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MONITOR Metric
Instruction book
674774-GB-84/4

DESCRIPTION

The HARDI spray monitor measures sprayer speed and application rate of spray liquid etc. To measure the speed a magnetic impulse meter is used. This is placed for instance on the front wheel of the tractor or in the case of a trailer sprayer on the sprayer wheel. The speed sensor is actuated by a number of magnets which send electric signals to the monitor which converts this into the speed read out.

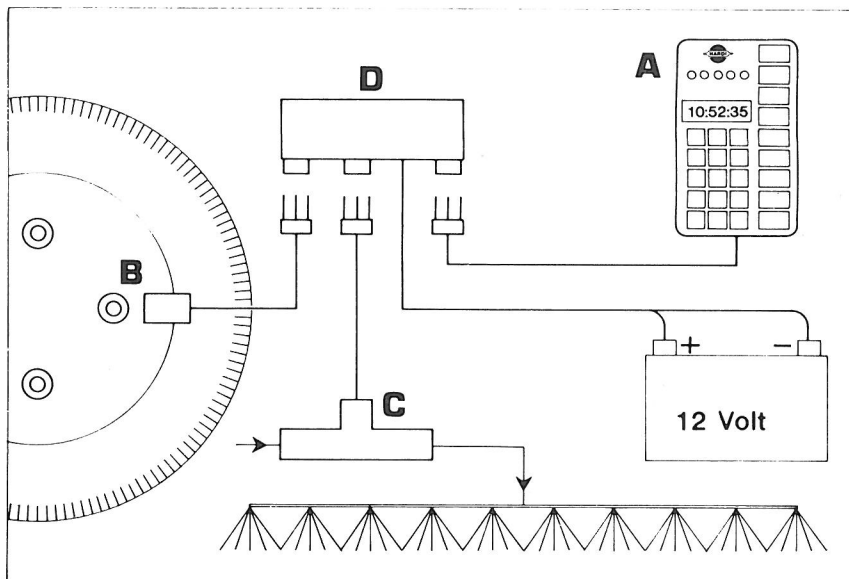
To measure the output of liquid to the spray nozzles a flowmeter is used which sends electric signals to the monitor. The monitor converts these electric signals to output/ha of the spray liquid.

The spray monitor is built up around a 6-figured LCD-display and an easily operated keyboard, which is divided into two sections:

- A. Function keys with one function per key.
- B. Keyboard with the numbers: 0-9 including coding and erasing keys etc.

The functions are activated by a single touch on the corresponding key emitting simultaneously sound- and light signals.

OPERATING DIAGRAM



- A. Spray monitor with keyboard
- B. Speed sensor with magnets
- C. Flowmeter mounted in the main feed line to the spray boom
- D. Assembly box:
Cables from spray monitor, speed sensor and flowmeter are connected to the assembly box by means of plug. The system requires a current supply of 12V D.C., which is connected to the assembly box from the tractor battery.

Important

The spray monitor can be adjusted to operate with one of two different unitary systems. A reverse switch under lid of the assembly box must be set in the desired position before calibration etc. is started.

1. Metric (Switch position):

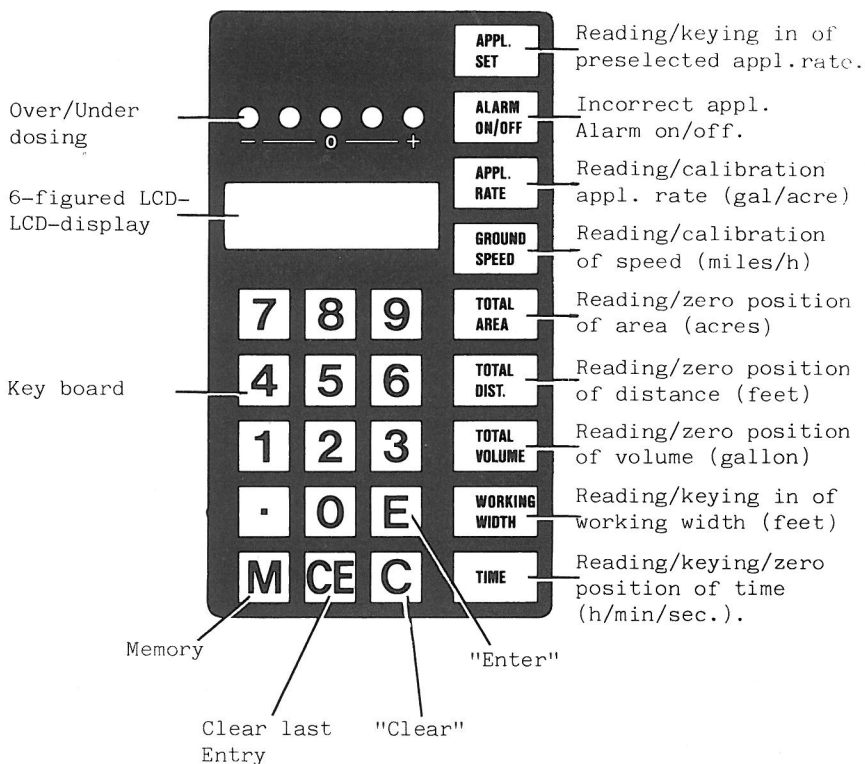
This means that the unit of length is METRES, the

unit of volume is LITRES, the unit of area is HECTARES and the speed is measured in KM/HOUR.

2. IMP/US (Switch position):

This means that the unit of length is FEET, the unit of volume is GALLONS, the unit of area is ACRES and the speed is measured in MILES/HOUR. This kind of unit system is used almost exclusively in English-speaking countries.

THE KEYBOARD OF THE SPRAY MONITOR



OPERATING INSTRUCTIONS

In connection with calibration, adjustment of the clock etc. figures are keyed in on the keyboard of the spray monitor. By keying thus, a sound signal is given and each single figure will be shown on the digital display.

NB! BEFORE KEYING FIGURES, THE CLEAR KEY "C" SHOULD BE ACTIVATED.

When miskeying, the Clear Entry Key "CE" is pressed thus clearing the display whereafter the correct figure can be keyed in.

When keying new numerical values for each function the corresponding red light will flash. This means that the function has received new numerical values. Another press on the key and the red light will stay on.

APPLICATION SET:

The chosen application rate in litre per hectare is keyed using application set touch key.

Keying/changing of application rate (example 200 l/ha).

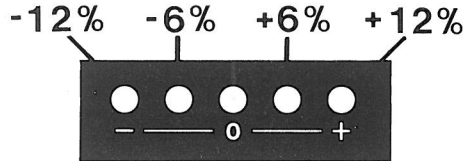


Demonstration of keyed application rate.



ALARM ON/OFF:

Correct or incorrect application rate is shown by means of 5 "watching lights". During correct application the middle green lamp will light depending on the deviation expressed in percentage, and at the same time a sound signal is heard in the form of a bleep.



The alarm is set/turned off by pressing the "ALARM ON/OFF" key.



NB! The alarm function should be disconnected when not spraying.

APPLICATION RATE:

The actual dosing in litres per hectare is shown by pressing the function key "APPLICATION RATE". Actual output is monitored every second and the information fed into the display.

Change of application rate can be made by changing forward speed and/or by changing the spraying pressure.

Should a sudden change in the application rate arise, the reason should be examined at once. Normally the reason is found in the operating parts of the sprayer as for instance the pump, hoses, operating unit, blocking up of the liquid system, filters etc.

Reading of actual application rate.



GROUND SPEED:

The forward speed is shown by pressing the function key "GROUND SPEED". The display will then show the speed to one decimal point. New information is continuously sent to the monitor from the speed sensor.

Reading of "GROUND SPEED".



TOTAL AREA:

By pressing the function key "TOTAL AREA" it is shown to two decimals how many hectares have been sprayed since setting to zero.

When the spraying is interrupted as on turning off at headlands the calculation of the area sprayed will stop automatically until turning on sprayer again.

When the spray monitor is used in connection with other agricultural implements (i.e. when the flow meter is not connected to the assembly box) the calculation of the area covered takes place continuously.

It can show up to 9,999.99 ha.

Adjustment of the zero is performed as shown.



Reading of this TOTAL AREA function.



TOTAL DIST.:

Pressing the function key "TOTAL DIST." shows how many metres have been covered since the last adjustment to zero. Up to 999,999 metres can be shown.

Adjustment of the zero takes place like this:



Reading of this trip control function.



TOTAL VOLUME:

The spray monitor measures and totals up the consumption on spray liquid. Pressing the function key "TOTAL VOLUME" shows how many litres of liquid have passed through the flowmeter since the last adjustment to zero.

The flowmeter can be used for different measurements as for instance:

- To check total tank capacity against notional capacity.
- the number of litres sprayed on a field.
- The number of litres sprayed in a day.
- The number of litres sprayed in a season.
- Up to 999,999 litres can be shown.

Adjustment to zero takes place like this.



Reading of the function of the flowmeter.

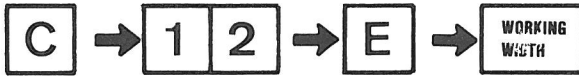


WORKING WIDTH:

By pressing the function key "WORKING WIDTH", the width is shown that is used when calculating "TOTAL AREA" and "APPL. RATE. Therefore it is most important that the exact working width is correctly keyed in as otherwise wrong totals for area and capacity will be calculated.

NB! The width must be keyed in complete metres only.

Keying/changing of the working width (example 12 metre spray boom).



Reading of keyed working width.



TIME:

The spray monitor has a 24 hours digital clock, showing hours/minutes/seconds. Besides showing the current time, the clock can be used as stop clock by adjustment of the zero.

Adjustment of the hour.
(Example 9.45.21 hours)



(Example 14.37.00 hours)



Adjustment of the zero



Reading of the hour.



When connecting the current and in case of temporary cutting off of the current, the spray monitor automatically shifts to the clock-function. When the clock works constantly after connection the current, the monitor is "READY TO WORK" and the desired function can be used. When the current is disconnected, the clock will stop.

CALIBRATION

For the spray monitor to give accurate information it is necessary to carefully calibrate both the speed sensor and the flowmeter.

The calibration numbers are constants which are keyed into the spray monitor. These calibration constants convert the electrical signals from the speed sensor into distance in metres and convert the electrical signals from the flowmeter into volume of liquid in litres. Together with the keyed in working width these constants form the basis of the calculations in the monitor of "GROUND SPEED" and "APPLICATION RATE" as well as over- and under dosage rate.

Different physical conditions such as wear and tear of the tyres, changed soil conditions, spray liquid viscosity etc. are all factors that may need cause for adjustment of the calibration constants. These constants must therefore frequently be checked and adjusted where necessary.

CALIBRATION OF THE SPEED SENSOR:

The speed sensor which is mounted close to the wheel rim is passed by magnets fastened on the rim. The speed sensor sends electrical impulses for each

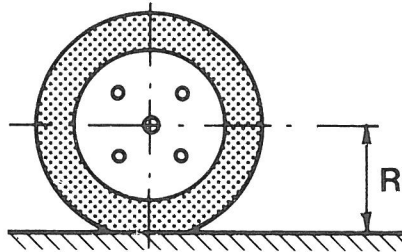
revolution of the wheel corresponding to the number of magnets used. Three different methods of calibration can be used:

- A. Calibration by calculation
- B. Calibration by trials
- C. Calibration by keying in of numbers from earlier experiences/trials/calculations.

A. Calibration by Calculation:

The calibration constant to be keyed in for the speed is calculated as follows:

R = roll radius is distance (in millimetres) from dead centre of the axle to the floor on a firm surface.



The calibration constant:

$$\frac{2 \times \pi \times R}{N} = \frac{2 \times 3.14 \times R}{N}$$

Where N stands for the number of magnets mounted on the rim.

Example!

R = 485 millimetres
 N = 4 (number of magnets)

The calibration constant:

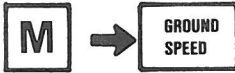
$$\frac{2 \times 3.14 \times 485}{4} = 762$$

The calibration constant corresponds to the length in millimetre that the wheel moves on the surface of the earth between two magnets.

Keying/changing of the calibration constant.



Check/display of the calibration constant.



B. Calibration by Trials:

This calibration takes place by driving a measured distance. This could be for instance the distance between 2 trees, the milestones on the roads etc.

NB! The distance must be at least 75 metres.

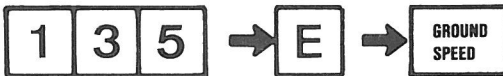
Now the spray monitor calculates automatically the calibration constant by dividing the driven distance by the number of impulses from the magnets.

Example!

A known distance is for instance 135 metres (without decimals). At the starting point the following is keyed:



The distance is covered and the machine is stopped when reaching the stop point. Now the 135 metres are keyed.



The spray monitor now shifts automatically to the "CLOCK FUNCTION". This means that the calibration has been done correctly.

Check display of the calibration constant



C. Calibration by Keying:

It will often turn out to be suitable to calibrate or adjust the speed sensor from earlier experiences or calculations. This experience for instance can be obtained from earlier trials of calibration whereas calculations can be carried out from knowledge of the roll radius of the wheel and the number of electrical impulses per revolution.

Furthermore it is important to be able to adjust the calibration in order to take into account different soil conditions, when changing the wheels and/or wear and tear of the wheels, different air pressure in the tyre as well as different loads on the wheel.

Example!

A known calibration constant 883 is keyed in the following way:



Check/display of the calibration constant



CALIBRATION OF FLOWMETER:

The flowmeter is mounted in the operating unit system of the sprayer in order to measure the volume of the liquid that is sprayed through the nozzles of the spray boom. In the T-arm of the flowmeter the flow sensor is mounted and secured by a screw cap. The flow sensor is a "mill wheel" with 4 vanes each of which has an embedded magnet. "The mill wheel" is put into rotation by the moving liquid. This activates the flow sensor to send electrical impulses to the spray monitor.

Three different methods of calibration can be used:

- A. Calibration by trials
- B. Calibration by keying numbers from earlier experiences/trials
- C. Factory calibration

A. Calibration by Trials:

Calibration by trials is done by pumping a known amount of liquid during one minute through the flowmeter. The spray monitor counts the number of electrical impulses corresponding to the liquid passed through. After one minute the spray monitor automatically stops counting the impulses. The quantity of liquid is keyed in numbers of whole litres (without decimals) and the spray monitor now calculates automatically the calibration constant for the flowmeter.

Example!

A sprayer with a 16 metre spray boom has 32 nozzles. Each nozzle in the example has a capacity of 1.59 l/min at a pressure of 3 Bar. The total quantity of liquid to the boom per minute is: 1.59 litres x 32 nozzles = 50.88 litres which is rounded up to 51 litres. The capacity of the nozzles in l/min can be found from the nozzle tables, but a measurement of one or more nozzles done with a graduated glass is a better method to find the capacity per nozzle and so, how many l/min the spray boom applies.

The calibration is made by keying the following while the sprayer pumps at the earlier determined settings.



Now the spray monitor will count the number of electrical impulses from the flowmeter during one minute. The red lamp in the "APPL. RATE" key flashes. After one minute the spray monitor automatically stops counting the electrical impulses and the red lamp lights constantly. Now the previously calculated quantity of liquid is keyed = 51 litres.



The monitor automatically shifts to the "CLOCK FUNCTION". This means that the calibration has been done correctly.

Check/display of the calibration constant

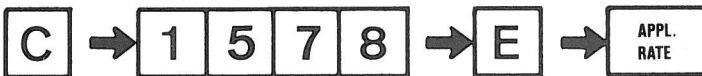


B. Calibration by Keying:

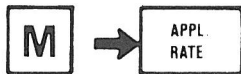
The calibration constant of the flowmeter may change when using different chemicals as earlier mentioned. Constants from earlier experiences/trials with different chemicals thus can be keyed directly without making new trials.

Therefore it is practical to note these numbers of calibration for instance next to a spray plan.

Keying of the calibration constant for instance 1578.



Check/display of the calibration constant



C. Factory Calibration:

At the factory the flowmeter is calibrated with clean water. Different circumstances around internal fitting in the operating unit of the sprayer, the vary viscosity of different spray liquids together with other physical conditions mean that the calibration constant from the factory which is 1567 should never be used without cross checking.

Important!

The calculation of the "TOTAL VOLUME" (litre) depends directly on the figure of the calibration constant. If the total registered volume in litres is less than the actual, the calibration constant must be raised correspondingly. Otherwise the constant must be lowered if the registered volume in litres is bigger than the actual.

Keying in of the calibration constant for instance 1567.



Check/display of the calibration constant



FAULT FINDING

Every fault finding exercise is started by checking the calibration constants as well as having keyed the correct working width.



No showing of speed:

1. Check the placing of the speed sensor in relation to the magnets. The distance should be 5-10 mm for all the magnets.
2. Check for breaks or damage on the cable from the speed sensor to the assembly box.

Unstable measurement of the speed:

1. A possible loss of magnet from the rim of the wheel will cause an unstable measurement of the speed. However, the damage can be mended provisionally by dismounting 1 or 2 magnets more, thus making the distance between these uniform again. By halving the number of magnets for each revolution of the wheel, the calibration constant must be changed to be twice the original figure.
2. Unstable measurement of the speed might also be due to the fact that the distance between the speed sensor and one or more of the magnets is less than 5 mm or bigger than 10 mm. In this case one should be aware of possible distortion and "BUCKLES" in the rim of the wheel.

Unstable or no showing of dosage TOTAL VOLUME (litre) during otherwise normal spraying:

The flowmeter sensor is dismounted by loosening the screwed cap of the T-arm, whereupon the sensor can carefully be pulled out.

The mill wheel must be able to rotate freely and easily on its axis. Possible foreign bodies can be removed, do not use hard or sharp tools. Thereupon the spray monitor is keyed to show TOTAL VOLUME (litre). The mill wheel is set in quick rotation by hitting carefully with the finger or by blowing several times. Now there should be an increase of the number of litres. Should this not be the case, the fault must be localized in the cable connection from the flow sensor to the assembly box. Before a possible repair of the cable it have to be unplugged from the assembly box.

Before replacing the flow sensor, the o-rings should be cleaned and lubricated with some grease or oil. It is important that sensor is pressed completely back in the T-arm and that the pin is correctly located before cap is screwed on.

If renewing the flowmeter or the speed sensor a new calibration is necessary (see corresponding paragraph).

MAINTENANCE AND STORAGE

The spray monitor is a precision instrument that can work without problems for many years if only the following few rules regarding maintenance and storage are followed.

1. All cables must be placed in such a manner that all kind of damage is avoided. Special attention must be drawn on wear and tear from the tractor as well as on direct tension in cable joints etc.
2. When not using the spray monitor this should be stored indoors, protected against humidity, dust, and extreme temperatures.

3. Avoid water or rain directly on the spray monitor, keyboard etc.
4. When the spraying season is over the flow sensor should be removed from the T-arm and cleaned and stored together with the spray monitor.
5. Before starting a new spray season the monitor system should be tested with clean water. The speed sensor, magnets, flowmeter and electric cables must be checked carefully for damage and repaired if necessary.
6. The wheel magnets will attract magnetic materials and same must be carefully removed every now and again.

Notes: