RIMIK
AGRICULTURAL ELECTRONICS

RIMIK CP 20 CONE PENETROMETER

HARDWARE INSTRUCTION MANUAL

Manufactured by:

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CP20 CONE PENETROMETER OPERATING INSTRUCTIONS

1.0 INTRODUCTION

The Rimik CP20 is a sophisticated cone penetrometer and data logger for use in soil density, trafficability and compaction studies. The instrument measures and records cone index data in the field and provides a flexible range of file recording formats for the data. Up to 30 000 data values can be stored and then transferred to a computer via the in-built RS232 interface. Cone index measurements can be made down to depths of 600 mm in soils with cone index values up to 5000 kpa.

The most important feature of this penetrometer is the use of an ultrasonic method for measuring depth. This unique feature allows for easier use of the instrument in the field as compared with other types of penetrometer.

2.0 FEATURES AND CONTROLS

Figure 1 shows the front panel of the penetrometer with the main operating controls. Details of these control are as follows:

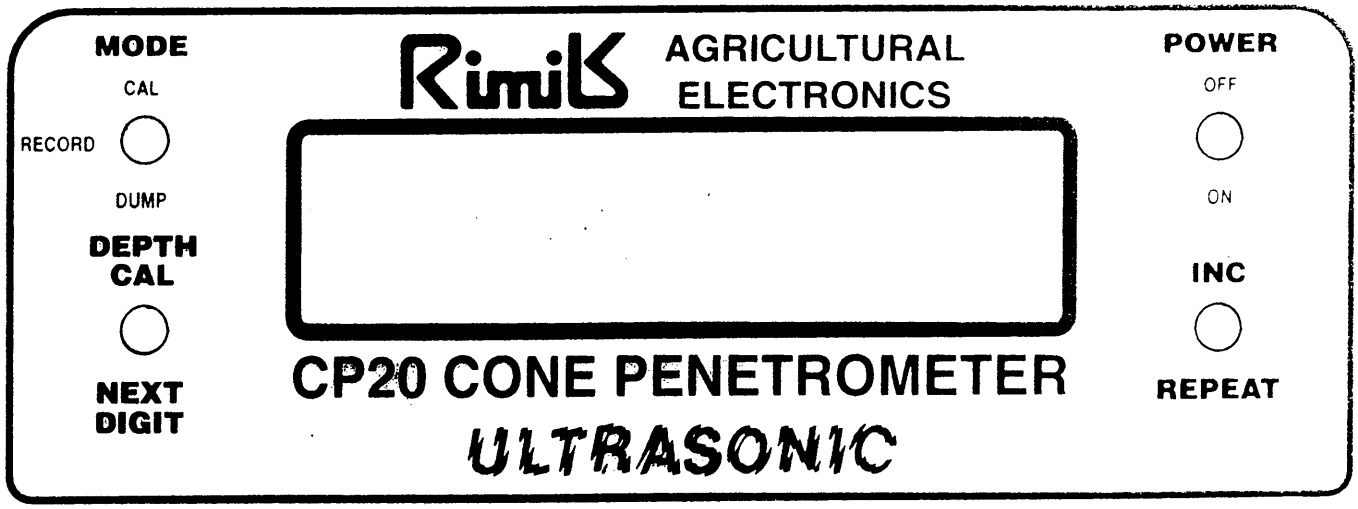


Figure 1. Instrument Front Panel

(a) Display

The 2 line by 16 digit display shows messages which indicate items such as file numbers, calibration data, mode, etc. The display can be seen best when viewed at an angle other than perpendicular to the display.

(b) On/Off switch

When switched on, the unit will always emit a 1 second duration beep. The display will be blank during the 1 second duration.

(c) Mode switch

This switch determines whether the unit is in "RECORD" mode for data acquisition, or data checking , in the CALIBRATE mode for instrument calibration or in the "DUMP" mode for data retrieval. This switch must always be set in the correct position before switching the instrument on.

(d) Inc/Repeat switch

This push button switch is used for incrementing the digits shown on the display when changing file numbers or operating parameters or for repeating a function.

(e) Depth Cal/Next Digit switch

This switch is used when performing depth calibrations and when entering numbers to move the curser to the next digit.

(f) Start / Enter switch

This is the push button on the right-hand-side of the enclosure. Its main function is to start the data-acquisition process when inserting the penetrometer in the soil. The start switch is also used for other functions such as setting file numbers and calibrating the unit.

(g) Rear panel of instrument

The battery charger socket is located on the right side of the rear panel of the instrument. The connector with the dust cover is the RS232 interface.

3.0 SETTABLE OPERATING PARAMETERS

The following operating parameters of the instrument may be changed by the user:

(a) File number

Every set of recorded data has its own file number in the range 1 to 750 for single insertion files or 1 to 250 for three insertion files. File numbers may be set by the user if desired. After the recording of each file the file number is automatically incremented.

(b) Auto abort

During each insertion of the penetrometer probe the insertion speed is monitored to check if it is too slow or too fast. The auto abort feature automatically aborts the recording of data in the event of the speed becoming too fast or too slow. When the auto abort is switched off the buzzer will sound if the speed is exceeded, but recording will still proceed. If the time taken to penetrate 15 mm exceeds 10 seconds the probe is always aborted.

This function can be set ON or OFF. When set ON the recording process will be stopped when the insertion speed exceeds the Maximum Speed setting. For best quality data this function should be set ON. In difficult field conditions it makes the gathering of data easier if the function is set to OFF.

(c) Maximum depth

The maximum depth of penetration is 600 mm. When this depth is reached the recording of data automatically ceases and the measured data is stored. If desired, the maximum depth can be set to a value less than 600 mm and recording will automatically stop at that depth.

(d) Interval

The depth interval over which cone index values are integrated may be set to 15 mm, 20 mm or 25 mm.

(e) Maximum load

By changing this parameter, which may be set at any value up to 60 kg, the recording process can be stopped at a predetermined load (cone index value).

(f) Maximum speed

This instrument is made to comply with ASAE standard S313.2 which specifies a maximum insertion speed of approximately 2 metres/minute. If the maximum speed is set to 2 m/min the operator will be alerted and/or the insertion aborted when this speed is exceeded.

In soils where soft layers underlie hard layers it is hard to avoid exceeding insertion speeds of 2 m/min when pushing through the hard/soft interface. For this reason maximum insertion speeds faster than 2 m/min can be set by the operator.

In the interests of collecting good quality data, free from inertia effects, the lowest useable insertion speed should be used always.

(g) Target height

This is the height from the ground to the top surface of the bush in the centre of the target minus the total depth of the bush. For the standard target and bush the dimensions are:
Height to top of bush - 90 mm
Bush height - 10 mm
Enter as height parameter (90 - 10) = 80 mm.

(h) Insertions per file

The number of insertions per file may be set to either 1 or 3.

WARNING!
DO NOT CHANGE THE NUMBER OF INSERTIONS PER FILE PARAMETER UNTIL ALL CURRENT DATA HAS BEEN RETRIEVED FROM THE INSTRUMENT.

Failure to observe this warning will result in data becoming irretrievable.

(i) Baud rate

RS232 baud rates may be set at the following: 300, 600, 1200, 2400, 4800, 9600.

4.0 OPERATION

Before using the penetrometer it is advisable to check the offset calibration. See section 4.5 for information on the procedure for calibration which explains how to check the offset.

To ready the penetrometer for use the target must be placed over the shaft with the two vertical sides facing down, the probe shaft with cone tip attached must then be screwed onto the loadcell at the base of the penetrometer. Read section 7.0 on Insertion technique for guidance on inserting the probe.

4.1 Recording cone index data

The data storage system is arranged such that data is stored in files numbered from 0 to 250 (0 to 750 if single insertion files are used). Each file will contain the data from 1 or 3 individual insertions. The instrument must not be turned off during the process of recording a file as the data is only stored at the completion of the last insertion in the file.

Before switching on, set the MODE switch to the "RECORD" position.

Switch on the unit. A beep will be emitted and then the display will show:

RIMIK CP20 Recording Mode

followed by:

Push START when ready. FN xxx Px

Where xxx is the current file number and x is the current insertion probe number.

When ready to start a probe press the START button. You will now hear the ultrsonic unit start to emit a soft clicking sound. It is very important that the top of the probe is at least 5 mm above the top surface of the soil when the "START" button is pushed. When the button is pressed a short beep will sound. If the probe is too close to the surface or in the ground the display will show:

Too close try again

The display will then revert to
the previous one so that you can restart after repushing the START button.

The probe should now be pushed slowly into the soil, through the hole in the target at a uniform speed. Push the probe down to the current maximum depth. As the probe is pushed into the soil the display will show:

CI xxxx kpa x.x m/min xxx mm

These values are the current
cone index, insertion speed in metres per minute and depth in mm. The values will change as the probe is pushed into the soil.

When the maximum depth is reached the buzzer will sound and the display will show either:

Finished FN xxx

or

Finished Probe x of FN xxx

depending upon whether the instrument is set for 1 or 3 probes per file.

After 3 seconds the display will revert to:

Push START when ready. FN xxx Px

Insertion two or three of a file may now be completed or a new file may be started.

If a new file is to be started you will notice that the file number will have been incremented by one.

During each insertion the speed will be monitored to ensure it does not exceed the current maximum speed parameter. If the speed is exceeded the consequence will depend upon the current setting of the Auto Abort parameter. If the Auto Abort parameter is set to OFF, then each time the maximum speed is exceeded the instrument will give a short beep. If the Auto Abort parameter is set to ON, the buzzer will beep and the display will show:

** Too fast **

START to repeat or INC to cont.

By pushing the INC/REPEAT button you will be able to repeat the insertion or by pushing the START button you can abort the insertion and continue on to the next one.

If an insertion takes greater than 10 seconds to move the 15, 20 or 25 mm integration distance the recording of data will be aborted automatically to avoid counter overflows in the software. In this event the buzzer will beep and the display will show:

** Too slow **

and then show:

INC to repeat or START to cont.

By pushing the INC/REPEAT button you will be able to repeat the insertion. To continue to the next insertion or file press the START button.

During each insertion it is possible to abort the recording process by pushing the START switch. If an insertion is aborted by this method the display will show:

** Aborted **

and then show:

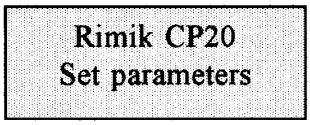
INC to repeat or START to cont.

If a file is to be totally abandoned for any reason simply turn the instrument off. When turned back on the file number shown will be the same as that shown before turning off, that is, the file number will NOT have been incremented.

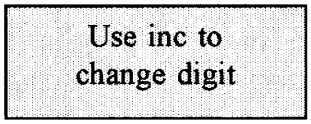
4.2 Change parameter mode

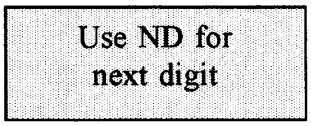
To change any of the parameters listed earlier, the following procedure is used to enter this mode.

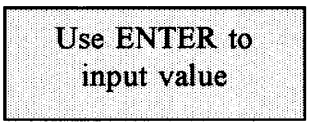
Set the MODE switch to the RECORD position. Hold down the START button and switch the instrument on. The display will show:



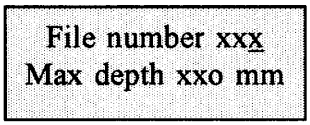
and then show:







and then show:



The file number or the maximum depth may now be changed. A blinking curser will be located under the right digit of the file number.

To change the file number use the INC and NEXT DIGIT buttons or if you wish to leave it unchanged push the ENTER switch to skip to maximum depth. The first push of the INC switch will stop the curser blinking. Thereafter each push of the INC switch will increment the digit by 1 until when 9 is reached the number will go back to zero. When the correct digit is in place use the NEXT DIGIT switch to move to the next digit. The curser will now move 1 digit to the left and the process can be repeated. When the most significant digit has been set press the ENTER switch to enter the value. The curser will now jump to the next parameter. The maximum depth parameter can only be set in units of 10 mm up to 600 mm.

If you make a mistake in entering a number, keep using the INC and NEXT DIGIT switches until you have the correct number showing then push ENTER.

Other parameter displays are as follows:

Interval xxmm	(options 15, 20, 25)
Max load xxkg	(options 1 to 60)
Max speed x m/mn	(options - 1 to 8)
Auto abort on	(options - on or off)
Probes/file x	(options - 1 or 3)
Baud rate xxoo	(options - 3, 6, 12, 24, 48, 96)
Target height xxmm	(options - 0 to 99)

In each case the same procedure is used to skip, increment or set the digits, that is,

Press ENTER to skip over
Press INC to fix the curser
Press INC to increment each digit
Press NEXT DIGIT to go to the next digit
Press ENTER to enter the value when all digits are correct.

4.3 Review data mode

This mode allows the operator to review the data in the last recorded file.

To enter the Review Data mode set the MODE switch to RECORD, hold down the INC button and switch on. Release the INC button as soon as the beep is heard. The display will show:

Rimik CP20 review FN xxx

and then show:

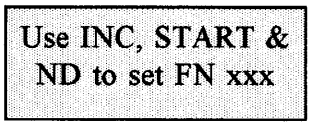
Push START to change FN

If the START switch is not pressed within the next 2 seconds the display will show:

Dxxx xxx xx xxx Cyyy yyy yyy yyy

where xxx is the depth in mm and yyy is the truncated (CI÷10) cone index for each depth. Each time the START button is pressed another 4 depth values will be shown until the maximum depth is reached. If 3 insertions per file are being used, the CI value shown will be the average of the 3.

If the START switch is pressed within the 3 second period mentioned above the operator has the opportunity to specify the file number for the data he wishes to review. The text on the display will be as follows:



The file number digits can be changed using the INC button and the NEXT DIGIT button. After all digits have been set enter the number by pushing the ENTER button. The display will show the depth and CI data as above. This file number change is only temporary while reviewing data. If a file number is entered for which there is no data a "File No. is invalid" message will appear on the display.

To exit from this mode the instrument must be switched off.

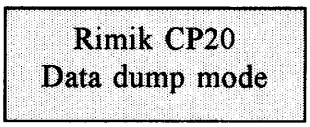
4.4 Dump (retrieve) data mode

Data is retrieved from the instrument using the inbuilt RS232 interface and the cable supplied with the instrument. The computer end of the cable must be connected to a PC compatable computer via the COM1 or COM2 serial port and the RS232 parameters of the computer need to be set as follows:

Data bit - 8
Stop bits - 1
Parity - none
Baud rate - same as instrument
(300, 600, 1200, 2400, 4800 or 9600)

The optional data retrieval software sets these parameters automatically (apart from baud rate) when the program is run.

To enter the retrieve mode put the MODE switch to the DUMP position and switch the instrument on. The display will show:



and then show:

Set start FN & finish FN

and then show:

Start FN 000 Finish FN 000

Use the INC button to increment digits and the NEXT DIGIT button to go to the next digit. The curser will show which digit is currently being set. After the last digit is set push the ENTER button and the data will start to be transferred via the RS232 interface one file at a time. Any non valid or corrupted files will be skipped over. During this process the display will show:

Dumping FN xxx Finish FN xxx

An end of file character will be transmitted after the last valid file. The display will then show:

** Files dumped **

After about 3 seconds the display will go back to the original screen giving the opportunity to dump further files if desired.

4.5 Check calibration mode

In this mode the instrument display will show whatever compressive load the load cell is subjected to. It is intended to be used as a quick check on the calibration of the instrument. Set the MODE switch to CAL and switch on. The display will show:

Rimik CP20 Check calibn.

and then show:

Current load = xx.x kg

If the instrument is supported with nothing hanging from the load cell the weight shown on the display (the offset value) should be 0.0 or ± 0.2 kg. If the value is greater or less than this the offset needs to be reset using the calibration mode (see section 4.8).

Balancing the instrument on the load cell will cause it to read its own weight of 3.4 kg. If the value shown is significantly different from this, recalibration is necessary.

To exit this mode turn the instrument off and reset the switches for the desired mode.

4.6 Test depth sensor

This mode is intended as a means of checking the calibration of the ultrasonic depth measuring system. To enter this made set the MODE switch to the RECORD position and hold the DEPTH CAL switch down while switching the instrument on.

When switched on the instrument will show:

RIMIK CP20 Check depth

You will hear the clicking from the ultrasonic system begin and the display will show:

Distance xxxx mm Time xxxx us

Check the calibration by allowing the target to rest on the top edge of the cone while holding the instrument with the cone well above the ground. Make sure that the top of the target is horizontal. The depth shown on the display should be 922 mm +/- 5 mm. If the indicated depth falls outside this range the depth sensing system should be recalibrated. For recalibration see section 4.7 below.