

Evaluation Report

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Microtek Automatic Depth Controller

A Co-operative Program Between



MICROTEK AUTOMATIC DEPTH CONTROLLER

MANUFACTURER AND DISTRIBUTOR:

Microtek Inc.
165 North Leonard Street
Regina, Saskatchewan
S4N 5X5

RETAIL PRICE:

\$3,500.00 (January, 1986, f.o.b. Lethbridge, Alberta)



FIGURE 1. Microtek Automatic Depth Controller. (1) Main Sensor Cable, (2) Valve Cable, (3) Electro-Hydraulic Solenoid Valve (4) Main Control Cable, (5) Automatic Control Box, (6) Monitor Console, (7) Power Cable, (8) Gauge Wheels, (9) Wing Cables.

SUMMARY

Performance: Functional performance of the Microtek automatic depth control unit was good. Performance was reduced when working in moist conditions due to soil build-up on gauge wheels.

Installation: The Microtek was easily installed by one man in about four hours. No modifications to the tractor or implement were required.

Seed Placement Accuracy: Seed placement accuracy depended on soil conditions. More uniform depth of seed placement resulted when using the depth control unit in varying soil conditions. No difference in seed placement was obtained with and without the depth control in firm soil conditions.

Response: The depth control unit response was acceptable for all types of conditions encountered.

Field Variables: Error in average depth could result when travelling along field ridges. The automatic depth control unit performance was improved when travelling at an angle to field ridges. Similar error in average depths occurred when one cultivator section (one gauge wheel) encountered an extended hard area in the field that it could not properly penetrate. Due to cultivator frame geometry, the depth control system could not effectively maintain a uniform depth through gullies and over sharp hill crests.

Ease of Operation and Adjustment: Control system operation and adjustment were easily performed. An experienced operator could adjust the depth control unit to suit most field conditions in less than fifteen minutes. Implement depth adjustments were easily made from the tractor cab. Approximate depth of tillage could be read from the digital display.

Operator Safety: The Microtek was safe for field and transport use. Implement safety lock-ups should be used to ensure safe transport.

Operator's Manual: The operator's manual was well written and contained useful installation, operation, set-up, maintenance and troubleshooting information.

Mechanical Problems: Two failures occurred during the evaluation. Three o-rings failed and a depth control cable was damaged. Both o-rings and cable required replacing.

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MANUFACTURER'S COMMENTS

1. To reduce soil build up on gauge wheels in moist conditions, tire pressure should be reduced down to 4-6 pounds per square inch to allow more tire flex. This information will be included in the 1986 manual.

2. To improve implement performance in sharply rolling conditions, it is recommended that the centre gauge wheel be placed on the rear frame member of the cultivator.

3. The following improvements have been made to the controller for 1986:

- A ten turn Depth Counting Dial replaces the Zeroing Knob. One complete turn of the Depth Dial, moves the implement one inch in the soil. This permits the operator to adjust his machine more precisely. The Depth Dial has a locking Tab to prevent the Dial from being accidentally bumped, altering implement depth.

- The two High Limit and Low Limit Set Knobs have been replaced by one three position switch. The operator simply turns the switch to the SMOOTH, AVERAGE or ROUGH setting depending on the surface ground condition.

- The Gauge Wheel Synchronizing Screws have been moved from the Gauge Wheels to the Monitor Console enabling one person to synchronize the reading from all three gauge wheels in seconds. This also moves the Adjust Pots from an exterior condition to a dry dust free atmosphere in the tractor cab for greater reliability.

- Separate Up and Down Rate Screws instead of one Rate adjustment for both up and down. This simplifies the adjustment of the implement to make the implement have equal adjustments in both the up and down direction. This allows the operator finger touch adjustment for operating his implement with both cold and warm hydraulic oil. It removes the need to adjust the One Way Flow Control Valve after the oil warms up.

- Self-Diagnostic Troubleshooting Circuit. Involves three Indicator Lamps, one for each Gauge Wheel on the Monitor Console. This circuit automatically disconnects a signal from a Gauge wheel to the monitor console if the signal is broken or shorted due to a broken cable, corroded connector, etc. This error signal then does not disrupt the implement average depth from the other two Gauge Wheels, enabling the operator to continue working if he cannot stop to check for the problem, and still get 80-90% control with two Gauge Wheels. The indicator Lamp on the Console will go out for the Defective Gauge Wheel. This circuit enables the operator to continue working even if he has a problem with one Gauge Wheel, and the Indicator Lamp localizes the problem for the operator.

GENERAL DESCRIPTION

The Microtek automatic depth control system is an electronically controlled, hydraulic system intended for maintaining constant implement depth in varying field conditions.

The depth control system consists of an electronic depth monitor and automatic depth control box mounted in the tractor cab, an electro-hydraulic solenoid valve mounted between the tractor remote hydraulic valve and the implement and three gauge wheels mounted on the implement.

The depth monitor console contains function knobs and rocker switches. The function knobs include "zeroing", "dampening", "high limit alarm", and "low limit alarm" while the rocker switches include "on-off", "power", "alarm", "left gauge wheel", "center gauge wheel", and "right gauge wheel". The automatic depth control box contains "pulse width" and "pulse rate" function knobs, and an "auto-off-lift" switch. A bar graph display is provided for depth monitoring.

The electro-hydraulic solenoid valve is electrically controlled. The pressure and tank ports are connected to the tractor hydraulic remote lines while the two outlet ports are connected to the implement depth cylinders. The Microtek can be used on tractors equipped with either open or closed center hydraulic systems.

The Microtek depth sensors consist of gauge wheels mounted on trailing arms. A potentiometer measures changes in the angle between the trailing arm and the implement frame as the implement depth changes. Each sensor is equipped with a compression spring to apply adjustable ground force and a shock absorber for dampening. The sensors are mounted to the implement frame with U-bolts supplied, to accommodate square tubing ranging in size from 3 to 4 in (75 to 102 mm). The sensors are designed for use on implements with frame heights ranging from 26 to 34 in (660 to 864 mm). The Microtek is powered by the tractor electrical system.

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

SCOPE OF TEST

The Microtek was operated in the field conditions shown in TABLE 1 for about 125 hours. The depth control unit was mounted on a Case 4694 four-wheel drive tractor. The implements used during the testing were a Concord AS1002 air seeder and a Blanchard 5-way air seeder. The Microtek was evaluated for ease of installation, adjustment, operation, safety and reliability. Measurements were taken and observations were made to determine the effectiveness of the depth control system in maintaining uniform implement depth in typical prairie conditions.

TABLE 1. Operating Conditions

CROP	FIELD TILLAGE CONDITION	FIELD AREA		HOURS
		ac	(ha)	
Spring Wheat	Stubble - Primary	120	(48)	13
	Summerfallow - Secondary	610	(244)	54
Durum Wheat	Stubble - Primary	150	(60)	14
	Summerfallow - Secondary	80	(32)	8
Barley	Stubble - Secondary	320	(128)	18
Barley & Oats	Stubble - Secondary	160	(64)	9
Soft Wheat	Stubble - Secondary	160	(64)	9
TOTAL		1600	(640)	125

RESULTS AND DISCUSSION

EASE OF INSTALLATION

The Microtek depth control system was easily installed. FIGURE 2 shows installation of the depth monitor and automatic depth control box in the cab of a Case 4694 tractor. It was necessary to fabricate a mounting bracket to mount the monitor, while

the control box had an adhesive strip on the bottom to allow for quick installation.

A bracket was fabricated to mount the electro-hydraulic solenoid valve on the rear frame member of the Case 4694 tractor (FIGURE 3). The valve could also be mounted on the implement hitch. Hydraulic fittings, hoses and quick couplers were purchased to connect the valve to the tractor hydraulics.

The Microtek gauge wheels were easily mounted on the front frame member of the cultivator used during the test (FIGURE 4). One gauge wheel was mounted on each of the three sections of the cultivator. Electrical cables were strapped to the implement frame and hitch using plastic cable ties.

Installation of the monitor console, depth control box, electro-hydraulic valve and three depth gauge wheels took one man approximately four hours.

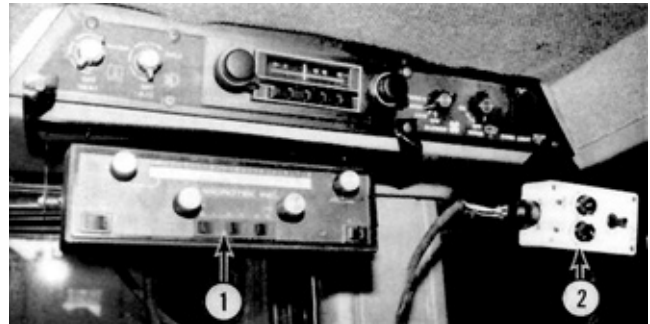


FIGURE 2. Microtek Depth Monitor (1) and Automatic Control Box (2) Mounted in Cab of Tractor.



FIGURE 3. Electro-Hydraulic Solenoid Valve Mounted at Rear of Tractor.



FIGURE 4. Microtek Gauge Wheel Mounted on Cultivator Frame.

QUALITY OF WORK

Seed Placement Accuracy: The Microtek depth control system was used predominately for controlling cultivator depth during normal spring seeding with an air seeder.

In addition to using the Microtek in normal air seeder operation, special field plots were prepared for the purpose of determining controller effectiveness. The test plot preparation work consisted of preworking a number of strips across a summer-fallow field with a cultivator to different depths. This resulted in a variation in field firmness when seeding along the field. Seed depth desired for both test plot and field work was 2.0 to 2.5 in (50 to 63 mm).

Depth control effectiveness was determined both by observing its performance during normal field operation and by comparing seed depth placement in adjacent strips seeded with and without the controller. Seed depth placement was determined by uprooting plants after they emerged and measuring the distance between the seed and the point where the plant emerged through the soil surface. Seed depth measurements were taken across the width of the machine and along the seed rows, both in test plots and in various fields.

Seed placement measurements in firm conditions showed little difference between average seed depth placement when seeding with and without the depth control system. When soil conditions varied from soft to very firm, the depth control system was effective in maintaining a more uniform seed placement depth. For example, without the depth control system, average seeding depth increases of almost an inch (25 mm) were experienced due to the cultivator penetrating deeper in soft conditions. When using the depth control system, little change in average seeding depth was observed.

Response: Response of the Microtek depth control system could be adjusted with the "pulse width" and "pulse rate" function knobs on the control box. The pulse width adjustment was used to set the amount of tillage depth correction (i.e. implement cylinder movement) each time a depth correction was called for. The pulse rate adjustment controlled the frequency of tillage depth adjustment and was used to compensate for the difference in time between when the hydraulics were activated and when the implement actually responded to the change. By use of the pulse rate adjustment "hunting" or searching for the required depth could be eliminated. The depth control system response could be adequately adjusted for all field conditions encountered during the test.

Field Variables: Overall best performance with the Microtek was obtained in fields which had not been previously tilled or on previously tilled fields which had been worked in a different direction or had been harrowed and packed. When working unpacked fields in the same direction as the previous operation, implement depth was subject to any surface ridges. For example, when one or more of the gauge wheels travelled along a surface ridge, the depth control system would adjust the implement to reflect the new depth readout. This readout would not be correct for the total width of the implement.

The effect of surface ridges on depth control could be reduced by travelling across surface ridges at an angle to the previous pass. Also, if the centre gauge wheel could be mounted on the rear frame member of the cultivator, so it travelled on tilled ground, the effect of surface ridging could be reduced. With both of the above approaches, the depth control unit when averaging the readings from the three gauge wheels, provided for improved depth control.

In hard field areas, such as those caused by extensive field traffic, uneven implement penetration occurred. This was evident in areas where one section of the implement encountered a very hard area while the remaining section(s) did not. Due to poor penetration of the implement section in the hard area, the depth control system would want to lower the implement, allowing the remaining implement section(s), which were on softer ground, to penetrate too deep.

In moist conditions, soil would build up on the gauge wheels, resulting in erroneous depth readings.

Due to cultivator frame geometry, the depth control system was not effective in maintaining a uniform depth of tillage when going through gullies or over sharp hill crests.

EASE OF OPERATION AND ADJUSTMENT

Calibration: An experienced operator could calibrate the monitor and control box in less than fifteen minutes. Calibrating the adjustable one way flow control valve and checking of the gauge wheels required two people. The calibration procedure required operation of the tractor and implement in an open, level field at normal operating speeds and conditions. The "zeroing" knob established the ground level reference and was set with the implement just skimming the soil surface. The "dampening" knob was set for changes in depth caused by irregularities in surface conditions. The one way flow control valve was set so that the down rate matched the up rate of the implement.

The "pulse width" knob determined the amount of depth control system response. Proper adjustment of the "pulse width" knob to obtain correct depth corrections was important to ensure adequate depth adjustment response. The "pulse rate" knob was set for the amount of time between corrections. Operator experience was required for proper setting of the "pulse rate" knob for the different soil conditions encountered. The range of response was from zero to four seconds.

The operating depth was set by the "high limit" and "low limit" knobs. The normal depth range was usually set one bar width on either side of the desired depth. Each bar width represented a 1/4 in (6 mm) change in depth.

Although during the first attempt, calibration procedures seemed complex, they became quite easy and simple for an experienced operator.

Depth Adjustment: To change the desired depth simply required changing the "high" and "low" limit knobs. Care had to be taken to ensure the upper and lower limits didn't cross or the controller would adjust both up and down constantly. When adjusting for a deeper depth, the high limit should be adjusted first. Conversely, when decreasing the depth, the lower limit had to be adjusted first.

Hydraulics: The Microtek automatic depth control unit could be used on tractors equipped with either open or closed center hydraulic systems. The maximum flow capacity of the solenoid valve was 18 gal/min (82 L/min) for open center systems and 24 gal/min (109 L/min) for closed center systems.

Visibility: The automatic depth controller was considered advantageous for use with air seeders where visibility of the cultivator was obstructed by the grain tanks. The depth control system provided the operator with an indication of seeding depth.

OPERATOR SAFETY

The Microtek depth control system was considered safe for field and transport use providing adequate precautions were taken. Caution should be used to avoid working under the implement without a safety lock-up in place. A safety lock-up should also be used to ensure safe transport.

OPERATOR'S MANUAL

The operator's manual for the Microtek depth control system contained useful information on components, installation, set-up, maintenance and troubleshooting. The manual was easy to follow and contained good, step-by-step set-up and operating instructions.

MECHANICAL PROBLEMS

The Microtek depth control system was operated in the field for about 125 hours. The intent of the test was functional performance and an extended durability evaluation was not conducted. TABLE 2 outlines the failures that occurred during functional testing.

TABLE 2. Mechanical History

ITEM	OPERATING HOURS
- three o-rings failed and were replaced at	60
- one depth control wire was damaged and replaced at	75

APPENDIX III

CONVERSION TABLE

acres (ac) x 0.40	= hectares (ha)
gallons (gal) x 4.55	= litres (L)
horsepower (hp) x 0.75	= kilowatts (kW)
inches (in) x 25.4	= millimetres (mm)
miles/hour (mph) x 1.61	= kilometres/hour (km/h)
pounds (lb) x 0.45	= kilograms (kg)

APPENDIX I

SPECIFICATIONS

MAKE:	Microtek
MODEL:	DM2
SERIAL NUMBER:	8400556
MANUFACTURER:	Microtek Inc. 165 North Leonard St. Regina, Saskatchewan S4N 5X5
CONTROL CONSOLE:	
- width	3.5 in (89 mm)
- length	11.2 in (285 mm)
- height	3.2 in (81 mm)
- weight	1.2 lb (0.5 kg)
- mounting	modified bracket to mount in tractor
- power supply	12 volt negative ground
GAUGE WHEELS:	
- tire pressure	10 psi
- height adjustment	26 to 34 in (660 to 864mm)
- mounting	two U-bolts
ELECTRO-HYDRAULIC VALVE:	
- make	Rexroth
- model	WE10
- manufacturer	Rexroth Worldwide Hydraulics 2315 City Line Road Bethlehem, PA 18018
width	2.75 in (70 mm)
length	12.3 in (312 mm)
height	4.75 in (121 mm)
solenoid	12 VDC
pressure	5000 psi (34450 kPa)
weight	22 lb (10 kg)
mounting	subplate 2-3/8 in (9 mm) bolts
plumbing	3/4 in (19 mm) NPT

**SUMMARY CHART
MICROTEK AUTOMATIC
DEPTH CONTROLLER**

RETAIL PRICE:	\$3,500.00 (January, 1986, f.o.b. Lethbridge)
QUALITY OF WORK:	
- seed placement accuracy	a more uniform depth of seed placement resulted when using the depth control unit in varying soil conditions. did not improve seed placement within uniform soil conditions. acceptable for all types of conditions encountered.
- response	inadequate depth control when travelling parallel to surface ridges or when penetration uneven across width of implement.
- field variables	inadequate depth control when travelling through gullies or over sharp hill crests.
EASE OF OPERATION AND ADJUSTMENT:	
- calibration	- experienced operator could calibrate in less than fifteen minutes.
- depth adjustment	- range set by "high limit" and "low limit" alarm knobs.
HYDRAULICS:	- could be used on either open or closed hydraulic systems.
VISIBILITY:	- provided indication of tillage depth when implement view was obstructed.
OPERATOR SAFETY:	- safe - implement safety lock-ups should be used for transport.
OPERATOR'S MANUAL:	- easy to follow - contained useful information

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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



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