, three section, tandem disk harrow suitable for heavy primary tillage. It is available in widths ranging from 22.6 to 30.8 ft (6.9 to 9.4 m). The test machine was 25.1 ft (7.7 m) wide at the fixed disk angle of 20°. It was equipped with 26 in (660 mm) diameter disks spaced at 10.5 in (265 mm), a spring cushioned shank centered behind the front gangs, 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 each wing is supported by one set of dual wheels. Two parallel sets of two hydraulic cylinders connected in series control tillage depth, and two hydraulic cylinders connected in parallel, fold the wings into transport position. A tractor with dual hydraulics is needed to operate the International 596.

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

SCOPE OF TEST

The International 596 was operated in the field conditions shown in TABLE 1 for 144 hours while tilling about 1640 ac (663 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	53	673	272
- heavy clay	91	967	391
Total	144	1640	663
Stony Phase			
- occasional stones	101	1074	434
- moderately stony	43	566	229
Total	144	1640	663
Surface Residue			
- stubble	39	539	218
- clover or alfalfa sod	80	841	340
- red clover (plow-down)	11	116	47
- native grass and brush	14	144	58
Total	144	1640	663

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was good in most soils. Penetration was reduced in hard dry soils and was inadequate in dry native grasses. The manufacturer recommends using notched blades in native grasses and hard to penetrate conditions. Penetration across the disk harrow width was uniform in most conditions. Front-to-rear depth uniformity was very good in most fields once the frame had been properly levelled. The four sets of dual wheels provided excellent flotation. The International 596 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 very good. In moist fields, some trash collected on the scrapers but did not cause plugging.

Scrapers were effective in keeping the disks and spools clean. The outer front disks, which were not equipped with scrapers, filled with moist soil. It is recommended that scrapers be provided for these disks.

The center shank cleared trash effectively.

Trash Burial: In most fields, 60 to 80% of the trash was buried during one operation (FIGURE 2). If dry, these fields would be susceptible to wind erosion.

Field Surface: The International 596 left a uniform level surface

in most fields. The optional furrow filling disks were effective. Hitch adjustments were adequate to prevent ridging or furrowing at the center. Some ridging occurred at the outside front disks when the disk harrow skewed in sharply undulating fields (FIGURE 3).

FIGURE 2. Typical Trash Burial.

FIGURE 3. Ridge Formed when Disk Harrow Skewed in Sharply Undulating Fields.

In established sod, the sod strips left a rough field surface (FIGURE 4). A second operation was required to cut up these strips to obtain a smooth field surface.

FIGURE 4. Rough Field Surface in Sod.

Furrow Bottom Ridging: The International 596, 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, unworked ridges remained. Unworked ridges also remained when the disk harrow skewed to one side causing some of the rear blades to follow in the path of the front blades.

The center shank (FIGURE 5) effectively cut the ridge remaining between the two front gangs. The shank was protected by a cushion spring assembly, which provided a rock clearance of 7.25 in (183 mm) before the shank contacted the wheel axle (FIGURE 6).

FIGURE 5. Center Shank.

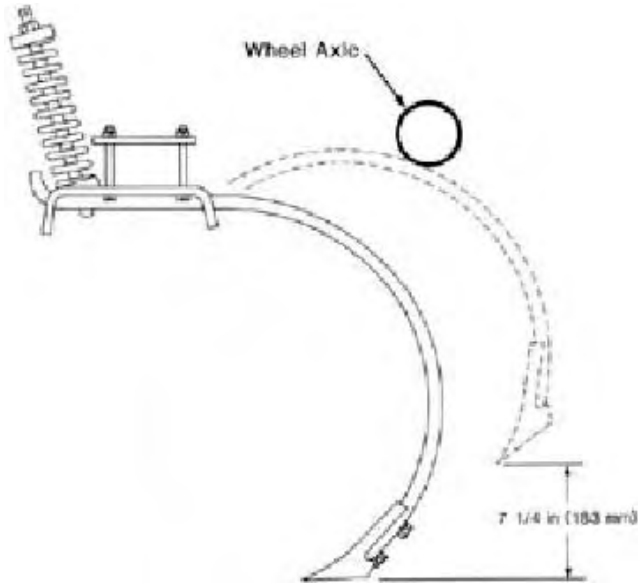

FIGURE 6. Center Shank Lilting Pattern.

Skewing and Stability: The stability of the International 596 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. Skewing caused the outer front disk to form a ridge (FIGURE 3). Stability could be improved by using the levelling adjustment 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 International 596 into transport position (FIGURE 7) was good. It usually took less than two minutes. The operator had to crawl under or over the machine frame to move the pins in the transport bars. The wing lock pins were conveniently installed from the rear of the disk harrow.

The International 596 towed well at normal tractor transport speeds with some front-to-rear rocking on rough roads. Disk-to-ground clearance of 8 in (200 mm) and a wheel tread of 4.3 ft (1.3 m) provided very good ground clearance.

Rear visibility during transport was very good.

Transport height was 11.4 ft (3.5 m) while transport width was 15.3 ft (4.7 m). Care was required when transporting on public roads, through gates and over bridges.

Hitching: The hitch jack and hitch link that remained nearly horizontal, made one-man hitching convenient. The hydraulic hoses provided were too short and had to be rerouted to obtain

adequate length for connecting to the tractor hydraulic outlets. It is recommended that the manufacturer lengthen the hydraulic hoses.

FIGURE 7. Transport Position. Angle.

Maneuverability: On sharp turns, the tire lugs on tractors with dual wheels caught on sharp corners of the hitch members (FIGURE 8) and were damaged. It is recommended that the disk harrow be modified to prevent tractor tire damage when making sharp turns.

FIGURE 8. Tractor Tire Contact with Frame.

Frame Levelling: Levelling the wings was convenient. Front-to-rear levelling was adequate but inconvenient. Two people were usually required to operate the tractor hydraulics and change the pin position on the wheel axle.

Tillage Depth: Tillage depth was controlled by two parallel sets of two hydraulic cylinders connected in series. The transport bars were equipped with mechanical stops to set the tillage depth. Adequate depth settings were provided, but the mechanical stops were inconvenient to change as the operator had to climb under or over the machine frame.

Gang Bolt Tightening: Periodic gang bolt tightening was necessary. Tightening gang bolts was difficult and required large wrenches to obtain the high torque of 1200 ft/lb (11,620 N/m) recommended by the manufacturer. It is recommended that the manufacturer provide suitable tools for tightening the gang bolts.

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 20° 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.

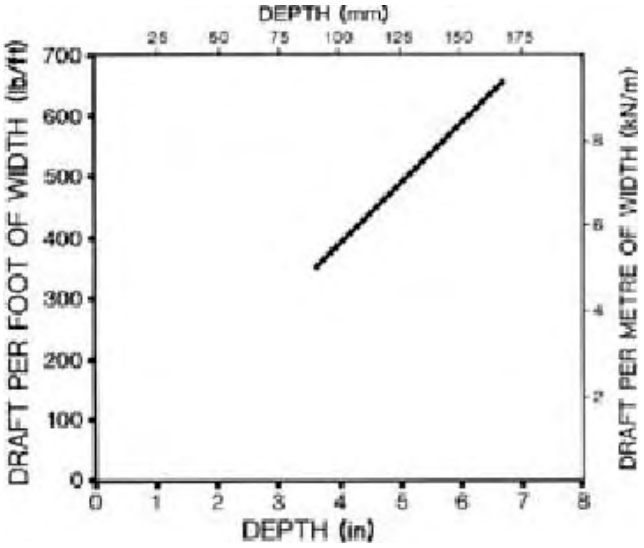

FIGURE 9. Average Draft Requirements for Disk Harrows at 5 mph (8 km/h) and 20° Disk.

In primary tillage, average draft at 5 mph (8 km/h) varied from 388 lb/ft (5.7 kN/m) at 4 in (1100 mm) depth to 584 lb/ft (8.5 kN/m) at 6 in 1150 mm) depth. This corresponds to a total draft ranging from 9740 to 14,660 lb (43.9 to 65.5 kN) for the 25.1 ft (7.7 m) test machine.

Tractor Size: TABLE 2 shows tractor sizes needed to pull the 25.1 ft (7.7 m) International 596 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 Nebraska tests or as presented by the tractor manufacturer.

TABLE 2. Tractor Size: Maximum Power Take-Off Rating hp (kW) Required to Pull the 25.1 ft

Depth		Speed					
in	mm	4 mph	6.4 km/h	5 mph	8 km/h	6 mph	9.7 km/h
4	100	155	116	203	151	255	190
5	125	196	146	254	189	316	236
6	150	237	177	305	228	378	282

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) a 254 hp (189 kW) tractor would pull the 25.1 ft (7.7 m) International 596.

OPERATOR SAFETY.

Extreme caution is needed when transporting most farm machinery to avoid contacting power lines. The transport height of the 25.1 ft (7.7 m) wide test machine was 11.4 ft (3.5 m), which was considerably lower than the minimum power line heights in the three provinces.

Wing locks for transport were provided and could be conveniently installed from the rear of the disk harrow. When relocating the pins in the transport bars to set the depth or insert the transport locks, a transport bar often swung down and could have injured the operator. It is recommended that the manufacturer connect the transport bars together to prevent operator injury.

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. A hitch safety chain was provided.

The International 596 was 15.3 ft (4.7 m) wide in transport. Rear visibility while transporting was very good. The center section tires were adequately sized for transporting the disk harrow at normal tractor transport speeds.

OPERATOR MANUAL

The operator manual provided information on adjusting and operating, set up, lubrication, maintenance, and safety. It was concise and clearly illustrated.

DURABILITY RESULTS

TABLE 3 outlines the mechanical history of the International 596 during 144 hours of field operation while tilling about 1640 ac (663 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)
-Several hydraulic hoses were rerouted to avoid contact with moving parts at		beginning of test	
-Several gang bearing mount bolts loosened and were tightened at	7	84	(34)
-A weld on a wing wheel support failed (FIGURE 10) and was rewelded at	33	450	(182)
-A wheel rim bent when it struck a rock and was straightened at	35	501	(203)
-Several gang bolts loosened and all were tightened at	75	963	(390)
-A scraper moved and was repositioned at	98	1156	(468)
-The wing depth adjusting spacers were lost when the bolts came loose at	98	1156	(468)
-A front outside disk broke because of a loose gang bolt. The disk was replaced at	103	1220	(494)
-A wing lift hydraulic hose failed and was replaced at	130	1506	(610)
-One gang bearing failed and was replaced at		end of test	
-Three gang bearings could not be properly lubricated at		end of test	

DISCUSSION OF MECHANICAL HISTORY

Gang Bolts: The gang bolts came loose several times during the test. Loose gang bolts contribute to blade breakage. It is recommended that the manufacturer provide a positive lock to prevent gang bolt nut loosening.

Weld Quality: Weld quality was poor in several places on the test machine. This resulted in a weld failure on the right wing wheel support (FIGURE 10). It is recommended that the manufacturer improve weld quality.

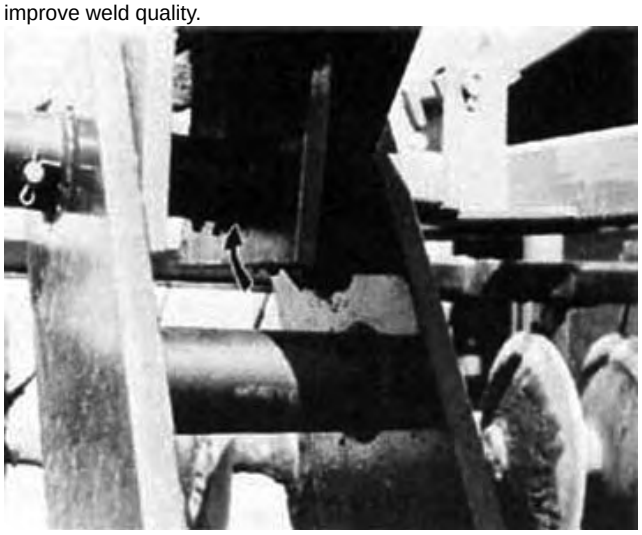

FIGURE 10. Weld Failure on Wing Wheel Support.

Hydraulic Hose Failure: Several hydraulic hoses were rerouted to prevent them from being damaged by the wheels and wing lift arms.

The wing lift hydraulic hose failed from rubbing against one of the transport bars. It is recommended that the manufacturer reroute the hydraulic hoses to prevent hose damage.

Gang Bearing Failure: One gang bearing failed, one grease fitting plugged, and three gang bearings would not accept grease by the end of the test. Investigation showed that the lubrication path to the bearings was inadequate. It is recommended that the manufacturer consider modifications to improve gang bearing lubrication and prevent premature bearing failure.

Disk Wear and Damage: Disk wear was minor during the 144 hours of operation. Many small nicks occurred when working in rocky conditions. One blade broke due to a loose gang bolt.

APPENDIX I
SPECIFICATIONS

MAKE: International Harvester Tandem Disk Harrow
MODEL: 596
SERIAL NUMBER: 470000V041520

OVERALL DIMENSIONS:

	FIELD POSITION	TRANSPORT POSITION
-- width	27.4 ft (8.4 m)	15.3 ft (4.7 m)
-- length	22.2 ft (6.8 m)	22.2 ft (6.8 m)
-- height	8.2 ft (2.5 m)	11.4 ft (3.5 m)
-- ground clearance	8 in (200 mm)	8 in (200 mm)

CUTTING WIDTH: 25.1 ft (7.7 m)

DISKS:

	plain
-- number	60 plus 2 furrow fillers
-- disk diameter	26 in (660 mm)
-- disk thickness	0.25 in (6.3 mm)
-- disk concavity	3.25 in (81 mm)
-- disk spacing	10.5 in (265 mm)
-- furrow filler diameter	18 in (450 mm)
-- disk angle	20°

TIRES:

-- center section	4, 31 x 13.50-15, 8-ply rating
-- each wing	2, 31 x 13.50-15, 6-ply rating

CENTRE SHANK:

-- type	spring cushion shank
-- shank cross section	1 in x 2 in (25 mm x 50 mm)
-- sweep size	8 in (200 mm)

WEIGHT:	FIELD POSITION	TRANSPORT POSITION
-- left center wheels	4189 lb (1900 kg)	6504 lb (2950 kg)
-- right center wheels	4189 lb (1900 kg)	6504 lb (2950 kg)
-- left wing wheels	2646 lb (1200 kg)	
-- right wing wheels	2646 lb (1200 kg)	
-- hitch	110 lb (50 kg)	772 lb (350 kg)
TOTAL	13,780 lb (6250 kg)	13,780 lb (6250 kg)
-- weight/unit width	548 lb/ft (812 kg/m)	

LUBRICATION POINTS:

-- 10 h	9 pressure grease fittings
-- 150 h	2 adjustable links
	22 disk gang bearings
-- periodic	4 wing wheel hub bearings
-- seasonal	8 wheel hub bearings

OPTIONAL EQUIPMENT:
-- center shank
-- bearing wear guards
-- furrow filler and furrow filler disk scraper
-- dual wing wheels

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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