

# Evaluation Report

# 46



## Watchdog Model AG3 Shaft Speed Monitor

A Co-operative Program Between



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PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

# WATCHDOG MODEL AG3 SHAFT SPEED MONITOR

## MANUFACTURER:

Watchdog Inc.  
 Box 438  
 Parkwater Station  
 Spokane, Washington  
 U.S.A. 99211

## DISTRIBUTOR:

Westward Pads Services Ltd.  
 651 7 - 67th Street  
 Red Deer, Alberta  
 T4P 1A3

## RETAIL PRICE:

\$660.00 (June, 1978, f.o.b. Humboldt with 6 channel control box, combination combine and drill detector package and 9.1 m (30 ft) extension)

### SUMMARY AND CONCLUSIONS

The Watchdog model AG3 shaft speed monitor was suitable for monitoring both slow and high speed shafts on agricultural machines and for signalling the operator that machine components had stopped or were operating at too slow a speed. The detectors were capable of monitoring slow speed components such as grain drill seed metering shafts and high speed shafts such as on combine straw choppers.

The control box channel lights were bright enough to signal the operator providing the control panel was not in direct sunlight. The audible alarm was loud enough to be clearly heard above tractor or combine noise.

Five channels could be successfully used for shaft speeds below 2200 rpm while the sixth channel was suited for shaft speeds above 3500 rpm. System sensitivity was adequate for all applications and was largely dependent upon fine adjustment of the speed dials. It was found most suitable to adjust sensitivity to cause the operator alarm to be triggered with a 20% drop in component speed. Response time was about 10 seconds for slowly turning shafts and was virtually instantaneous for high speed shafts. Response time was adequate for all applications.

The monitoring system could be installed in about five hours on a multiple grain drill hookup and could be installed in about four hours on a self-propelled combine. Alignment of the detectors was difficult due to the limited range of adjustment in the mounting brackets. The bar magnets were too long for mounting on the seed metering shafts of several common drills.

The operator's manual was brief and poorly illustrated. It was vague regarding identification of components and relative positioning of detectors and magnets.

### RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the bar magnets to permit installation on all common grain drill seed metering shafts.
2. Supplying mounting brackets for grain drills and increasing the range of detector adjustment to aid in installation.

Chief Engineer -- E. O. Nyborg

Senior Engineer -- L. G. Smith

Project Engineer -- G. E. Frehlich

### THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Where standard magnet length inhibits installation on a particular grain drill shaft, cut the plastic material from the magnet and use wire ties over the magnet to secure them to the feeder shaft.
2. This recommendation is presently being considered.

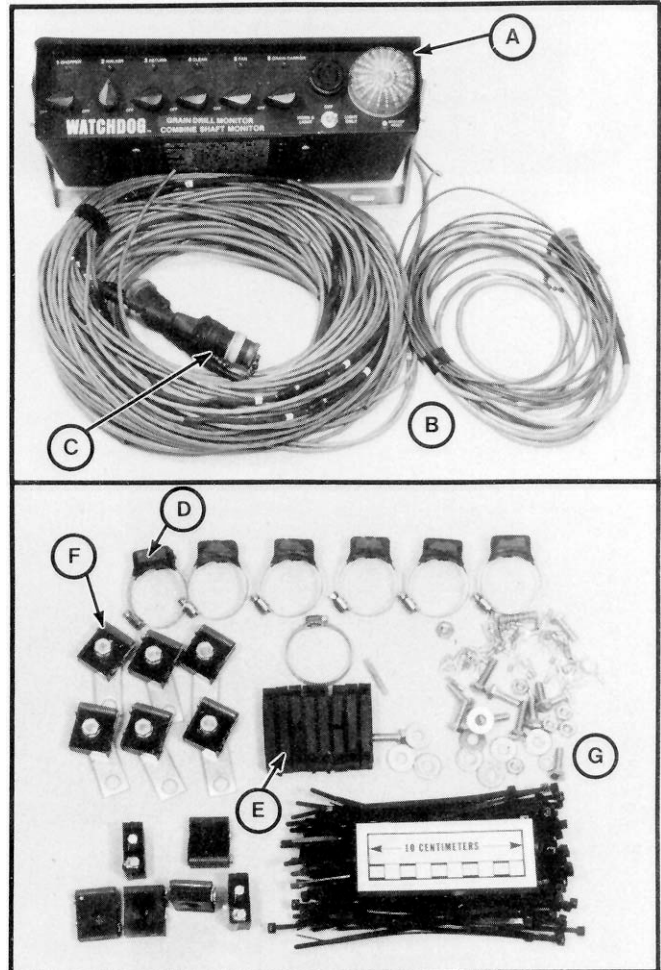


FIGURE 1. Watchdog Shaft Speed Monitor: (A) control box, (B) wiring harness, (C) quick connector, (D) magnets for combine mounting, (E) magnets for drill mounting, (F) detectors, (G) mounting hardware.

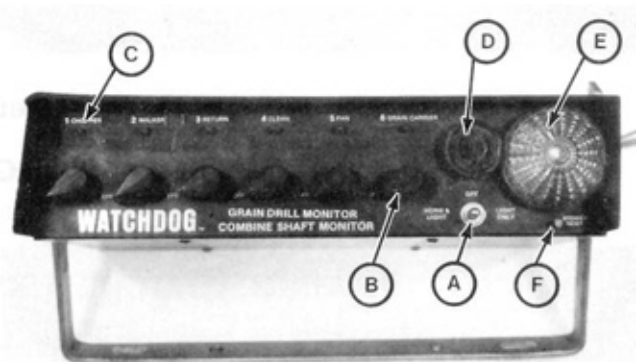


FIGURE 2. Control Box: (A) power switch, (B) speed adjustment dials, (C) channel warning lights, (D) buzzer, (E) main alarm light, (F) breaker reset button.

## GENERAL DESCRIPTION

The Watchdog model AG3 shaft speed monitor is designed to monitor slow speed shafts such as grain drill seed metering shafts and high speed shafts such as combine straw chopper shafts. It can be set to warn an operator that shafts have stopped or are turning slower than desired. The monitor will also indicate overheating of bearings. It is powered by the tractor or combine electrical system and will operate on either positive or negative ground circuits. The standard control box will monitor up to six shafts.

The Watchdog AG3 consists of a control box that is mounted near the operator, detectors, magnets, wiring harness and the necessary mounting hardware and instructions. The detectors are small magnetic switches that are activated by magnets attached to a rotating shaft.

Detailed specifications are given in APPENDIX I.

## SCOPE OF TEST

The Watchdog model AG3 was used for 45 hours on a grain drill and for 50 hours on a self-propelled combine. It was evaluated for ease of installation, ease of operation and adjustment, quality of work and suitability of the operator's manual.

## RESULTS AND DISCUSSION

### EASE OF INSTALLATION

**Installation Time:** Installation of the Watchdog AG3 on a grain drill or a combine was easy but fairly lengthy. It took about five hours to install the system on a grain drill and four hours to install it on a self-propelled combine. Installation instructions were quite brief and vague regarding the relative positioning of the magnets and detectors.

**Control Box:** The control box (FIGURE 2) is mounted in a convenient location in the tractor or combine cab. The large size of the control box restricts its location to only a few areas within a cab. The control box face should not be positioned in direct sunlight to provide clear viewing of the channel lights. The control box attaches with two bolts and is wired directly into the vehicle electrical system. With the quick couplers supplied, the tractor mounted control box may be used for monitoring either drills or a pull-type combine.

**Installation on Grain Drills:** Installing the detector system on a grain drill is fairly easy. Small bar magnets are attached to the seed metering shaft with plastic ties (FIGURE 3). A detector has to be installed adjacent to each magnet and is attached to the seed box or drill frame with a mounting bracket. The grain drill detector mounting brackets had to be fabricated as they were not supplied by the manufacturer. The detector can be located at any angle to the magnet but the painted end must be positioned within 6 mm (0.25 in) of the magnet.

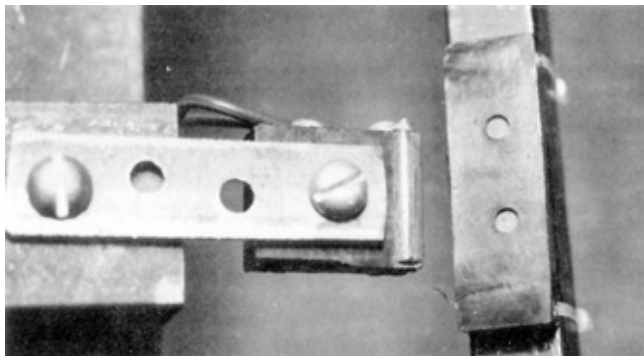


FIGURE 3. Bar Magnet Attached to the Seed Metering Shaft.

The bar magnets were too long to fit between the seed cups on two different makes of press drills. On these drills, hose clamp magnets from the combine detector system had to be installed on the primary drive shafts (FIGURE 4) although in this location, the system could not detect failure of the seed metering drive chain. It is recommended that the manufacturer modify the bar magnets to

permit installation on all common grain drills and supply suitable grain drill mounting brackets.

**Installation on Combines:** Installation of the system on a combine was similar to installation on grain drills. The hose clamp magnets are attached to selected rotating shafts. Detectors are attached to the combine body with mounting brackets and positioned within 6 mm (0.25 in) of the magnet (FIGURE 5). The detector mounting brackets supplied by the manufacturer were modified to suit the mounting location. The hose clamp magnets are encased in a plastic which melts at about 120°C. A hot shaft, caused by an overheating bearing will melt the plastic, causing the magnet to drop off thereby signalling the operator of bearing failure.

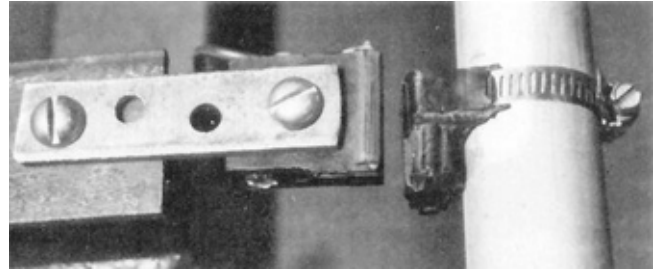


FIGURE 4. Hose Clamp Magnet Attached to the Primary Drill Drive Shaft.

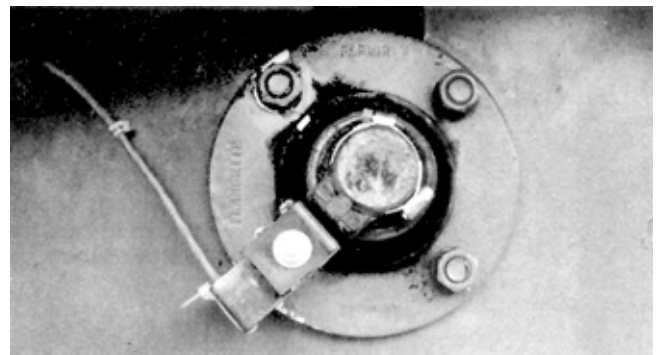


FIGURE 5. Detector and Magnet Mounted on a Straw Chopper Shaft.

**Wiring Harness:** The wiring harness included a sufficient number of ties for securing cables away from pinch points and moving components. Connections at the detectors were screw terminals and connections to the control box were through a quick connector. Cables were attached to the detectors either by looping the wires or by using crimp-on connectors.

Pull-apart connectors at the tractor and between individual drills were included to permit unhitching.

### EASE OF OPERATION AND ADJUSTMENT

Only occasional adjustments were needed once the detectors had been properly installed. Occasional checks were required to ensure that cables were properly attached and clear of moving parts.

A switch on the back of the control box selected either a low or high speed operating range for monitoring drills or combines, respectively. Each channel was equipped with a dial for setting the desired alarm speed. This set the shaft speed at which a flashing channel light and buzzer would be activated to signal the operator. Channel lights were quite visible as long as the control box face was not in direct sunlight. The warning lights could be used with or without the buzzer by selecting the proper position of the power switch. The buzzer was clearly audible above tractor or combine noise.

Final adjustments to obtain the 6 mm (0.25 in) gap between magnets and detectors were difficult due to the limited movement permitted by the mounting brackets.

## QUALITY OF WORK

**Operating Range:** The detectors were capable of monitoring shaft speeds from 5 to 500 rpm, with the control box on the low speed drill setting and with one magnet attached to the seed shaft. Slower shaft speeds could be monitored by attaching more magnets to each shaft. At the high speed combine setting, shaft speeds from 35 to 2200 rpm could be monitored with one magnet attached to the rotating shaft. Channel number one was designed to monitor shaft speeds above 3500 rpm, such as straw chopper shafts.

**Sensitivity:** The amount of shaft speed reduction necessary to activate the alarm was adjustable. With the control box set for slow speed monitoring of drills, the minimum speed reduction required to trigger the alarm varied from 3 to 24% of shaft speed. With the control box set for high speed monitoring of combines, the minimum shaft speed reduction required to trigger the alarm varied from 1 to 26% of shaft speed. The sensitivity was generally dependent on the operator's ability to control the speed adjustment dials.

For most applications it was suitable to set the sensitivity so that a 20% reduction in shaft speed would trigger the alarm. In this way, slipping belts or malfunctioning components could be detected before damage or blockage occurred but minor normal speed variations would not be detected.

**Response Time:** The time required for the indicator to detect a shaft speed reduction depended upon the shaft speed, the number of pickups used on each shaft and the control box setting. Since the monitor compared the time between consecutive on-off pulses, the response time was longer for slowly turning shafts than for high speed shafts. It took about 10 seconds to activate the alarm on very slow shafts while activation was virtually instantaneous on high speed shafts.

**Environmental Effects:** The detectors were well sealed and were not affected by rain or moisture. The chaff and dust common to normal combine operation did not hamper detector performance.

## OPERATOR'S MANUAL

Instructions supplied by the manufacturer consisted of two pages for grain drill monitoring and three pages for combine monitoring. Installation instructions were brief and poorly illustrated. Detector and magnet positioning instructions were vague. The various parts of the monitoring system were not identified and the speed selection switch at the back of the control box was neither mentioned nor its purpose explained.

## POWER REQUIREMENTS

The Watchdog shaft speed monitor drew a maximum current of 0.4A and could be attached to a 12 volt electrical system with either a positive or negative ground.

## DURABILITY RESULTS

The Watchdog model AG3 shaft speed monitor was operated in the field for 95 hours. The intent of the test was functional evaluation and an extended durability evaluation was not conducted. Two of the detectors failed during combine operation. One of the failures occurred when a shaft magnet contacted the detector face, damaging it. The second failure was due to a malfunction of a magnetic reed switch.

## APPENDIX I

### SPECIFICATIONS

MAKE:	Watchdog Shaft Speed Monitor
MODEL:	AG3
SERIAL NUMBER:	281
ELECTRICAL POWER	
REQUIREMENTS:	12V DC
CONTROL BOX:	
- size	330 x 76 x 230 mm (13 x 3 x 9 in)
- number of channels	6
- alarm system	buzzer and warning lights
- controls	on-off power switch, shaft speed adjustment dials, speed range switch
CONNECTORS:	screw and crimp on detector connections, pull apart control box connection.
DETECTORS:	
- type	magnetic reed switch detectors
- number	6 combine detectors 6 grain drill detectors
OPTIONS:	drill wing harness extensions, 9.1 m (30 ft) harness extension, 12.2 (40 ft) harness extensions.

## APPENDIX II

### METRIC UNITS

In keeping with the Canadian Metric Conversion Program, this report has been prepared in SI units. For comparative purposes, the following conversions may be used.

1 metre (m) = 1000 millimetres (mm) = 39.37 inches (in)



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