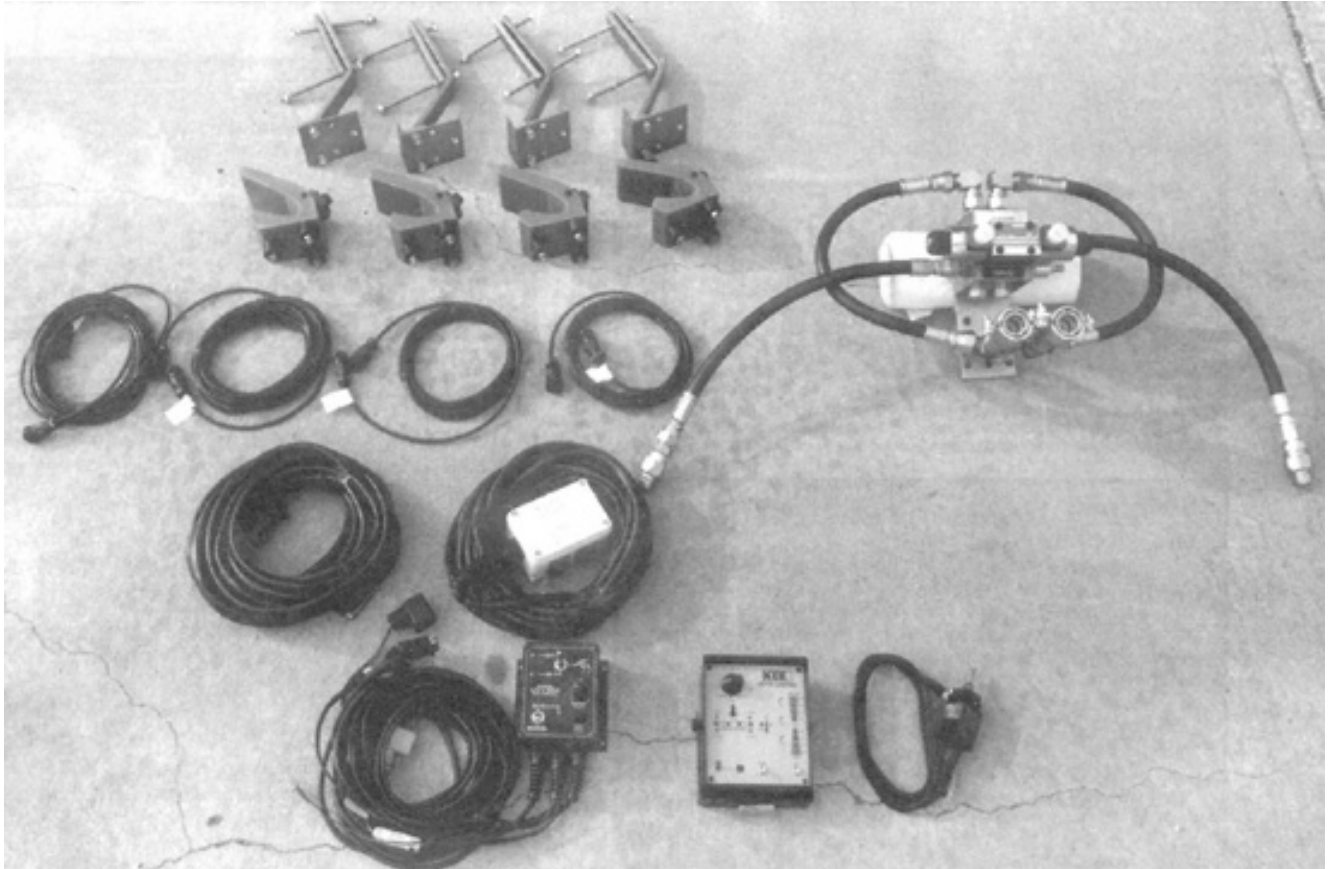


# Evaluation Report 713



## Kee Ultrasonic Depth Control System

A Co-operative Program Between



## KEE ULTRASONIC DEPTH CONTROL SYSTEM

### MANUFACTURER:

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### DISTRIBUTOR:

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### RETAIL PRICE:

\$5,643.00 (August, 1994, f.o.b. Carseland, Alberta) KEE Ultrasonic Depth Control complete with Control Unit, Hydraulic Controller, Four Ultrasonic Sensor Assemblies, Hydraulic Solenoid Valve, Throttle Interlock Switch and Implement and Tractor Cables.

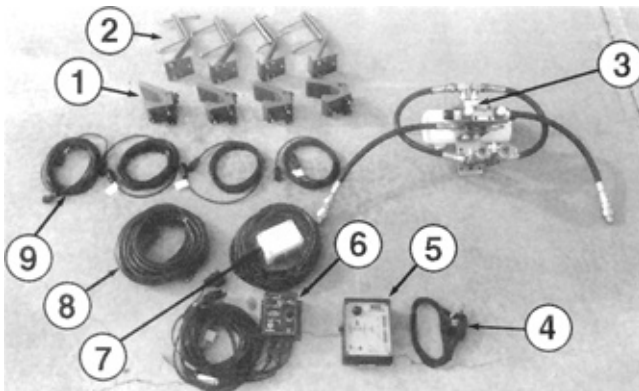


FIGURE 1. KEE Ultrasonic Depth Control: (1) Ultrasonic sensors, (2) sensor mounting brackets, (3) electro-hydraulic solenoid valve, (4) throttle interlock switch, (5) control box, (6) hydraulic controller, (7) sensor junction box, (8) extension cable, (9) sensor cables.

## SUMMARY

### QUALITY OF WORK

Tillage depth accuracy of the KEE Ultrasonic depth control was very good. The depth control was effective in maintaining the desired tillage depth in both normal and deep tilled fields. In primary soil conditions there was no difference in tillage depth between the depth controller and using no depth control.

The depth control response to field surface variations was very good. The depth control was effective in maintaining a constant working depth.

Performance of the KEE depth control was good in variable field conditions. The number of measurements taken and the filtering process of the controller enabled the tillage unit to maintain uniform depth in varying field conditions. The depth controller had difficulty properly adjusting to hard soil conditions and in fields with heavy residue coverage. A temperature sensor allowed the depth controller to correct sensor depth measurements due to changes in the temperature.

### EASE OF OPERATION AND ADJUSTMENT

Ease of calibrating the KEE depth controller was very good. Five minutes was required to calibrate the zero position. The system required rezeroing after cleaning a plugged sensor, changing to a different tillage tool or replacing worn tillage tools.

Ease of setting the depth adjustment was very good. The vertical bar graph on the control box displayed the depth operating range. Implement depth was manually or automatically controlled. In manual operation the tractor's hydraulics were isolated from the control box. The hydraulics then could not be activated automatically.

The hydraulic solenoid valve could be installed on tractors equipped with either open or closed centred hydraulic systems or a load sensing hydraulic system.

## EASE OF INSTALLATION

Ease of installing the KEE depth control system was good. For proper operation of the sensors the distance between the sensor's backing plate and the tillage tool point was 27.5 in (70 cm). The hydraulic lines were difficult to connect to the tractor remote hydraulic couplers. Installation of the control box, hydraulic controller, four sensors, junction box and hydraulic solenoid valve took two people five hours.

## OPERATOR SAFETY

The KEE depth control was safe to operate if normal safety precautions were observed. A throttle interlock switch disabled the automatic operation of the controller at low tractor throttle speeds.

## OPERATOR'S MANUAL

The operator's manual was good. The manual contained useful information on operation, installation and troubleshooting.

## MECHANICAL HISTORY

Two hydraulic coupler fittings were replaced during the test.

## RECOMMENDATIONS

The Alberta Farm Machinery Research Centre (AFMRC) recommends the manufacturer:

1. Supply longer hydraulic lines for easier connection to the tractor hydraulics.
2. Rewrite the manual to ASAE standards.

**Manager: R.P. Atkins, P.Eng.**  
**Field Technologist: G.A. Magyar**

## MANUFACTURER'S REPLIES TO RECOMMENDATIONS:

The manufacturer states that with regards to recommendation number:

1. The kit supplied should have had an additional two short hoses which extend the supplied hoses. The hoses supplied are correct on a John Deere when plugging into their remotes. When connecting our hydraulics to a "Pressure" and "Return" port on the main manifold which creates a complete new set of remotes (on our hydraulics) the additional two hoses are required to comfortably fit. I believe this to be the case on your fitup.
2. We will follow this recommendation and instigate a rewrite of the manual to ASAE standards.

### Additional manufacturer's replies:

1. In relation to the fitting time, the first installation can take quite some time but please note, generally trained dealers fit these units and take an average of four man hours (one person).

## GENERAL DESCRIPTION

The KEE Ultrasonic depth control is an electronically controlled, hydraulic system used to control implement tillage depth in varying field conditions. The system consists of a control box, hydraulic controller, throttle interlock switch, hydraulic solenoid valve and four ultrasonic sensors. The hydraulic controller powers the depth control system while the hydraulic solenoid valve is matched to the tractor's hydraulic system. The four ultrasonic sensors can be mounted on one, three or five frame implements.

The implement working depth is controlled and monitored by the control box and hydraulic controller. The depth sensors transmit an ultrasonic sound wave to the ground. The period of time for the sound wave echo to return to the sensor determines the distance from the ground. The control box processes the depth sensor signals from the four sensors and displays the average depth on the vertical bar graph. The average depth is compared to the desired tillage

depth set on the control box. Any difference in depth is adjusted by the hydraulic controller. The hydraulic controller electronically operates the electro-hydraulic solenoid valve to correct differences in tillage depth. The hydraulic controller can either manually or automatically control the movement of the tractor hydraulics.

The automatic hydraulic control operation is disabled by the throttle interlock switch when the tractor is idling.

The KEE ultrasonic depth control can be used on tractors equipped with either open or closed centred hydraulic systems or a load sensing hydraulic system.

The ultrasonic sensors are secured to the implement frame by mounting brackets. Two sensors are mounted to a front frame member on the centre section, while one sensor is mounted to a front frame member on each wing frame. FIGURE 1 shows the major components. Detailed specifications are given in APPENDIX I.

## SCOPE OF TEST

The KEE Ultrasonic depth control was operated for 167 hours in field conditions shown in TABLE 1. The depth control was used predominantly to control tillage depth when seeding with pneumatic air delivery systems. The KEE depth controller was mounted on two closed centred four-wheel drive tractors and used on an air seeder and air drill. Depth measurements and field observations were made to determine the effectiveness of the depth control system in maintaining uniform implement depth. The unit was evaluated for quality of work, ease of operation and adjustment, ease of installation, operator safety and suitability of the operator's manual.

The unit evaluated by the AFMRC was configured as described in the General Description, FIGURE 1, and the Specifications section in APPENDIX I of this report. The manufacturer may have built different configurations of this unit before and after AFMRC tests. Therefore, when using this report, be sure to first check the unit under consideration is the same as the one reported here. If differences exist, assistance can be obtained from AFMRC or the manufacturer to determine changes in performance.

TABLE 1. Operating Conditions

FIELD CONDITIONS	FIELD AREA		HOURS
	ac	ha	
OPERATION			
- Primary	1105	447	60
- Secondary	2070	838	107
<b>TOTAL</b>	<b>3175</b>	<b>1285</b>	<b>167</b>
STONY PHASE:			
- Stone free	1880	761	96
- Occasional Stones	925	374	51
- Moderately Stony	370	150	20
<b>TOTAL</b>	<b>3175</b>	<b>1285</b>	<b>167</b>
SLOPE CLASS:			
- Level	180	73	8
- Nearly level	340	138	18
- Very gentle slopes	1775	718	93
- Gentle slopes	720	291	39
- Moderate slopes	160	65	9
<b>TOTAL</b>	<b>3175</b>	<b>1285</b>	<b>167</b>

## RESULTS AND DISCUSSION

### QUALITY OF WORK

**Tillage Depth Accuracy:** The tillage depth accuracy of the KEE Ultrasonic depth control was very good. Seed placement measurements showed little difference between the desired and actual seed depth.

Tillage depth accuracy was determined by comparing seed depth placement in adjacent field strips seeded with and without the KEE depth control. In addition to using the depth control in normal pneumatic seeding operations, test plots were prepared to determine controller effectiveness. The test plots consisted of worked and nonworked strips across a primary field. The worked strips were cultivated to different depths. This resulted in a variation in field firmness from primary to deep secondary tillage. Desired seed depth for both test plots and field work ranged between 1.5 and 2.0 in (38 and 51 mm).

Depth control effectiveness was determined by comparing the desired seed depth to the measured seed depth. 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 measure-

ments were taken across the width of the seeding implement and along the seed rows, both in test plots and various fields.

Seed placement measurements for the KEE depth control in various field conditions are shown in TABLE 2. The average seed depth measured in primary soil conditions showed no difference between the KEE depth control and no controller. The depth control was effective in maintaining the desired 1.6 in (40 mm) seed depth in both normal and deep tilled fields compared to no depth control.

TABLE 2. Seed placement measurements for 1.6 in (40 mm) desired seed depth

CONTROL	FIELD CONDITIONS					
	Primary		Normal Tillage		Deep Tillage	
	in	mm	3 in (75 mm) depth		6 in (150 mm) depth	
			in	mm	in	mm
No Control	2.13	54.2	2.34	59.5	3.13	79.4
KEE Control						
- Fast response	2.04	51.9	1.43	36.4	1.34	34.0
- Slow response	2.06	52.4	1.54	39.2	1.49	37.8

**Control Response:** Response of the KEE depth control to field surface variations was very good. The depth control was effective in maintaining a constant working depth.

The depth control was set to either a "fast" or "slow" response setting. The response setting changed the number of depth readings taken to determine the average depth reading. The manufacturer recommended the "slow" response for rough field conditions or when travelling at slow speeds.

**Field Variables:** Performance of the KEE depth control was good in variable field conditions. The controller determined if a signal from a sensor was a correct estimate of the tillage depth and whether the value should be ignored by comparing the signal to the average of the signals from the other sensors. The number of measurements taken and the filtering process of the controller enabled the tillage unit to maintain uniform depth in varying field conditions.

The depth control reduced the effect of surface ridging on the average tillage depth when working in the same direction as the previous operation. Uniform depth was maintained because of the location of the depth control sensors and the ability of the controller to ignore signals from the sensors which were not a correct estimate of the average tillage depth.

The depth control had difficulty properly adjusting to hard soil conditions. Uneven penetration of the tillage unit resulted in a portion of the implement working at a deeper depth than indicated on the depth control box.

Working in field conditions with heavy residue coverage affected the operation of the depth control. The sound waves from the sensors could not penetrate the residue cover. The result was the tillage implement worked at a shallower depth than indicated on the depth control box.

A temperature sensor was mounted in the cable junction box to allow the depth control to correct sensor measurements due to temperature changes.

### EASE OF OPERATION AND ADJUSTMENT

**Calibration:** Ease of calibrating the KEE depth controller was very good. Five minutes were required to calibrate the zero position.

During calibration the tractor and implement were operated in a level field at a slow forward speed. The "auto-manual" toggle switch was placed in the manual position and the "select-depth" dial knob turned to read zero. While moving forward the "implement out-in" toggle switch was activated to hydraulically raise or lower the implement until the tillage tools were scraping the soil surface. The "zero" toggle switch was then held down until the horizontal sensor lights started to flash. The system was zeroed when the lights stopped flashing.

When the control box detected a faulty sensor during calibration the depth control system could be operated on three sensors. The system ignored the faulty sensor measurements. The faulty sensors were due to plugged sensors. Rezeroing of the system was required after cleaning the faulty sensor. Rezeroing was also required after changing to a different tillage tool or after replacing worn tillage tools.

**Depth Adjustment:** Ease of setting the depth adjustment was very good. The working depth was changed by adjusting the "select-depth" dial knob on the control box (FIGURE 2). The depth operating ranged from 0 to 6.3 in (0 to 16 cm).

The vertical bar graph on the control box displayed the depth operating range. Four hydraulic sensor lights displayed the opera-

tion of each sensor. A "high" and "low" wing sensor light displayed when a wing depth was above or below the centre sensors by more than 1.2 in (3 cm). The implement depth could be manually or automatically controlled (FIGURE 2). In manual operation the operator was required to toggle the "implement out-in" switch to control the implement depth. In automatic operation the depth control electronically controlled the implement depth. An "auto" light on the control box displayed when the unit was automatically controlling the tractor hydraulics.

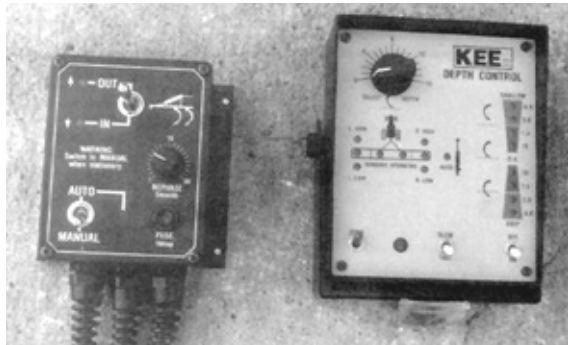


FIGURE 2. KEE hydraulic controller (left) and depth control box (right).

**Manual Override:** Manual override of the KEE depth controller was very good. When the "auto-manual" switch was in manual operation the tractor's hydraulics were isolated from the control box. The hydraulics then could not be activated automatically.

The "implement out-in" toggle switch overrode the automatic control when activated. When turning at headlands the toggle switch was activated twice in the "out" direction which fully raised the implement. To reengage the automatic operation the toggle switch was activated once in the "in" direction. A "rephase" knob on the hydraulic controller set the time required to rephase the hydraulic cylinders when in the raised position.

#### EASE OF INSTALLATION

Ease of installing the KEE depth control system was good. Installation included installing the control box, hydraulic controller and throttle interlock switch, mounting the ultrasonic sensors, cable junction box and hydraulic solenoid valve, and routing the electrical cables.

The KEE control box and hydraulic controller (FIGURE 3) were installed in the tractor cab within easy reach and view of the operator. The throttle interlock switch was mounted to the tractor's throttle control. The ultrasonic sensors were secured to the implement frame by mounting brackets (FIGURE 4). Two sensors were mounted to a front frame member on the centre section, while one sensor was mounted to a front frame member on each wing frame. The manufacturer stated for proper operation of the sensors the distance between the sensor's backing plate and the tillage tool point had to be 26.5 in (70 cm).



FIGURE 3. Depth control box and controller mounted in tractor cab.



FIGURE 4. Ultrasonic sensor mounted on tillage frame.



FIGURE 5. Hydraulic solenoid valve mounted at rear of tractor.

The junction box was mounted on the implement between the two centre frame sensors. The box was positioned in an area away from direct sunlight for the temperature sensor to work properly.

The hydraulic solenoid valve could be installed on tractors equipped with either open or closed centred hydraulic systems or a load sensing hydraulic system. A bracket was fabricated to secure the hydraulic solenoid valve (FIGURE 5) to the rear of the John Deere tractor. The pressure and tank ports were connected to the tractor hydraulic remote couplers. The two outlet ports were connected to the implement depth control system. The hydraulic lines were difficult to connect to the tractor hydraulic remote couplers. The AFMRC recommends the manufacturer supply longer hydraulic lines for easier connection to the tractor hydraulics.

Installation of the control box, hydraulic controller, four sensors, junction box and hydraulic solenoid valve took two people five hours.

#### OPERATOR SAFETY

The KEE depth control was safe to operate if normal safety precautions were observed. A throttle interlock switch disabled the automatic operation of the controller at low tractor throttle speeds. Before working on the tillage implement the operator should secure the transport locks or lower the implement to the ground.

#### OPERATOR'S MANUAL

The operator's manual was good. The manual contained useful information on operation, installation and troubleshooting. The information in the manual did not follow ASAE standards. The AFMRC recommends the manufacturer rewrite the manual to ASAE standards. A parts list was not provided.

#### MECHANICAL HISTORY

The KEE Ultrasonic depth control was operated in the field for 167 hours. The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted. TABLE 3 outlines the mechanical problems that did occur during the functional testing.

**TABLE 3.** Mechanical History

<b>ITEM</b>	<b>OPERATING HOURS</b>
Replaced leaking hydraulic coupler	60, 140

**APPENDIX I**  
**SPECIFICATIONS**

<b>MAKE:</b>	K. Eldredge Electronics Pty. Ltd.
<b>MODEL:</b>	KEE Depth Control
<b>SERIAL NUMBER:</b>	9311365
<b>MANUFACTURER:</b>	K. Eldredge Electronics Pty. Ltd. 36 New Road, Box 294 Clare, South Australia AUSTRALIA 5453 Phone: 011-6118-423188
<b>DISTRIBUTOR:</b>	K. Eldredge Electronics (Canada) Ltd. Box 188 Carseland, Alberta T0J 0M0 Phone: (403) 934-3591
<b>CONTROL CONSOLE:</b>	
- width	2.5 in (64 mm)
- length	4.8 in (122 mm)
- height	5.8 in (147 mm)
- weight	2.4 lb (1.1 kg)
- mounting	3.5 x 5 in (89 x 127 mm) hanging bracket
- power supply	powered by hydraulic controller
<b>HYDRAULIC CONTROLLER:</b>	
- width	2.0 in (51 mm)
- length	4.3 in (109 mm)
- height	4.5 in (114 mm)
- weight	2.2 lb (1.0 kg)
- mounting	four, 1/8 in (3 mm) screws or adhesive tape
- fuse	10 amp
- power supply	12 volt DC negative ground, 25 amp in-line fuse
- cables	11.3 ft (3.5 m) power supply 8.2 ft (2.5 m) control console 4.4 ft (1.3 m) hydraulic solenoid valve 1.5 ft (0.5 m) throttle switch
- throttle switch	disables automatic operation of controller
<b>SENSORS:</b>	
- number	four
- width	3.0 in (76 mm)
- length	4.8 in (122 mm)
- height	3.6 in (91 mm)
- mounting	adjustable implement mounting bracket
<b>JUNCTION BOX:</b>	
- width	2.3 in (58 mm)
- length	3.1 in (79 mm)
- height	4.5 in (114 mm)
- cables	27.9 ft (8.5 m) tractor to implement 27.9 ft (8.5 m) implement to junction box
<b>HYDRAULIC SOLENOID VALVE:</b>	
- make	Bosch
- model	081091211
- manufacturer	Robert Bosch GMBH Platz 1, Stuttgart 1 GERMANY
- width	8.5 in (216 mm)
- length	9.0 in (229 mm)
- height	8.5 in (216 mm)
- solenoid	12 volt DC, 2.7 amp
- pressure	315 bar (31500 kPa)
- weight	19 lb (8.6 kg)
- mounting	3 x 6.1 in (76 x 155 mm) subplate
- plumbing	3/4 and 7/8 in (19 and 22 mm) UNF
<b>OPTIONAL EQUIPMENT:</b>	27.9 ft (8.5 m) junction box extension cable, hydraulic solenoid valve for open centre or floating tractor hydraulic systems

**APPENDIX II**

**MACHINERY RATINGS**

The following rating scale is used in Alberta Farm machinery Research Centre Evaluation Reports.

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

## SUMMARY CHART

### KEE ULTRASONIC DEPTH CONTROL SYSTEM

**RETAIL PRICE:** \$5,643.00 (August, 1994, f.o.b. Carseland, Alberta)

**QUALITY OF WORK:**

- tillage depth accuracy **very good;** maintained desired seed depth in normal and deep tillage conditions
- response **very good;** effective in maintaining a constant working depth
- field variables **good;** difficulty properly adjusting to hard soil conditions and fields with heavy residue coverage

**EASE OF OPERATION AND ADJUSTMENT:**

- calibration **very good;** required five minutes to calibrate the zero position
- depth adjustment **very good;** depth manually or automatically controlled
- manual override **very good;** control box could not operate tractor hydraulics when in manual

**EASE OF INSTALLATION:** **good;** required five hours to install

**OPERATOR SAFETY:** **safe;** throttle interlock switch disables automatic operation at low tractor throttle speeds

**OPERATOR'S MANUAL:** **good;** contained useful information

**MECHANICAL HISTORY:** two hydraulic coupler fittings were replaced during the test



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