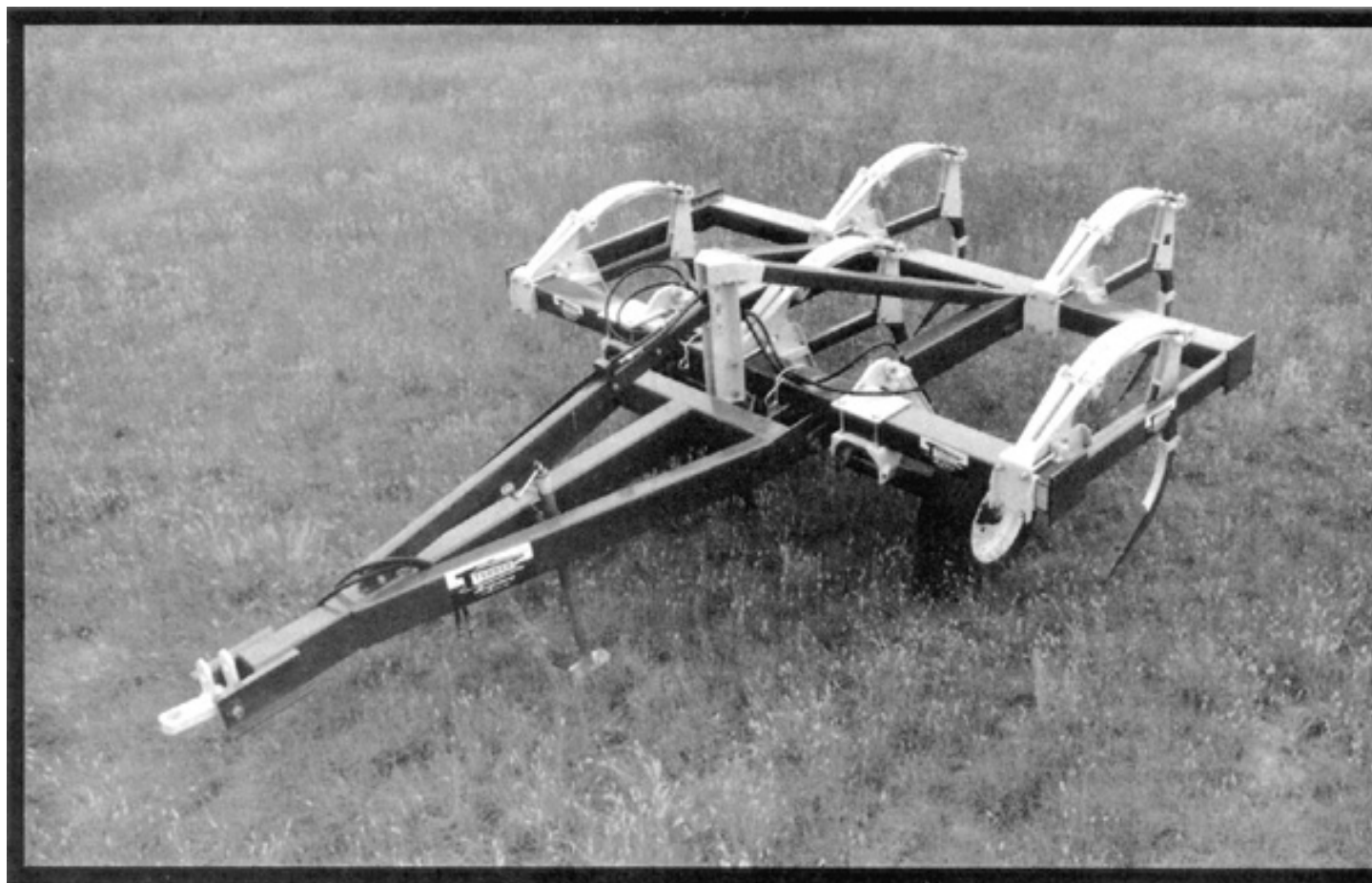


Evaluation Report

642



Tebben Automatic Reset Deep Till

A Co-operative Program Between



TEBBEN AUTOMATIC RESET DEEP TILL

MANUFACTURER:

Tebben Manufacturing
West Highway 7
Clara City, Minnesota 56222
Phone: (612) 847-3512

DISTRIBUTOR:

Crawford's of Alberta Ltd.
P.O. Box 1720
Camrose, Alberta
T4V 1X6
Phone: (403) 672-2471

RETAIL PRICE: \$11,140 (January 1991, f.o.b. Lethbridge, Alberta)

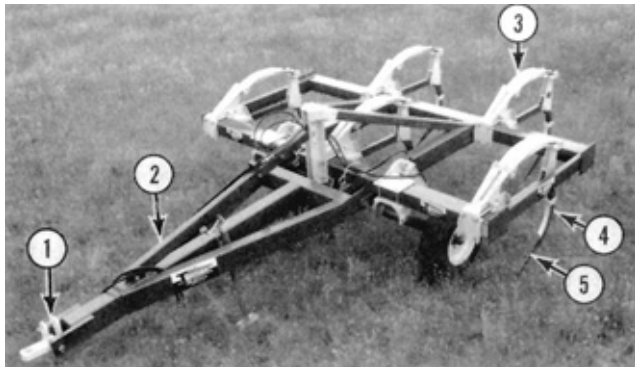


FIGURE 1. Tebben Automatic Reset Deep Till. (1) Cat Hitch, (2) Pole Hitch, (3) Spring Assembly, (4) Parabolic Shank and (5) Reversible Point.

SUMMARY AND CONCLUSIONS

QUALITY OF WORK

Penetration was good. Shank tripping occurred in clay soils. The average trip force of a shank was 1640 lbs (7.3 kN).

The soil fracturing pattern was fair. There was no consistent soil fracture pattern with the shanks tripping.

Working in untilled soil conditions caused significant soil disturbance. Shank movement scattered the soil in some field conditions,

Trash clearance was good. In heavy trash conditions straw accumulated around the parabolic shanks,

Operation in subsurface stony conditions was very good. The leaf spring trip assembly prevented damage to the shanks.

EASE OF OPERATION AND ADJUSTMENT

Ease of performing routine maintenance was very good. All grease fittings were easily accessible.

Ease of hitching was good. One person could hitch or unhitch the unit in five minutes. The location of the jack was inconvenient.

Ease of transporting was very good. Removeable transport locks for the cylinders were provided. Transport width of 11.2 ft (3.4 m) allowed for safe transporting of the unit.

Maneuverability of the unit was very good. Cornering required the unit to be raised out of the ground.

Ease of levelling the frame was very good providing the operator had assistance.

Ease of setting the depth was very good. Tillage depth was changed using the depth stop collars. A hydraulic jack was required to set the leaf spring camber.

Ease of rotating or changing the wear points was very good.

POWER REQUIREMENTS

The overall tractor size required to operate the test unit at the maximum tillage depth and speeds up to 3.0 mph (4.8 km/h) varied from 100 to 201 PTO hp (75 kW and 150 kW). Higher operating speeds decreased power requirements because of increased shank movement.

OPERATOR SAFETY

The Tebben Deep Till was safe to operate if normal safety precautions were observed. A slow moving vehicle sign was not provided.

OPERATOR'S MANUAL

The operator's manual was very good. A detailed parts list was also provided.

MECHANICAL HISTORY

One leaf spring camber was re-set. The points were rotated after wear of 50 ac (20 ha) per point side. Replacement cost of one point with nuts and bolts was \$46.75. One parabolic shank was bent during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying a slow moving vehicle sign as standard equipment.
2. Providing a safety tow chain and the accommodations to secure the chain.
3. Repositioning the jack stub to allow for easier movement of the hitch jack.

Manager: R.P. Atkins

*Project Engineer: L.W. Papworth
Field Technologist: G.A. Magyar*

GENERAL DESCRIPTION

The Tebben Automatic Reset Deep Till is a trailing, parabolic shank, deep tillage unit suitable for primary tillage operations. The Tebben unit is available in 5, 7, 9 or 11 shank configurations on a 30 in (762 mm) shank spacing and in 7, 9, 11, 13, 15, 17 or 19 shank configurations on a 15 in (381 mm) shank spacing. The pole hitch can be removed to make the Tebben into a Category III three-point hitch unit. The parabolic shanks are protected from stones by a leaf spring trip.

The unit is supported by two hydraulically adjusted gauge wheels. The gauge wheels are used to set the depth and transport the unit. The leaf spring automatically resets the parabolic shank. An adjustable top arm sets the fore-to-aft levelling of the unit. The reversible point is secured to the shank by two bolts.

The unit tested had five parabolic shanks arranged in two rows and spaced at 30 in (762 mm) intervals. The unit was equipped with a cat hitch and two helper leaf springs per shank. The test machine required a tractor with one set of remote hydraulics.

Optional equipment include cover blades for soil ridging, helper leaf springs, single coulter trash cutters, solid section trash cutters with leaf spring automatic reset, clevis or cat hitch, single or double extensions, double drop-through extension and three-point hitch single rank units equipped with manual gauge wheels.

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

SCOPE OF TEST

The Tebben Automatic Reset Deep Till Model DT5-30 was operated in the field conditions shown in TABLE 1 for 94 hours while deep tilling 580 ac (235 ha). The Tebben was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was good. Uneven penetration occurred when the leaf spring trip force of the shanks was exceeded. Excessive shank tripping occurred in clay soils. Trip force characteristics of the Tebben shank are shown in FIGURE 2. Camber of the leaf spring shank assembly (FIGURE 3) was set by the operator. On the test

machine the average trip force of a shank was 1640 lbs (7.3 kN).

Uniform penetration across the width of the deep tiller required synchronizing the gauge wheel hydraulic cylinders and proper levelling of the pole hitch.

TABLE 1. Operating Conditions

FIELD CONDITIONS	HOURS	FIELD AREA	
		ac	(ha)
Soil Type			
Sand - Primary	33.5	218	(89)
Loam - Primary	39.5	238	(96)
Clay - Primary	21.0	124	(50)
TOTAL	94.0	580	(235)
Subsurface Stones			
Occasional Stones	52.0	318	(129)
Moderately Stony	42.0	262	(106)
TOTAL	94.0	580	(235)

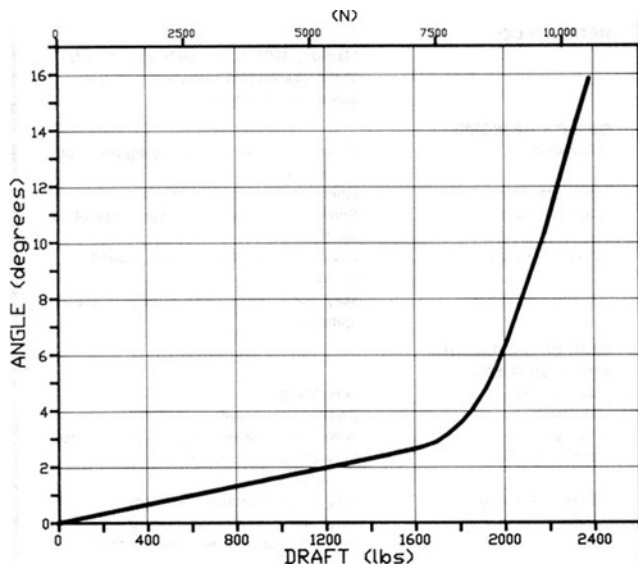


FIGURE 2. Trip Force Characteristics of Tebben Shank.

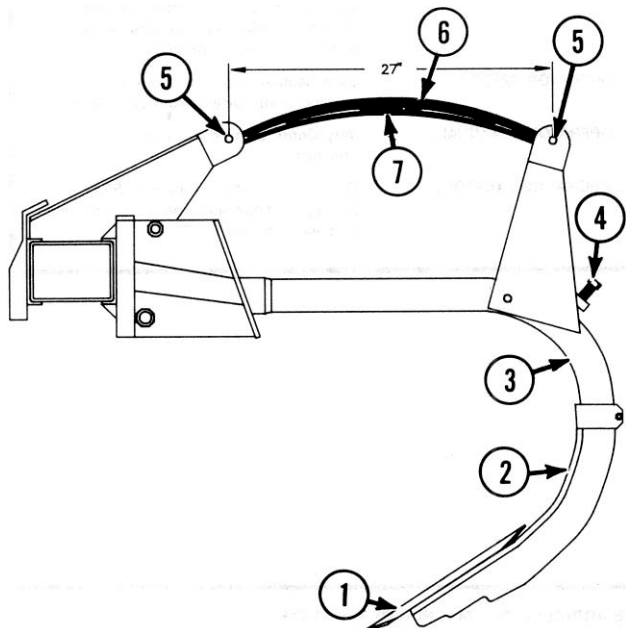


FIGURE 3. Tebben Shank: (1) Reversible Point, (2) Wear Plate, (3) Parabolic Shank, (4) Adjusting Bolt, (5) Pivot Pins, (6) Leaf Springs and (7) Helper Leaf Springs.

Soil Fracturing: The soil fracturing pattern was fair. No consistent soil fracture pattern occurred because of the shanks tripping. Soil fracturing between the shanks varied from 0 to 14 in (0 - 346 mm) depending on soil type and moisture.

FIGURE 4 shows a soil fracture pattern in an untilled loam soil condition. The dry and hard soil provided ideal deep tillage conditions. Tillage depth measured 16 in (406 mm). Average soil fracture between the shanks was 10 in (254 mm), resulting in 6 in (152 mm) of undisturbed soil. FIGURE 5 shows the soil fracture pattern in the same field where the amount of soil fracture between the shanks averaged 6 in (152 mm), leaving 10 in (254 mm) of undisturbed soil.

For proper soil fracturing between tillage passes, the spacing between passes should not exceed the 30 in (762 mm) lateral shank spacing.

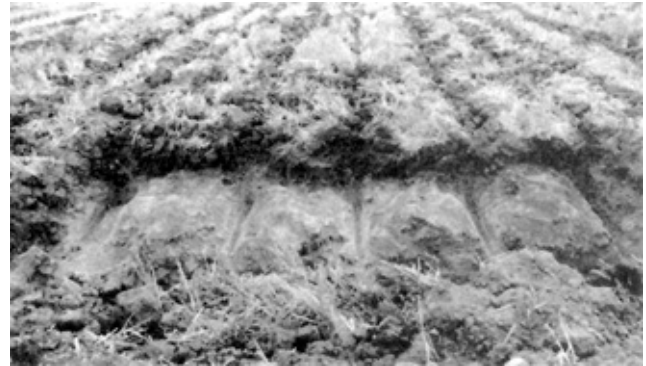


FIGURE 4. Soil Fracture of 10 in (254 mm) Between Shanks.



FIGURE 5. Soil Fracture of 6 in (152 mm) Between Shanks.

Soil Surface: FIGURE 6 shows the soil surface after deep tilling into an untilled loam soil condition. Significant soil disturbance occurred, leaving furrows with large lumps of soil on the surface. In some field conditions the shank tripping action would scatter soil. Straw was buried in the furrows in every field condition. The amount of straw buried depended on the tillage depth, furrow size, speed of tillage and soil conditions. In fields with light straw coverage the majority of the straw was buried.



FIGURE 6. Soil Surface Left by the Tebben Deep Till.

Trash Clearance: Trash clearance of the Tebben was good. A maximum tillage depth of 17 in (432 mm) left a working clearance of 9 in (228 mm). This working clearance and a lateral shank spacing of 30 in (762 mm) allowed trash to clear. In heavy trash conditions straw accumulated around the shanks, then fell to one side leaving piles of straw on the soil surface.

Stony Conditions: Operation in subsurface stony conditions was very good. The leaf spring trip assembly prevented damage to the shanks while working in subsurface stony conditions.

EASE OF OPERATION AND ADJUSTMENT

Maintenance: Ease of performing routine maintenance on the unit was very good. Daily servicing of the seven grease fittings took one person five minutes. The manufacturer suggested bolts should be checked for tightness after a couple of hours and then periodically checked. The wheel bearings required seasonal repacking.

Hitching: Ease of hitching the Tebben was good. One person could hitch or unhitch the unit in five minutes. To move the hitch jack (FIGURE 7) to the vertical position required the operator to remove the jack from the jack stub. The jack was then turned and placed back on the stub. It is recommended that the manufacturer consider repositioning the jack stub to allow for easier movement of the hitch jack.



FIGURE 7. Hitch Jack Location.

Transporting: Ease of transporting the Tebben was very good. To place the unit into transport position (FIGURE 8) required five minutes. The optional cat hitch allowed safe transporting of the unit by either a tractor or a vehicle.

The manufacturer suggested recharging the hydraulic cylinders and checking wheel lug bolt tightness before transporting. Removable transport locks for the cylinders were provided.

Transport width was 11.2 ft (3.4 m) and transport height was 5.0 ft (1.5 m). This allowed safe transportation of the unit. The unit towed well at a transport speed of 18 mph (29 km/h). A transport wheel tread width of 5.9 ft (1.8 m) made the unit stable during transport. The tractor drawbar was pinned while transporting.

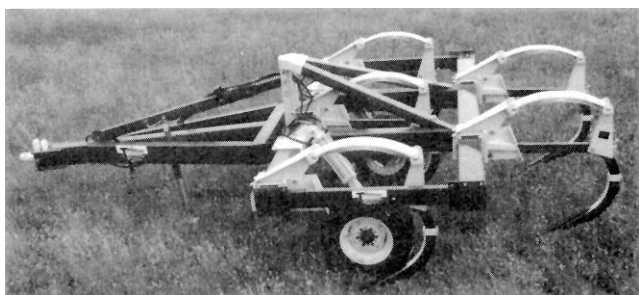


FIGURE 8. Transport position.

Maneuverability: Maneuverability of the Tebben unit was very good. The unit was raised out of the ground when turns were made to prevent shank damage. The location of the outer shanks allowed for close tillage to obstacles and fence lines.

Frame Levelling: Ease of levelling the frame of the Tebben was very good provided the operator had assistance. Recharging the gauge wheel cylinders controlled lateral levelling. The sliding arms (FIGURE 9) on the pole hitch controlled fore-and-aft levelling. Holes spaced at 1.0 in (25.4 mm) on the interior arm and three vertical positions on the centre mast provided ample adjustment of the sliding arms.

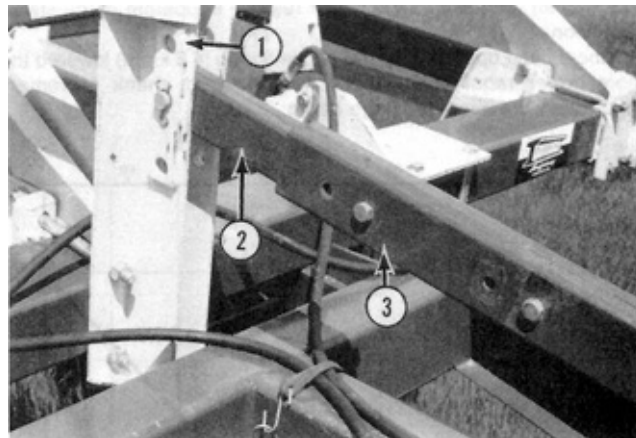


FIGURE 9. Pole Hitch Sliding Arms: (1) Centre Mast, (2) Interior Arm and (3) Exterior Arm.

Depth Adjustment: Ease of setting the tillage depth was very good. Tillage depth was set by inserting depth stops on the master (left) cylinder (FIGURE 10). Four different sizes of depth stops were provided. No depth stops were used at the maximum tillage depth. The manufacturer suggested that the distance between the pivot pins (FIGURE 3) of the leaf springs, or the camber, be set to 27 in (686 mm). A hydraulic jack was required to set the spring camber. The adjusting bolt on the shank was loosened before setting the spring camber.

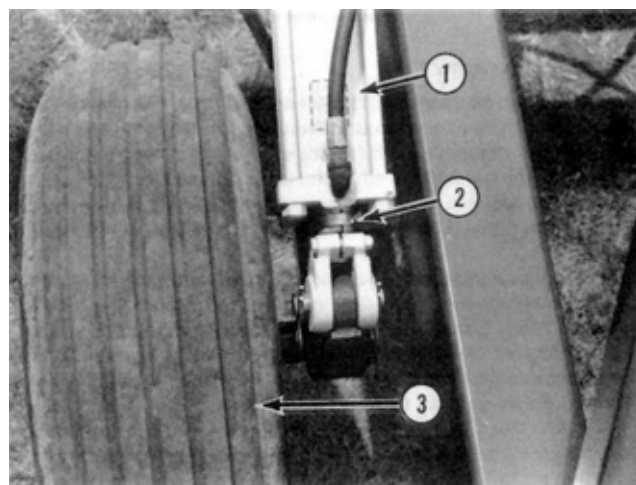


FIGURE 10. Depth Adjustment. (1) Master Cylinder, (2) Depth Stop and (3) Gauge Wheel.

Wear Part Replacement: Ease of changing or rotating the wear points was very good. Changing or rotating the points took one person thirty minutes. The points were secured with a 2.5 in (63.5 mm) and a 3.0 in (76.2 mm) length bolt. Excessive point wear required replacing the nuts and bolts.

POWER REQUIREMENTS

Draft Characteristics: Draft (drawbar pull) requirements depended on operating depth, operating speed, field conditions, soil type and moisture content. In untilled loam soil the average draft of the 12.5 ft (3.8 m) unit at 3.0 mph (4.8 km/h) varied from 8,090 lb (36.0 kN) at a 12 in (305 mm) tillage depth to 16,220 lb (72.1 kN) at a 17 in (432 mm) tillage depth. Average hitch weight varied from 546 lb (2.4 kN) to 1,200 lb (5.3 kN).

Tractor Size: The power take-off horsepower requirements per unit of working width for untilled soil conditions and varying tillage depths at 3.0 mph (4.8 km/h) are given in FIGURE 11. Requirements

varied from 8.0 PTO hp/ft (20 kW/m) at a 12 in (305 mm) tillage depth to 16.1 PTO hp/ft (39 kW/m) at a 17 in (432 mm) tillage depth. Overall tractor size needed to operate the Tebben at speeds up to 3.0 mph (4.8 km/h) and at tillage depths up to 17 in (432 mm) varied from 100 to 201 PTO hp (75 to 150 kW). Tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80 percent of maximum power take-off ratings as determined by Nebraska tests or as presented by the tractor manufacturer. The tractor sizes given will have ample power reserve to operate in the stated conditions.

Increasing operating speed above 3 mph (4.8 km/h) lowered the horsepower requirements because increased shank movement decreased the average tillage depth.

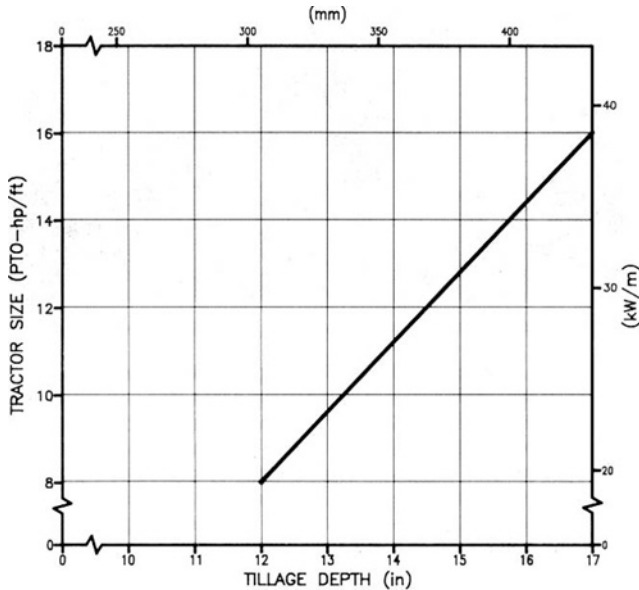


FIGURE 11. Average Horsepower Requirements at 3.0 mph (4.8 km/h).

OPERATOR SAFETY

The Tebben was safe to operate if normal safety pre-cautions were observed. The transport ground clearance of 9.0 in (229 mm) and the transport height of 5.0 ft (1.5 m) allowed for safe transportation of the unit. The transport width of the test machine was 11.2 ft (3.4 m). Caution was required when transporting on public roads, over bridges and through gates. The operator's seat belt should be worn during operation.

Removeable transport locks were provided for the depth cylinders. Caution was required when setting the leaf spring camber. The unit could be safely transported up to speeds of 18 mph (28.8 km/h). A slow moving vehicle (SMV) sign was not provided by the manufacturer. It is recommended that the manufacturer consider supplying a slow moving vehicle sign as standard equipment.

A safety tow chain and accommodations for securing the chain were not provided. It is recommended that the manufacturer consider providing a safety tow chain and the accommodations to secure the chain in accordance to ASAE standards.

OPERATOR'S MANUAL

The operator's manual was very good. Information on assembly, safety, shank spacing, operation and maintenance was provided. The manual also contained a detailed parts list and list of options. The manual was clearly written and used illustrations for explanation.

MECHANICAL HISTORY

The Tebben Deep Till was operated for 94 hours while deep tilling 580 ac (235 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 occurred during the functional testing.

DISCUSSION OF MECHANICAL PROBLEMS

Wear Parts: FIGURE 12 shows a new point compared to a worn point. The worn points were turned after deep tilling 250 ac (101 ha) giving 50 ac (20 ha) per point. Total point wear could be doubled for

wear on both points. The replacement cost of one point complete with nuts and bolts was \$46.75. The wear on the 0.5 in (13 mm) thick wear plates for the shanks showed rounding on the corners. The plates were considered to have considerable wear left.

Over-Centred Leaf Spring: After encountering a rock, the resetting of the shank assembly was very quick. Return force and loose shank bolts caused one leaf spring assembly (FIGURE 13) to go over centre. The leaf spring camber was re-set and the bolts retightened. No other problems occurred to the leaf spring assemblies.

Shank Damage: The middle shank was damaged during field evaluation and was replaced at the end of the test. Shank damage was possibly caused by a large buried rock or turning with the unit in the ground, the latter being operator error.

TABLE 2. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA ac	FIELD AREA (ha)
Reset leaf spring at	14.0	87	(35)
Turned points at	41.5	248	(100)
Set shank spacing at	58.0	332	(134)
Changed points at	60.0	340	(138)
Replaced bent shank at		End of Test	

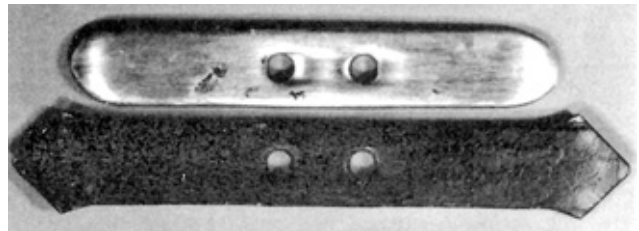


FIGURE 12. Point Wear: Top - New Point, Bottom - Worn Point.



FIGURE 13. Over-Centred Leaf Spring.

APPENDIX I

MAKE: Tebben
MODEL: TM76-00-1
SERIAL NUMBER: 5-89-1634
MANUFACTURER: Tebben Manufacturing
 West Highway 7
 Clara City, Minnesota 56222

OVERALL DIMENSIONS:
 - Width 11.2 ft (3.4 m)
 - Length 17.2 ft (5.2 m)
 - Height 5.0 ft (1.5 m)
 - Maximum Ground Clearance 9.0 in (228.6 mm)
 - Working Width 12.5 ft (3.8 m)
 - Wheel Tread 5.9 ft (1.8 m)

HITCH:
 - Type Trailing Drawbar
 - Adjustment Adjustable Arm
 - Coarse 3 positions on centre mast
 - Fine 1.0 in (25.4 mm) increments on arms

SHANKS:
 - Type Parabolic
 - Number Five
 - Spacing 30.0 in (762 mm)
 - Number of rows Two
 - Distance between Rows 55 in (1397 mm)
 - Row Pattern W-shaped
 - Blade/Point Tip-to-Frame Clearance 29.0 in (736.6 mm) to Frame
 27.75 in (704.9 mm) to Shank Assembly
 - Shank Thickness 1.5 x 2.75 in (38.1 x 69.9 mm)
 - Stone Protection Leaf Spring Assembly
 - Shank Angle 29 degrees
 - Adjustment Set by Leaf Spring Camber
 - Maximum Working Depth 17 in (431.8 mm)
 - Lateral Adjustment infinite
 - Wear Plates 0.5 x 1.5 in (12.7 x 38.1 mm)

GAUGE WHEELS:
 - Number Two - 9.5L-15SL

POINT:
 - Type Reversible Straight Point
 - Mounting 2.5 in (64 mm) and 3.0 in (76 mm) bolts
 - Width 2.25 in (57.2 mm) at tip
 - Thickness 0.75 in (19.0 mm)
 - Length 17.25 in (438.2 mm)
 - Rockwell Hardness 50 B

DEPTH CONTROL:
 - Type Doughnut Depth Stops
 - Adjustment 0.75 in (19 mm), 1.0 in (25 mm),
 1.5 in (38 mm), 2.0 in (51 mm) stops

FRAME:
 - Shape Rectangular
 - Cross Section 7 x 5 in (177.8 x 127 mm) front/rear
 2 x 5 in (50.8 x 127 mm) laterals

NUMBER OF LUBRICATION POINTS:
 - Grease Fittings Five - Shank Pivot
 Two - Axle Pivot
 - Wheel Bearings Four

WEIGHT:
 - Hitch 130 lb (59.1 kg)
 - Transport Wheels
 - Right 1390 lb (631.8 kg)
 - Left 1370 lb (622.7 kg)

OPTIONS INCLUDED ON TEST MACHINE: Two Helper Leaf Springs per Shank, Cat Hitch and Pole Hitch

OTHER AVAILABLE OPTIONS: Single Coupler Trash Cutter, Cover Blades, Solid Section Trash Cutters with Leaf Spring Reset, Single or Double Extensions, Double Drop Through Extensions, 3-Point Hitch Single Rank Units and 15 in (381 mm) Shank Spacing

APPENDIX II

The following rating scale is used:

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

SUMMARY CHART

RETAIL PRICE: \$11,140
 (January 1990, f.o.b. Lethbridge, Alberta)
 11.2 ft (3.4 m) unit, complete with five automatic reset shanks

QUALITY OF WORK:
 Penetration: **Good**; excessive shank tripping occurred in clay soils.
 Soil Fracturing: **Fair**; inconsistent soil fracture
 Soil Surface: Shanks left furrows and large lumps of soil on the surface
 Trash Clearance: **Good**; accumulation of straw around shanks in heavy trash
 Stony Conditions: **Very Good**; leaf springs prevented shank damage

EASE OF OPERATION AND ADJUSTMENT:
 Maintenance: **Very Good**
 Hitching: **Good**; inconvenient jack location
 Transporting: **Very Good**; transport locks were provided
 Maneuverability: **Very Good**; unit raised out of ground when turning
 Frame Levelling: **Very Good**; required assistance
 Tillage Depth: **Very Good**; depth stops were provided, leaf spring setting required a hydraulic jack

POWER REQUIREMENTS: Varied from 100 to 201 PTO hp (75 to 150 kW); speeds above 3.0 mph (4.8 km/h) decreased power requirements because of increased shank movement

OPERATOR SAFETY: Safe; seatbelt should be worn when working in subsurface stony conditions

OPERATOR'S MANUAL: **Very Good**; detailed parts list also provided

MECHANICAL HISTORY: One parabolic shank was bent, 50 ac (20 ha) per point side wear before rotating. Replacement cost \$46.75.



**ALBERTA
 FARM
 MACHINERY
 RESEARCH
 CENTRE**

3000 College Drive South
 Lethbridge, Alberta, Canada T1K 1L6
 Telephone: (403) 329-1212
 FAX: (403) 329-5562
<http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html>

Prairie Agricultural Machinery Institute

Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
 Telephone: (306) 682-2555

Test Stations:
 P.O. Box 1060
 Portage la Prairie, Manitoba, Canada R1N 3C5
 Telephone: (204) 239-5445
 Fax: (204) 239-7124

P.O. Box 1150
 Humboldt, Saskatchewan, Canada S0K 2A0
 Telephone: (306) 682-5033
 Fax: (306) 682-5080