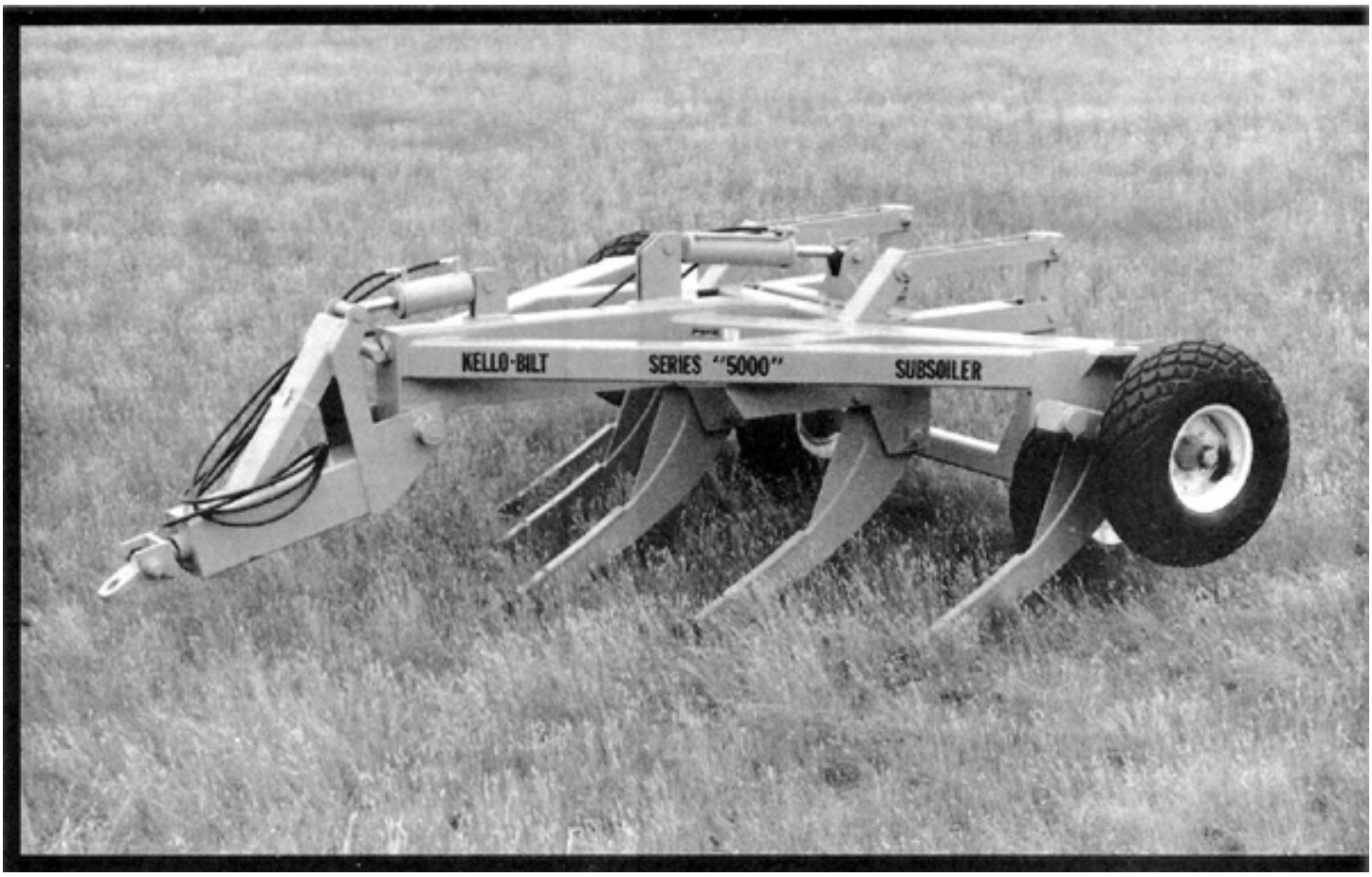
Alberta Farm Machinery Research Centre

Printed: April 1991
Tested at: Lethbridge
ISSN 0383-3445
Group 10 (c)

Evaluation Report 643



Kello-Bilt Series 5000 Subsoiler

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

KELLO-BILT SERIES 5000 SUBSOILER

MANUFACTURER AND DISTRIBUTOR:

Kello-Bilt Industries Ltd.
P.O. Box 1119
Stettler, Alberta
T0C 2L0

RETAIL PRICE: $14,500 (January 1991, f.o.b. Stettler, Alberta)

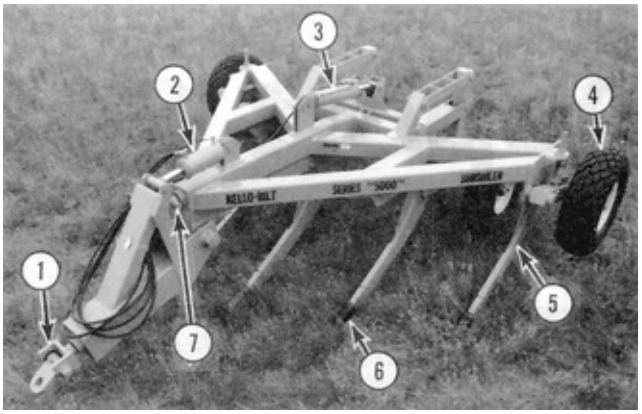


FIGURE 1. Kello-Bilt Series 5000 Subsoiler: (1) Spring-loaded hitch, (2) Front hydraulic cylinder, (3) Transport Cylinder, (4) Gauge Wheels, (5) Parabolic Shank, (6) Wear Point and (7) Adjustable T-Bar.

SUMMARY AND CONCLUSIONS

QUALITY OF WORK

Penetration was good. In heavy clay soils the points rode on the soil hardpan.

The soil fracturing pattern was good. The depth and uniformity of soil fracture was reduced in moist soil, previously tilled conditions and shallow tillage depths.

Working in untilled soil conditions caused significant soil disturbance. The four outside shanks made furrows, leaving large lumps of soil on the surface.

Trash clearance was very good. The 32.5 in (826 mm) lateral leg spacing allowed for large amounts of trash to clear.

Operation in subsurface stony conditions was good. The spring-cushioned hitch did not provide shock protection.

EASE OF OPERATION AND ADJUSTMENT

Ease of performing routine maintenance was very good. A service schedule was not provided.

Ease of hitching was very good. One person could hitch or unhitch the unit in ten minutes. Hitching required the hydraulic lines to be connected first. The shanks were lowered to the ground before the unit was unhitched.

Ease of transporting was very good. Transport locks for the cylinders were provided. A transport width of 14.8 ft (4.5 m) allowed for safe transporting of the unit.

Maneuverability of the subsoiler 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 tillage depth was good. Tillage depth was changed by adjusting the threaded rod on the gauge wheels. At deeper depths there was poor access to the lower locking nut.

Ease of changing the wear points was very good.

POWER REQUIREMENTS

The overall tractor size required to operate the test unit at tillage depths up to 22.0 in (559 mm) and speeds up to 2.5 mph (4.0 km/h) varied from 177 to 246 PTO hp (132 to 183 kW). Increased depths or speeds required an increase in power take-off horsepower.

OPERATOR SAFETY

The Kello-Bilt subsoiler was safe to operate if normal safety precautions were observed. A slow moving vehicle sign was not provided.

OPERATOR'S MANUAL

An operator's manual was not provided with the test unit.

MECHANICAL HISTORY

Seven shear bolts were replaced. The points were replaced after wear of 150.0 ac (61 ha) per point. Replacement cost of one point was $55.00. The adjustable t-bar and hydraulic hoses were damaged 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 accomodations to secure the chain.
3. Supplying an operator's manual with the Keilo-Biit subsoiler.
4. Modifying or eliminating the spring-cushioned hitch.
5. Supplying the rear cylinder with the depth stop valve removed.
6. Providing a warning sign indicating the t-bar should be left in a horizontal position.
7. Providing convenient access to the lower locking nuts for all depth settings.
8. Modifying or eliminating the forward axle position.
9. Improving the routing of hydraulic hoses to prevent hose failure.

Manager: R.R Atkins
Project Engineer: L.W. Papworth
Project Technologist: G.A. Magyar

THE MANUFACTURER STATES THAT:

With regard to recommendation number:

1. As of 1 January 1991, slow moving vehicle signs will be standard equipment.
2. As of January 1991, safety tow chain and integral attachment point will be standard equipment.
3. Operator's manual is available and supplied with new subsoiler.
4. Spring cushion hitch will be eliminated in 1991 production.
5. Rear cylinder is normally supplied less depth stop but is subject to availability of appropriate cylinders.
6. Warning decals will be applied on 1991 production.
7. If the procedures outlined in the owner's manual is adhered to, adjustment of the depth control arms is greatly simplified and the use of the wrench is not normally required. Generous and frequent lubrication of the eye-bolt threads will also facilitate ease of adjustment.
8. Forward axle position has been eliminated.
9. Hose clamps are now installed to prevent hose movement.

GENERAL DESCRIPTION

The Kello-Bilt Series 5000 subsoiler is a trailing parabolic shank, deep tillage unit suitable for primary tillage operations. The Kello-Bilt is available in 3, 5 or 7 shank configurations with shank spacings of 30.0 and 32.5 inches (762 and 826 mm). The parabolic shanks are arranged in a v-shape pattern and shear bolt protected.

Depth is manually set by adjusting the threaded rod length on the two gauge wheels. The drawbar hitch is spring loaded and includes an adjustable t-bar stop which holds the unit level. The front hydraulic cylinder vertically rotates the hitch until it rests against a t-bar stop. The wear points are wedged onto the shanks and then

bolted into position. A rear hydraulic cylinder is used to raise the subsoiler into transport position.

The unit tested had five parabolic shanks with a spacing of 32.5 in (825.5mm). The test unit required a tractor with two remote hydraulic controls.

Optional equipment includes extra heavy hard faced points, coulter type splitters and wider clamp-on shins.

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

SCOPE OF TEST

The Kello-Bilt Series 5000 Model 530 subsoiler was operated in the field conditions shown in TABLE 1 for 140 hours while subsoiling 672 ac (272 ha). The subsoiler was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

TABLE 1. Operating Conditions

FIELD CONDITIONS	HOURS	FIELD AREA ac	(ha)
Soil Type			
Sand	67	324	(131)
Loam	42	199	(81)
Clay	31	149	(60)
TOTAL	140	672	(272)
Subsurface Stones			
Occasional Stones	99	488	(198)
Moderately Stoney	41	184	(74)
TOTAL	140	672	(272)

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was good. The Kello-Bilt parabolic shanks (FIGURE 2) maintained penetration in untilled loam and sand conditions. Poor penetration occurred in heavy clay soil conditions because the points rode on the soil hardpan causing a decrease in working depth.

Uniform penetration across the width of the subsoiler required equal setting of the gauge wheels and proper levelling of the hitch. The hitch required levelling after the depth was changed during the test.

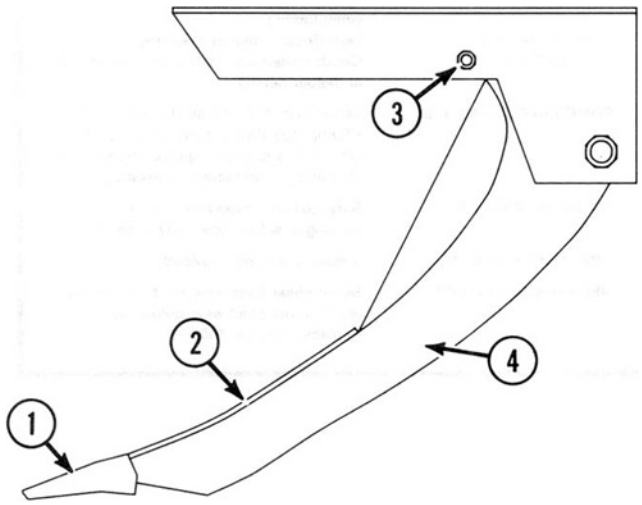


FIGURE 2: Kello-Bilt Shank: (1) Wear Point, (2) Wear Plates, (3) Shear Bolt and (4) Parabolic Shank.

Soil Fracturing: The soil fracturing pattern was good. Depth and uniformity of soil fracture was reduced in moist soils, previously tilled conditions and shallow tillage depths.

FIGURE 3 shows a soil fracture pattern in an untilled loam soil condition. A dry and hard soil provided ideal deep tillage conditions. Tillage depth measured 18 in (457 mm). Average soil fracture between the shanks was 11 in (279 mm), resulting in 7 in (178 mm) of undisturbed soil.

The manufacturer recommended the subsoiler be operated at tillage depths between 18 and 24 in (457 - 610 mm). In fields where the tillage depth was shallower than 18 in (457 mm), uneven soil fracture patterns (FIGURE 4) resulted.

For proper soil fracturing between tillage passes, spacing between passes should not exceed the lateral shank spacing of 32.5 in 825.5 mm).

FIGURE 3. Soil Fracturing Pattern in Previously Untilled Loam Soil.

FIGURE 4. Uneven Soil Fracturing Pattern.

Soil Surface: FIGURE 5 shows the soil surface after deep tilling into a previously untilled loam soil condition. Soil disturbance from the centre shank was minimal. Significant soil disturbance resulted from the remaining shanks which left furrows with large lumps of soil on the surface. Straw was buried in the furrows in all field conditions. 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 5. Soil Surface Left by Kello-Bilt in Previously Untilled Loam Soil.

Trash Clearance: Trash clearance of the Kello-Bilt subsoiler was very good. A tillage depth of 18 in (457 mm) left a working clearance of 18 in (457 mm). This working clearance and a lateral shank spacing of 32.5 in (825.5 mm) allowed large amounts of trash to clear.

Stony Conditions: Operation in subsurface stony conditions was good. A total of seven shear bolts were replaced.

In all field conditions the spring cushioned hitch (FIGURE 6) maintained a fully extended position. When encountering a large rock there was no shock protection. It is recommended that the manufacturer consider modifying or eliminating the spring cushioned hitch. The tractor's drawbar was allowed to swing during the test to reduce the shock load.

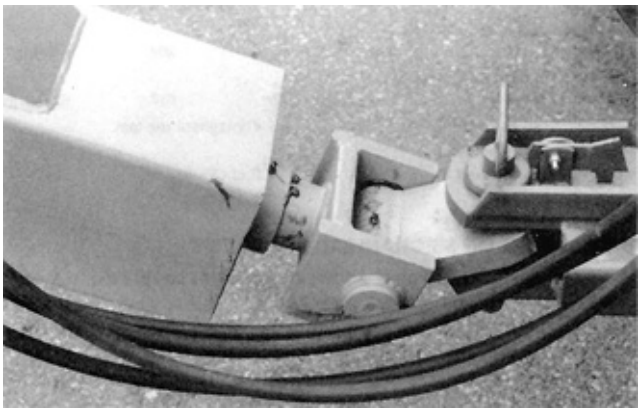


fIGURE 6. Spring Cushioned Hitch.

EASE OF OPERATION AND ADJUSTMENT

Maintenance: Ease of performing routine maintenance on the subsoiler was very good. Servicing of the fourteen grease fittings took one person ten minutes. A service schedule was not provided.

Hitching: Ease of hitching the Kello-Bilt subsoiler was very good. One person could hitch or unhitch the unit in ten minutes. Hitching required the hydraulic lines be connected first. The hitch could then be adjusted to the proper drawbar height. The parabolic shanks were lowered to the ground before the unit was unhitched.

Transporting: Ease of transporting the subsoiler was very good. To place the unit into transport position (FIGURE 7) required five minutes. Removeable transport locks for the cylinders were provided. The depth stop valve on the rear cylinder was removed to allow for easier installation and removal of the transport lock. It is recommended the manufacturer consider supplying the rear cylinder with the depth stop valve removed.

Transport width was 14.8 ft (4.5 m) and transport height was 6.4 ft (2.0 m). This allowed safe transporting of the unit. The unit towed well at a transport speed of 18 mph (29 km/h). Fully extending the adjustable hitch cylinder gave a point to ground clearance of 9.5 in (241 mm). A transport wheel tread width of 7.1 ft (2.2 m) made the unit stable during transport.

The subsoiler required the use of a tractor with two sets of remote hydraulics. The tractor drawbar was pinned during transport.

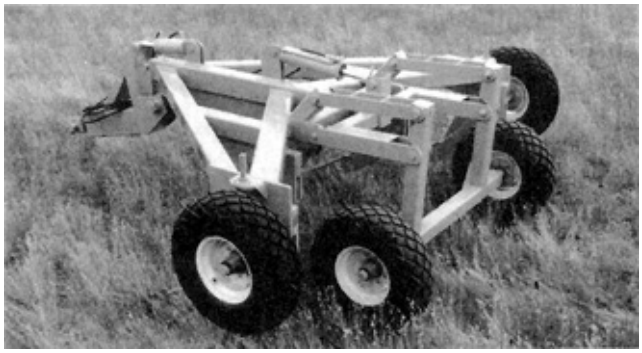


FIGURE 7. Transport Position.

Maneuverability: Maneuverability of the Kello-Bilt subsoiler 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 frame levelling of the Kello-Bilt was very good provided the operator had assistance. The right and left gauge wheels controlled lateral levelling. The adjustable t-bar (FIGURE 8) controlled fore-and-aft levelling. The manufacturer suggested, to ensure even point wear, the t-bar be set so the front of the unit was slightly higher than the back.

The hitch cylinder moved the hitch vertically until the frame rested against the t-bar. To prevent t-bar damage it should be secured in a horizontal position by the locking nut. It is recommended that the manufacturer consider providing a warning sign indicating the t-bar should be left in a horizontal position.

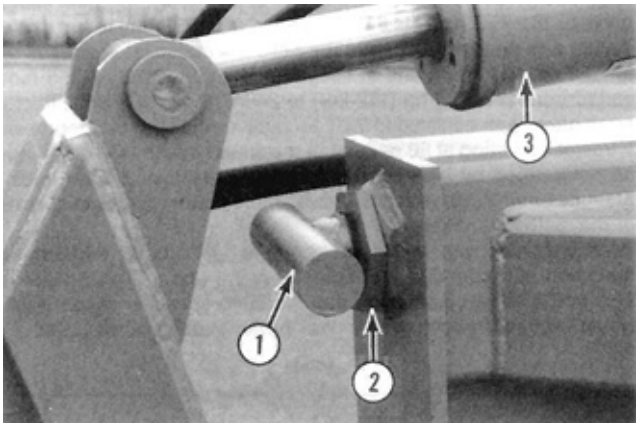


FIGURE 8. Adjustable T-Bar: (1) T-Bar, (2) Locking Nut and (3) Adjustable Hitch Cylinder.

Depth Adjustment: Ease of setting the tillage depth was good. Tillage depth was set by adjusting the height of the gauge wheels (FIGURE 9). A large adjustable wrench was used to loosen and tighten the locking nuts. An equal amount of thread exposed above the top nuts indicated a level depth setting. Access to the lower locking nut was difficult when adjusting the gauge wheels for depths greater than 18 in (457 mm). It is recommended that the manufacturer consider providing convenient access to the lower locking nuts for all depth settings.

The manufacturer recommended that the transport hydraulic cylinder not be used for supporting the frame during field operation.

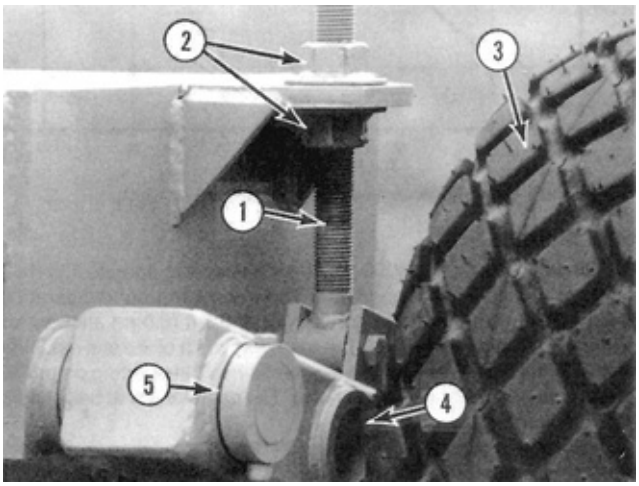


FIGURE 9. Depth Adjustment: (1) Rod, (2) Locking Nuts, (3) Gauge Wheel, (4) Rear Axle Position and (5) Front Axle Position.

Wear Part Replacement: Ease of changing the wear points was very good. Changing the points took one person 20 minutes. The points were wedged into position and secured with a 0.5 x 3.25 in (13 x 83 mm) bolt. Worn nuts and bolts were replaced when changing the points. A drift punch was used to remove the worn bolts.

POWER REQUIREMENTS

Draft Characteristics: Draft (drawbar pull) requirements depended on operating depth and speed, field conditions, soil type and moisture content. In primary loam soil average draft of the 13.5 ft (4.1 m) unit at 2.5 mph (4.0 km/h) varied from 17,100 lbs (76 kN) at an 18 in (457 mm) tillage depth to 23,800 lbs (106 kN) at a 22 in (559 mm) tillage depth.

Average hitch weight at 2.5 mph (4.0 km/h) and at 22 in (559 mm) tillage depth was 6,890 lbs (31 kN). The manufacturer suggested that moving the gauge wheel to the forward axle position (FIGURE 9) would help reduce hitch weight. The average hitch weight with the axles moved forward was 6,998 lbs (31 kN), while the average draft

was 24,870 lbs (111 kN). It is recommended that the manufacturer consider modifying or eliminating the forward axle position.

Tractor Size: The power take-off horsepower requirements per foot of working width for primary soil conditions and varying tillage depths at 2.5 mph (4.0 km/h) are given in FIGURE 10. Requirements varied from 13.1 PTO hp/ft (32.0 kW/m) at an 18.0 in (457 mm) tillage depth to 18.2 PTO hp/ft (44.5 kW/m) at a 22.0 in (559 mm) tillage depth. Tractor size needed to operate the Kello-Bilt subsoiler at speeds up to 2.5 mph (4.0 km/h) and at tillage depths up to 22.0 in (559 mm) varied from 177 PTO hp (132 kW) to 246 PTO hp (183 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. Tractor sizes will have ample power reserve to operate in the stated conditions.

The horsepower available from the test tractor allowed for operation at a speed of 2.5 mph (4.0 km/h) and a tillage depth of 22.0 in (559 mm). Increasing the operating speed or tillage depth would require a tractor with higher power take-off horsepower.

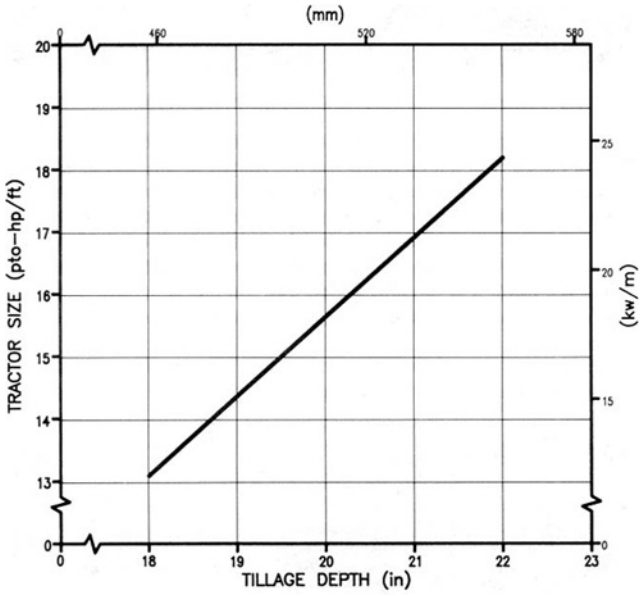


FIGURE 10. Average Horsepower Requirements at 2.5 mph (4.0 km/h).

OPERATOR SAFETY

The Kello-Bilt Series 5000 subsoiler was safe to operate if normal safety precautions were observed. The transport ground clearance of 9.5 in (241 mm) and transport height of 6.4 ft (2.0 m) allowed for safe transportation of the unit. The transport width of the test machine was 14.8 ft (4.5 m). Caution was required when transporting on public roads, over bridges and through gates. The operator's seat belt should be worn during operation.

Transport locks were provided for the hitch cylinder and the transport cylinder. The unit could be safely transported up to speeds of 18.0 mph (29 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 accomodations 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.

The test machine could be safely hitched or unhitched by one person.

OPERATOR'S MANUAL

An operator's manual was not provided with the test unit. It is recommended that the manufacturer consider supplying an operator's manual with the Kello-Bilt subsoiler.

MECHANICAL HISTORY

The Kello-Bilt was operated for 140 hours while deep tilling 672 ac (272 ha). The machine was operated for an additional 79 ac (32 ha) by the manufacturer. The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted. TABLE 2 outlines the mechanical problems that did occur during the functional testing.

TABLE 2. Mechanical History

ITEM	OPERATING EQUIVALENT FIELD AREA HOURS	ac	(ha)
Seven shear bolts were replaced	Throughout the test		
Damaged adjustable T-Bar and repaired at	41	202	(82)
Lost nut from centre shank pivot bolt and replaced at	128	617	(250)
Hydraulic hose damage	Throughout the test		
Right top gauge wheel nut would not turn, repaired at	End of test		
Replaced points at	End of test		

DISCUSSION OF MECHANICAL PROBLEMS

Wear parts: FIGURE 11 shows a new point compared to a worn point. The worn points were changed after subsoiling 750 ac (304 ha) giving 150 ac (61 ha) per point wear. The points were worn out when replaced. The replacement cost of one point was $55.00.

The wear on the 0.75 in (19 mm) thick lower wear plates (FIGURE 12) ranged from 0.42 in (10.7 mm) at the bottom to 0.27 in (6.9 mm) at the top. The wear on the upper wear plates (FIGURE 12) ranged from 0.33 in (8.4 mm) at the bottom to 0.12 in (3.0 mm) at the top. The wear plates should be replaced after wearing out the second set of points.

Hydraulic Hose Damage: The hydraulic hoses rubbed on the steel guide causing damage to the hose coverings. Excessive rubbing could cause hose failure. It is recommended that the manufacturer consider improving the routing of hydraulic hoses to prevent hose failure.

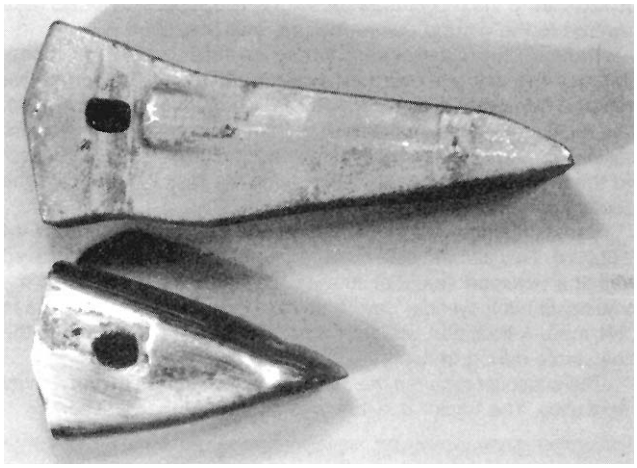


FIGURE 11. Point Wear: Top - New Point, Bottom - Worn. Point.

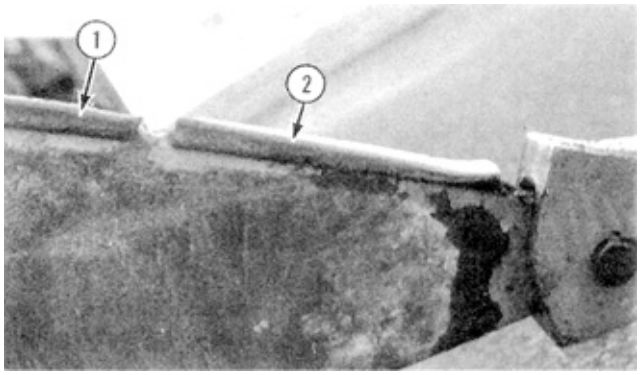


FIGURE 12. Shank Wear Plates: (1) Upper and (2) Lower.

APPENDIX I

MAKE:	Kello-Bilt
MODEL:	Series 5000 Model 530
SERIAL NUMBER:	KB530150162.89
MANUFACTURER:	Kello-Bilt Industries Ltd. P.O. Box 1119 Stettler, Alberta T0C 2L0

OVERALL DIMENSIONS:	**FIELD**	**TRANSPORT**
- Width	14.8 ft (4.5 m)	14.8 ft (4.5 m)
- Length	15.8 ft (4.8 m)	15.1 ft (4.6 m)
- Height	5.5 ft (1.6 m)	6.4 ft (2.0 m)
- Maximum Ground Clearance		9.5 in (241.3 mm)
- Working Width	13.5 ft (4.1 m)	
- Wheel Tread		7.1 ft (2.2m)

HITCH:	
- Type	Trailing Drawbar
- Adjustment	Threaded T-Bar to level, hydraulic cylinder to raise for transport
- Shock Protection	Spring Loaded
SHANKS:	
- Type	Parabolic
- Number	Five
- Spacing	32.5 in (825.5 mm)
- Number of Rows	Three
- Distance between Rows	15.5 in (393.7 mm) between one and two, 22.5 in (571.5 mm) between two and three
- Row Pattern	V-Shaped
- Blade/Point Tip-to-Frame Clearance	3.7 ft (1.1 m) to Frame 3.1 ft (0.9 m) to Shank Assembly
- Shank Thickness	1.5 in (38.1 mm)
- Stone Protection	1.0 in (25.4 mm) Grade 2 Shear Bolt
- Shank Angle	31.5 Degrees
- Maximum Working Depth	26 in (660.4 mm)
- Wear Plates	Two per shank - 0.75 x 2 x 6 in (19 x 50.8 x 152.4 mm) - 0.75x2x 18 in (19 x 50.8 x 457.2 mm)
GAUGE WHEELS:	
- Adjustment	1.5 x 15 in (38.1 x 381.0 mm) threaded rod with locking nuts
- Number	Two
POINT:	
- Type	Wedged onto shank tip
- Mounting	0.5 x 3.25 in (13 x 82.6 mm) Bolt
- Width	3.25 in (82.6 mm) at Tip
- Depth	3.5 in (88.9 mm) at Back
- Length	9.75 in (247.7 mm)
- Rockwell Hardness	52 C
DEPTH CONTROL:	
- Type	Gauge Wheels and Rear Hydraulic Cylinder
- Hydraulic Cylinder Size	5 x 16 in (127 x 406 mm)
FRAME:	
- Shape	V-Shaped
- Cross Section	6 x 6 in (152.4 x 152.4 mm) 6 x 8 in (152.4 x 203.2 mm)
TIRES:	Four 12.4 x 16, 8-ply
NUMBER OF LUBRICATION POINTS	
- Grease Fittings	14
- Wheel Bearings	8 - two per wheel
WEIGHT:	
- Hitch	2030 lb (923 kg)
- Transport Wheels	4370 lb (1986 kg)
- Total	6400 lb (2909 kg)

OPTIONS INCLUDED ON TEST MACHINE:	None
OTHER AVAILABLE OPTIONS:	Extra Heavy Hard Faced Points 30 in (762 mm) Shank Spacing Coulter Type Splitters Wider Clamp-on Shins

APPENDIX II

The following rating scale is used:

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

SUMMARY CHART

RETAIL PRICE:	$14,500 (January 1990, f.o.b. Stettler, Alberta) 14.8 ft (4.5 m) unit complete with five shear bolt protected shanks
QUALITY OF WORK:	
Penetration:	**Good;** points would ride on hardpan in clay soils
Soil Fracturing:	**Good;** reduced in moist soils, secondary tillage conditions and clay soils
Soil Surface:	Four outside shanks made furrows leaving large lumps of soil on the surface
Trash Clearance:	**Very Good**
Stony Conditions:	**Good;** spring hitch did not provide shock protection
EASE OF OPERATION AND ADJUSTMENT:	
Maintenance:	**Very Good;** service schedule not provided
Hitching:	**Very Good;** takes one person 10 min.
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:	**Good;** limited access to lower locking nuts at deeper depths
POWER REQUIREMENTS:	Varied from 177 PTO hp (132 kW) to 246 PTO hp (183 kW), speeds above 2.5 mph (4.0 km/h) and depths greater than 22.0 in (559 mm) would require increased power.
OPERATOR SAFETY:	Safe; seatbelt should be worn when working in subsurface stony conditions
OPERATOR'S MANUAL:	A manual was not provided
MECHANICAL HISTORY:	Seven shear bolts were replaced, 150 ac (60.7 ha) per point wear before replacing. Replacement cost $55.00

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