HANDBOOK ©

C50

50kg TESTING MACHINE

For:-

TABLET HARDNESS TESTING

and

COMPRESSION TESTING

by
ENGINEERING
SYSTEMS (NOTTM)

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1. INTRODUCTION TO THE C50

1.1 DESCRIPTION OF THE C50

The Engineering Systems C50 is a horizontal loading, mechanical strength testing machine. Easy to use, it has been specifically designed for tablet hardness testing in a factory environment. Whilst it has been designed for ease of use, the provision of analogue outputs on the rear panel and the ability to alter some of the internal settings such as % fracture detect etc. make the machine more versatile and suitable for use in research and development departments. For extra sensitive measurements a 5kg load cell, with a resolution of 1 gram, is available.

1.2 FEATURES

* Automatic sizing of new tablets
* Wipe clean front panel
* Push button zeroing
* Analogue and RS232 outputs are provided as standard
* Statistical Analysis and
* Time & Date output
* Maximum load (Hardness) 50kg
* Maximum jaw opening of 36mm
* Digital display of tablet count
* 24 Column printer with easy to change paper roll and ribbon
* Choice of units; kg, kp, N or lb.
* Loading by Test button or Guard

1.3 ADDITIONAL INFORMATION

The C50 was introduced in February 1992. Various updates have since been incorporated, with a major mechanical re-design of the loading frame in November 1997.

Internal wiring and connections have been minimised to increase reliability and ease of maintenance.

The integral printer is flush mounted on the side panel of the main casing and the paper roll and ribbon occupy a space within the body of the printer. The roll and ribbon can easily be changed via. the printer's hinged door which opens to expose these items.

Overload and over-travel protection is incorporated into the control electronics. The loading plunger is automatically reversed if a load in excess of 50kg is detected or the end of travel is reached.

Fracture is detected when the instantaneous load detected by the load cell falls to a set % of the maximum (peak held) load which has been reached during a particular test. This % is typically set to 70% but can be changed if the tablet or specimen characteristics are unusual. A potentiometer screw provides for settings over the full range of 0-100%.

1.4 OPERATION OF THE C50

The tablet is placed between the two jaws (platen and plunger). The left hand platen is stationary and is attached to a precision strain gauged load cell. The right hand plunger is motorised and crushes the tablet between the jaws when the test is commenced. Tablet fracture is automatically detected and the fracture load (hardness) is displayed on the digital display. Meanwhile the plunger returns to its preset position and the printer prints the hardness data. The tablet fragments are collected in a drawer situated underneath the loading platform. When testing of the batch is complete the STATISTICS button can be pressed and the statistical data is printed by the printer.

New tablet sizes are set by pressing the NEW TABLET SIZE button and inserting a tablet. The new size is automatically detected and the machine is ready to test the new batch. The plunger operates at two speeds, test speed and full speed. Test speed is adjustable and can be set to a range of speeds between 1 and 31mm/min. in 1mm/min. increments. Full speed is approx. 80mm/min.

When testing, the test sequence is :-

Full forward speed is applied to the plunger until the tablet diameter is reached, test speed is then applied until tablet fracture is detected, full reverse speed is then applied to the plunger and it returns to its preset position. The result is printed out.

If required, the safety guard can be set (by a rear switch) to automatically operate the test button.

1.5 USING THE C50 MACHINE FOR THE FIRST TIME

The machine's controls are situated either on the front panel (non adjustable controls) or the rear panel (adjustable controls).
For normal use, only the front panel switches (buttons) are used.
When the machine is first delivered,
the rear panel controls are set to give :-
Load Output in kg.
Test Speed of 6mm/min.
Test Mode Switch set to Panel Switch.
Printer is ON.

The front panel looks like this:-

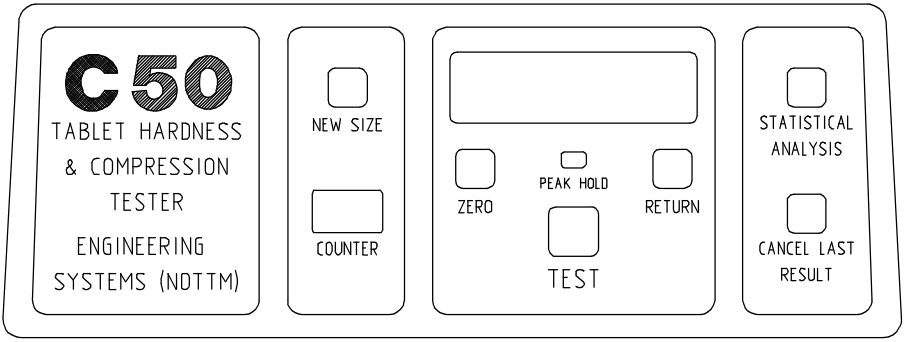


Figure 2

To operate the machine for the first time:-
Check that the mains supply voltage is correct. Refer also to section 3.2
Plug in the IEC/MAINS connector.
Switch on the rear panel mounted mains switch.
The LOAD DISPLAY should illuminate and show 88.88; this checks that all the display segments are working, and the COUNTER should show a count of 0.

The printer should now print out the message:

C50 TESTER
SW vx.xx
TIME xx:xx
DAY xx-xx-xxxx
Mean of Means OFF/ON

When the printing has finished the LOAD DISPLAY should change from 88.88 to 0.00, and the machine will then be ready to use. If the display is not exactly zero, press the ZERO button.

Have a 'new size tablet' ready for placement onto the loading platform. Press the NEW TABLET SIZE button, the loading plunger will return i.e. move to the right and to the extremity of its travel. During the return motion, position the new tablet onto the loading platform. When the plunger reaches its extreme position, it changes direction and travels at its FAST FORWARD speed until it approaches and touches the tablet. The plunger will stop and then reverse approximately 5mm to its preset return position.

The machine is now set up for the new tablet size. Place a tablet onto the loading platform and press TEST. The plunger will fast forward up to approximately 0.2mm of the tablet and then change to the set test speed. When the plunger reaches the tablet, loading commences and the digital load display can be seen to increase. Fracture is detected automatically and the plunger stops and reverses to its preset return position. The test result is now printed out, on the printer. Further tablets from the batch can then be tested by placing a new tablet onto the loading platform and pressing the TEST button.

When the batch is complete, and the statistical information is required, press the STATISTICAL ANALYSIS button. The statistical data will then be printed out. When the printing is complete, the TABLET COUNT is automatically re-set to zero and a further batch of tablets can be tested. If the next batch of tablets is a different size, then the NEW TABLET SIZE procedure will have to be followed, if they are the same size as the previous batch then no resetting of the size is required.

NOTE:- SW vx.xx in the initial print-out indicates which software version is installed in the machine

2. DESCRIPTION OF THE FRONT PANEL CONTROLS

MORE DETAILED INFORMATION ON THE MACHINE OPERATION & NON-ADJUSTABLE FRONT PANEL CONTROLS

The six push button membrane switches, situated on the front panel, control the normal operation of the machine.

Secondary controls and adjustments are situated on the rear panel.

2.1 LOAD DISPLAY. When the standard 50kg load cell is fitted the maximum load (hardness) is 50kg and the resolution is 0.01kg. In addition to reading in kg the units of load can be changed (see Rear Panel, section 3.10) to read in kp or Newton's or lbs.

2.2 TEST switch. When pressed the automatic test (or loading) sequence is:- Fast Forward to approx. 0.2mm of the tablet, Test Speed, Tablet loading at Test Speed, Detection of Fracture, Stop, Update the Counter, Loading Plunger reverse to preset position, Print the Peak Load (hardness) result.

2.3 GUARD Whilst not strictly a front panel control, the TEST switch can be substituted by the GUARD operation. If the rear panel TEST MODE SWITCH (see 3.6) is switched to GUARD the loading cycle is started by lowering the guard. If the guard is lifted during the cycle, the plunger will stop and reverse and the test will be abandoned. The TEST switch is disabled whilst in GUARD operation but the NEW SIZE cycle (see 2.8) operates as normal. If the TEST switch is pressed, the TEST button, RETURN and NEW SIZE lamps will all flash to indicate that the guard mode is set.

2.4 PEAK HOLD Indicator. Indicates whether the peak hold is activated (hold mode) or not activated (disabled). In some circumstances i.e. during calibration, the peak hold needs to be disabled (see rear panel, section 3.8). So that the machine always operates correctly, the peak hold is automatically activated when the TEST button is pressed and then remains activated until disabled by pressing the rear panel switch.

2.5 ZERO button.
Pressing this switch disables the peak hold and zero's the Load Display. When the machine is first switched on the load display is automatically zeroed.

2.6 RETURN button. This indicates that the plunger is returning. The plunger can be returned at any point during the TEST cycle by pressing the RETURN button.

2.7 COUNTER The counter is set to read zero when the machine is first switched on. The counter is also re-set to zero after the STATISTICAL ANALYSIS button has been pressed. The counter is incremented each time a genuine fracture is detected. A genuine fracture can only occur during loading at test speed. If an object e.g. a tablet which is too large, is encountered during the fast forward plunger motion, the plunger will touch the object and return to its preset position, the tablet count will not be incremented and no result will be printed out on the printer.
Units, see later, can only be changed when the COUNTER = 0.

2.8 NEW SIZE. This button is used to start the automatic sizing procedure for a new batch of tablets, the button when pressed illuminates and remains illuminated until the sizing sequence is completed.
If in guard mode, the guard must be raised before the new tablet size sequence will operate.

If the COUNTER shows a reading of 2 or greater (i.e. statistical information is available), then the Statistical information (from the previous batch) is printed out when the NEW SIZE button is pressed.

Setting up for a new size Have a 'new size tablet' ready for placement onto the loading platform. (The loading platform is situated underneath the Perspex guard) Lift up the Perspex guard and press the NEW SIZE button, the loading plunger will return i.e. move to the right and to the extremity of its travel. During the return motion, place the new tablet onto the loading platform and in line with the axis of the plunger. When the plunger reaches its extreme position, it immediately changes direction and travels at its FAST FORWARD speed whence it approaches and pushes the tablet up to touch the loading platen. The platen detects the touch and then returns approximately 5mm to its preset return position. The printer prints the message NEW SIZE. The TEST button will not operate until the printer has finished printing. The new size sequence is then complete and the NEW TABLET SIZE button lamp is extinguished. The machine is ready for testing the new batch of tablets.
It is not necessary to carry out this procedure if the new batch is the same size as the previous batch.
Note:- If small tablets are being sized, it is not necessary to wait until the plunger has fully returned; pressing the TEST button at any time during the return motion will set the plunger moving forwards.

2.9 CANCEL LAST RESULT. Pressing this button cancels the last result. The cancelled No. is then used for the next tablet to be tested. The button can only be used to cancel the immediately previous result.

2.10 STATISTICAL ANALYSIS. When the correct batch size is reached and the STATISTICAL ANALYSIS button is pressed, the statistical data is printed out on the printer. This data is also sent to the rear RS232 output and the tablet counter is zeroed. The maximum batch size is 99. If the batch size reaches 99, the statistical data is automatically printed out and the counter reset to zero.
The Standard Deviation (STD.DEV.) is calculated by using the 'SAMPLE STANDARD DEVIATION' calculation. A typical printout is shown below and includes the Time and Date.

No. 1 HARDNESS= 1.04 kg
No. 2 HARDNESS= 1.63 kg
No. 3 HARDNESS= 1.82 kg
CANCEL 03
No. 3 HARDNESS= 1.43 kg
No. 4 HARDNESS= 1.86 kg

BATCH Size. = 4
MINIMUM = 1.04 kg
MAXIMUM = 1.86 kg
STD.DEV. = .34
MEAN = 1.49 kg
TIME 13.57
FRIDAY 20-05-2004

The printout shows that reading No. 3 was manually cancelled. The result is overwritten by the next result, which is then called No.3.
To change the Time & Date, see Appendix 3

As normal, when statistics are required the STATISTICS button is pressed and released. However, if this button is held down for a few seconds, (until printing of the data commences) **an abridged version of all the test results is printed**, prior to the printing of the statistical data.

2.11 Definition of Standard Deviation

Note: The sample standard deviation σ_{n-1} is defined as

$$\sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

Where: n=sample size & x=test result(s)

2.12 MEAN OF MEANS.

A mean of means capability is available. This facility can be enabled or disabled (ON or OFF). Because there are no spare front panel buttons, an existing button (TEST) has been configured for dual use. The status of the mean of means i.e. ON or OFF is shown on the printer output when the machine is switched on. The status can be toggled. This can only be done when the machine is first switched on, by pressing the TEST button and holding it pressed until the printer stops printing. When the button is released, the printer continues printing and indicates the new mean of means status i.e. ON or OFF.

With the mean of means ON, the end of batch statistical analysis button operates as normal. Each subsequent batch is consecutively numbered, up to a maximum of 199 batches. Before a mean of means can be output, the latest batch statistical data must have been printed. When the mean of means is required, press the Stats. button, whilst still pressed, press and release the TEST button. When printing commences, release the Stats. button immediately and the mean of means will be printed out. The batch No. is automatically reset (to 1) for the next set of batches. Loss of power will loose the stored data but not the batch data or reset the batch No. If required, an abridged version of the test results can be printed out. To achieve this, the Stats. button must be pressed and released as usual to enable a Stats. print-out, then, the Stats. button must be pressed for a second time immediately; when the printing commences. If the mean of means is to be printed, the abridged test results will be printed out unless the Stats. button is released immediately; when the final mean of means printing commences.

When new CLOCK/RAM's are first installed or retrofitted, they will be random in their choice of Mean of means ON or Mean of means OFF and if Mean of means is ON, then the batch No. will also be random and it is not obvious how to reset to zero. The cure is to set the Mean of means to be OFF, and then set the Mean of means to be ON, at which point the counter will be set to zero.

3. REAR PANEL SECONDARY CONTROLS

3.1 REAR PANEL SECONDARY CONTROLS, INPUTS, OUTPUTS and ADJUSTMENTS

Situated on the REAR PANEL are :-

Mains input IEC plug, Mains fuse holder and Mains switch.
Analogue and Digital (RS232) outputs.
Test Speed, Units and Decimal point position switch.
Calibrate, Peak Hold, Test Mode and Printer switches.
Calibration Potentiometers.

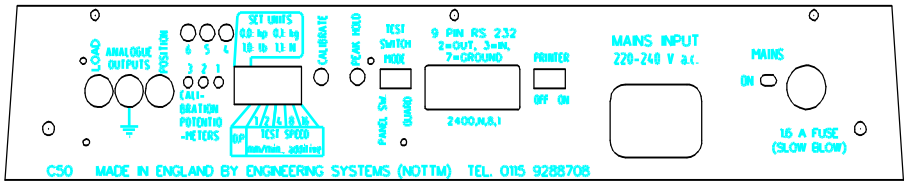


Figure 3

The following is a detailed discussion of the rear panel controls and adjustments.

3.2 MAINS INPUT

This comprises an IEC plug, toggle switch and screw in fuse. An IEC/MAINS connector lead is supplied with the machine and should be fitted with a 5A fuse if applicable.
The mains input voltage is normally set to 220-240 V a.c., this can be changed to 110-120 V a.c. by removing the bottom cover (4 screws) and switching the VOLTAGE SELECTOR SWITCH which is situated adjacent to the fuse holder. When this has been done the 1.6A SLOW BLOW (T) mains fuse which is normally fitted should be changed to a 2.5A SLOW BLOW (T) fuse. A 110-120 V a.c. label (obtainable from ENGINEERING SYSTEMS) should be fitted over the existing 220-240 V a.c. printing.

3.3 PRINTER ON/OFF SWITCH

When OFF the printer output is disabled.
Digital data still appears at the RS232 output and the counter is still updated. Test data continues to be stored in the memory and the full statistical information will be available if the printer is subsequently switched ON during a batch of tests.

3.4 DIGITAL RS232 DATA INPUT/OUTPUT

The 9 way 'D' type female connector provides the RS232 output which is transmitted only when a fracture is detected or when the STATISTICAL ANALYSIS button is pressed. Data appears at the RS232 output at the same time that it is printed on the printer.

Whilst the RS232 output is exactly the same format as the printer output, provision has been made internally so that the RS232 and printer outputs can be different. Customised outputs are available to suit individual requirements. Contact Engineering Systems for details.

The data is transmitted in the format:-

2400 bits/sec, No parity, 8 Data bits, 1 Stop bit.
The C50 is configured as a TERMINAL device but is fitted with
a female 9 way 'D' connector.
RS232 output, is transmitted from the C50 on pin 2.
RS232 input, is on pin 3.
Pin 7 is GROUND.

Correct polarity of externally connected equipment must be observed.
The remaining pins on the 9 way connector are not connected.

3.5 DUST COVER

A dust cover plate is fitted over the remaining controls and outputs. This is useful if the machine is used in a dusty environment and it also prevents the settings, such as calibration, the test speed or unit display, from being altered.

3.6 TEST MODE SWITCH

This switch enables the test cycle to be started either by pressing the TEST button or by lowering the Perspex guard which covers the loading area.

3.7 CALIBRATE BUTTON

When pressed a 'calibration reading' is displayed on the load display. See section 5.3 (Electronic Calibration) for further details.

3.8 PEAK HOLD

When the machine is switched ON the PEAK HOLD is activated. The Peak Hold indicator is illuminated when the peak hold is active. When calibration is carried out disable the peak hold by pressing the rear PEAK HOLD button or the ZERO button. It is not necessary to re-activate the peak hold before continuing with testing. The peak hold is automatically activated whenever the TEST button is pressed (or, if in 'guard mode', the guard is lowered) and will remain activated during testing. The peak hold is also disabled after a set of statistical results have been printed.

3.9 SPEED, UNITS and DECIMAL POINT

See figure 4. The Test Speed, Units and the position of the Decimal Point can all be changed by altering the position of the switch elements of the 8 Way DIL Switch. Changing either Units or D.P. position or both, changes the output format for both the Digital Load Display and the Printer Output.

3.10 UNITS CHANGE

NOTE***:- The machine will only allow the units to be changed if the TABLET COUNT = 0. This is because the machine cannot output the correct statistical data for a batch which has mixed units***.

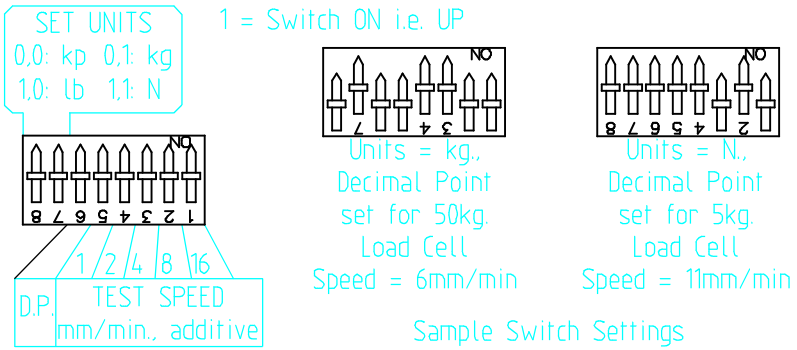


Figure 4

Switches 7 & 8 change the displayed units. The digital display shows the correct output for the units chosen. i.e. an internal multiplication/division takes place when the units are changed. The decimal point is positioned in the same relative position when the units kp or kg or lb are displayed. When N is selected the D.P. is automatically shifted one place to the right.

3.11 DECIMAL POINT.

If the optional 5kg. load cell is fitted the D.P. should be moved one place to the left. Switch 6 changes the D.P. position and should be changed to give the correct position for the load cell which is installed. See figure 4. for D.P. positions

3.12 SPEED.

Switch positions 1 to 5 inclusive set the speed. Switch 1 is 16mm/min., 2 is 8mm/min. etc. and 5 is 1mm/min. Each switch introduces an increment to the total speed setting i.e. the switch setting is additive. e.g. switch 1 and switch 4 both ON give a speed of 18mm/min.

3.13 CALIBRATION POTENTIOMETERS (6 off)
These adjustments are made by rotation of the 20 turn potentiometers located just inside the rear panel. A small insulated trim tool (R.S. part No. is 543-434) can be used for the potentiometer adjustments. The small end is used for adjustment of pots 2 & 3 and the large end is used for pots 4,5 & 6.
The function of each calibration potentiometer is:-
2.) Load Analogue Output Zero
3.) Load Analogue Output Range
4.) Digital Display Output Range
5.) % Difference for Fracture Detect
6.) Over range Cut-out

3.15 DIGITAL DISPLAY OUTPUT RANGE (POT 4)
This adjusts the range of digital output to correspond to the applied load and only needs to be adjusted when calibrating the machine, see section 5. regarding calibration.

3.16 % DIFFERENCE FOR FRACTURE DETECT (POT 5)
Fracture is detected and the plunger motor is stopped when the instantaneous load measured by the load cell falls below a preset % of the maximum load (i.e. the peak held load) attained during testing. The fracture detect pot can be adjusted to give any fracture detect % up to 100% (Typically 60%-70%).
See Appendix 1 for a further discussion and adjustment details.

3.17 OVERRANGE CUT-OUT (POT 6)
Setting the Over range cut-out level
Remove the bottom cover.
To set to 49kg. (480 N) :-
Use the formula CUTOUT = (49 x R)/C
Where C= Load reading when Calibrate switch is pressed.
and R= corresponding reading on TP2 (situated on the Main Circuit Board) measured with a Voltmeter.
Set the calculated CUTOUT voltage onto TP6 by adjusting Pot6.
Note :- the calibration button must not be pressed at this stage.
Turning Pot 6 clockwise increases the voltage on TP6.

The functions of POT 2 & POT 3 are described below

3.18 ANALOGUE OUTPUTS
These d.c. voltages are outputted via. 4mm terminals. BLACK is GROUND, RED output is proportional to LOAD and the YELLOW output is proportional to PLUNGER POSITION.

3.19 LOAD CELL OUTPUT Red terminal

This output can be used to drive a variety of external recording devices, i.e. pen recorder, U.V. recorder, A/D input of a computer card etc. It is independent of the setting of the peak-hold switch. i.e. this output follows the value of the load applied to the loading platen. An output of 1 volt/10kg (standard load cell) load is given at these output terminals. It should be noted that the low (Black) output is indirectly connected to the chassis i.e. earthed. Some external equipment may also have the low terminal earthed and care should be taken when using these terminals to ensure that the correct polarity connections are made. The adjustments for this output are described below.

3.20 LOAD ANALOGUE OUTPUT ZERO (POT 2)

Adjustment for the Load cell output zero. Clockwise rotation causes the output to decrease.

3.21 LOAD ANALOGUE OUTPUT RANGE (POT 3)

This adjusts the load cell analogue output voltage to match that shown on the digital display. A voltmeter, set to read a 10 volt range, should be connected to the load cell output terminals on the rear panel, polarity must be observed. Zero if necessary (described above), push the calibrate switch, the digital display on the C50 should now read the same as the reading shown on the voltmeter. If in error, turn pot 3 until the readings match. A clockwise rotation causes a decrease in output range.

3.22 PLUNGER POSITION Yellow terminal

This output is not internally adjustable and an approximate output voltage in the range 0 - 10 volts is given at these terminals, the low (Black) terminal is at ground potential and the voltage output is proportional to the position of the plunger.

4. PRINTER

4.1 THE PRINTER automatically prints the peak reading at fracture, as indicated on the digital display. The printer also prints the statistical data when the STATISTICAL ANALYSIS button has been pressed.

The printer can be disabled by switching the rear mounted printer ON/OFF switch to OFF.

The printer is fitted with two external vertical bar controls which are situated at the top left hand side of the printer's front cover. The left hand bar is for opening the printer door and the right hand bar is the paper feed switch. It is not advisable to press the paper feed whilst a tablet is being tested or when printing, as erroneous results may be printed.

4.2 CHANGING THE PAPER ROLL AND CARTRIDGE RIBBON

The printer door is hinged vertically on its right hand side. To open the door, rotate (anti-clockwise) the left hand (of two) vertical catches and the door will swing open to reveal the paper roll and the ink ribbon. To release the print mechanism and ribbon from the front panel, push the door and the chassis horizontally apart.

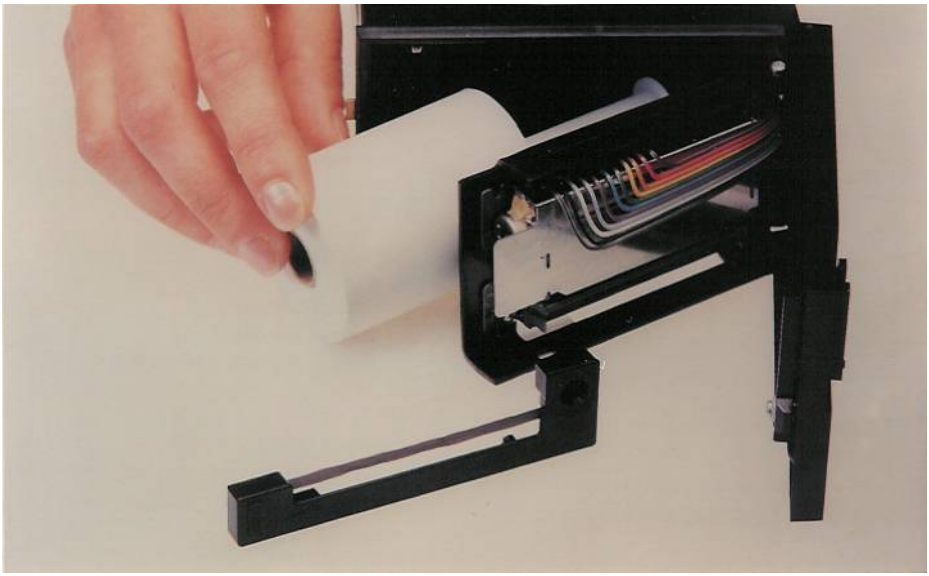


Figure 5

4.3 PAPER ROLL REPLACEMENT

Open the printer door as described above and swing the door open to expose the paper roll.

Remove the old paper roll by pressing the black paper roll retaining button situated at the end of the paper roll spindle. Slide off the old roll and tear off any remaining paper. Pull any remaining paper out from the front of the printer.

Take a new roll of paper and separate the end from the rest of the roll. Remove any damaged or gummed part of the paper and cut the free end into a 'V' shape using scissors or a knife. Put the new roll onto the spindle with the paper unspooling in an anti-clockwise direction when viewed from the outer end. Insert the end of the paper up and into the printer mechanism and press the paper feed actuator rod which is situated inside the top left hand portion of the printer casing. Wait and check that the paper emerges from the front of the printer before releasing the actuator rod and closing the printer door.

Use 57mm wide, 50mm maximum diameter, 13mm internal diameter paper rolls,
or use 58mm wide, 45mm diameter, 13mm internal diameter paper rolls.
These can be ordered from various suppliers e.g.

The printer mechanism which is used is from the standard EPSON M180 (a faster version of the M160) series. Paper rolls and printer ribbons should be available from local suppliers worldwide.

For U.K. users:-

If you have an account at :
Farnell Electronic Components Tel. 08701 200200
their order code is 177-306 for paper rolls and 308-213 for ribbons.
or
Able Systems Ltd. Tel. 01606 48621
their order code is A160PR for paper rolls and A1601RCP for ribbons.

Order code correct, November 2004

4.4 RIBBON CARTRIDGE REPLACEMENT

After approx. 5 paper rolls have been used, the ribbon cartridge will need replacement. To expose the Ribbon Cartridge, position the forefinger underneath the outer edge of the door and the thumb on top of the printer mechanism chassis and press in vertically opposite directions until the catch is released and the chassis swings away from the door.
DO NOT FORCE OR PULL THE DOOR AND CHASSIS APART WITHOUT FIRST RELEASING THE CATCH.

When the chassis and the door have been parted the ribbon can be removed by pressing down on the end of the cartridge marked PUSH. Carefully remove the old cartridge and replace with the new one ensuring that the paper lies between the ribbon and the steel printer platen. Check that the ribbon cartridge is correctly seated over the printer ribbon drive shaft and snap the cartridge into place.
Ensure that the ribbon is tight and parallel to the paper and if necessary tighten the ribbon by turning the faceted disc clockwise.

Replacement ribbons can be ordered from Able Systems Ltd., see previous page.

5. CALIBRATION

Before the C50 is delivered, it is calibrated to conform with the ASTM standard E4-83a (Load Verification of Testing Machines). A calibration certificate accompanies each machine and shows that it has been loaded up to 49kg, with 4 x 10kg, 1 x 5kg and 2 x 2kg weights.
If the user requires re-calibration which conforms to the above standard then the same procedure should be followed. However usage of lower weights i.e. 3 x 5kg can provide an interim check especially if the machine is being used at the lower end of its loading range.
Whilst it is best to use the specially shaped weight hanger manufactured by Engineering Systems, users may wish to purchase their own weights locally (because of carriage costs). Preferably use ∅150mm (6") Cast Iron slotted weights with a slot that is at least 12mm (1/2")wide

5.1 CALIBRATION PROCEDURE

The machine's displayed units can be changed to show kg, kp, lb or N (see section 3.10). When calibrating it is essential to use weights which correspond to the displayed units. e.g. if the weights used are kg then the displayed units should be kg. If the user subsequently wants to use alternative units such as lb or N (changed by using the rear mounted DIL switches), then the displayed output will still be valid, as calibrated, for the changed units.
The machine can be calibrated using weights as shown in the photograph.

An electronic calibration switch is provided so that a daily calibration check can be made. If there is a calibration error of more than say 10 digits (0.10kg), check the calibration with 49kg of dead weights. If there is a 'dead weight' error greater than 6 digits (0.06kg), then recalibrate i.e. turn Pot 4 so that the digital indicated load = 49kg.

Figure 6

5.2 CALIBRATION BY DEAD WEIGHT LOADING

Caution:- if the machine is not correctly positioned during loading of the calibrating weights, there is a danger of the weights and the machine falling over. Damage to personnel and the machine could result. It is recommended that the special fixture (mentioned overleaf) is used when calibrating.

1.) Turn the machine to rest on its left hand side and position near to the edge of a bench which has a clear space underneath (as shown in the photograph). For accurate calibration, the load cell platen should be horizontal. Preferably use the special fixture, available from ENGINEERING SYSTEMS, which ensures that the machine is held vertical during calibration. Alternatively, with regard to the caution note above, a suitable piece of packing could be inserted under the top edge of the casing.

2.) Zero the display by pressing the ZERO button.

3.) Using a suitably shaped hanger (can be supplied by ENGINEERING SYSTEMS) and set of weights (as suggested above) load the machine with the weights hanger resting on the loading platen. If the applied weights are equal to the load value displayed on the digital display, then the machine is correctly calibrated. If the calibration is in error adjust the LOAD RANGE using Pot4.

4.) Make a note of the new electronic calibration value.

If the machine is set up for testing small tablets, it may not be possible to position the weights hanger on the loading platen because the plunger is too close. If so the plunger can be retracted by pressing the NEW SIZE button, waiting until the plunger has fully retracted and has just started to move forwards; and then pressing down on the loading platen. This simulates a large new tablet size and the plunger will remain in approximately its fully retracted position to allow for the positioning of the weights hanger.

5.3 ELECTRONIC CALIBRATION

Pressing the calibrate button connects a high stability resistor into the load cell circuit and gives an apparent load reading on the digital display.
A calibration value (for units of kg) for each load cell supplied with the machine is given on the calibration certificate. When the calibrate button is pressed this calibration value should be displayed on the digital display. These calibration values are only valid for numbered load cells which relate to the corresponding C50 machine number. If it is required to use load cells on different machines, a load cell calibration value has to be obtained for each machine and load cell combination.
When calibration using dead weights has been completed the calibration value should be noted and compared to the value given on the calibration certificate. The values should not be significantly different. If in error by more than 1 or 2%, it would be advisable to return the machine to the manufacturers for servicing and checking against their dead weight loading system.
Calibration using dead weight loading should be carried out occasionally.
A 6 month period between calibrations is recommended.

6. PARTS

6.1 COMPONENT PARTS

The following parts list, component layout and circuit diagrams show only the major parts. Small items such as individual screws etc. are not listed.

6.2 PARTS LIST

Load Frame
Motor Power Amplifier (APEX PA73)
Load Cell
Linear Displacement Potentiometer (TML 3FLP50A-10k)
Geared Motor & Tacho Unit (Maxon 143967)
Timing belt - Reliance Gear Co. TXM25F6-92
Linear Potentiometer Connector
Motor - Tacho Connector
Printer / Power Supply Board Connector
Printer connector board (PRINTER.PCB)
Display Circuit Board (C50D.PCB)
Main Board (C50M.PCB)
Mains Input Voltage Selector Switch
Toroidal Transformer (ILP 6D486P)
Motor Power Amplifier Connector
Mains Input Connector and fuse holder and on/off switch
24 column Printer (Able Systems ASL 03-AP24+IN-NL)
Guard cut-out micro switch

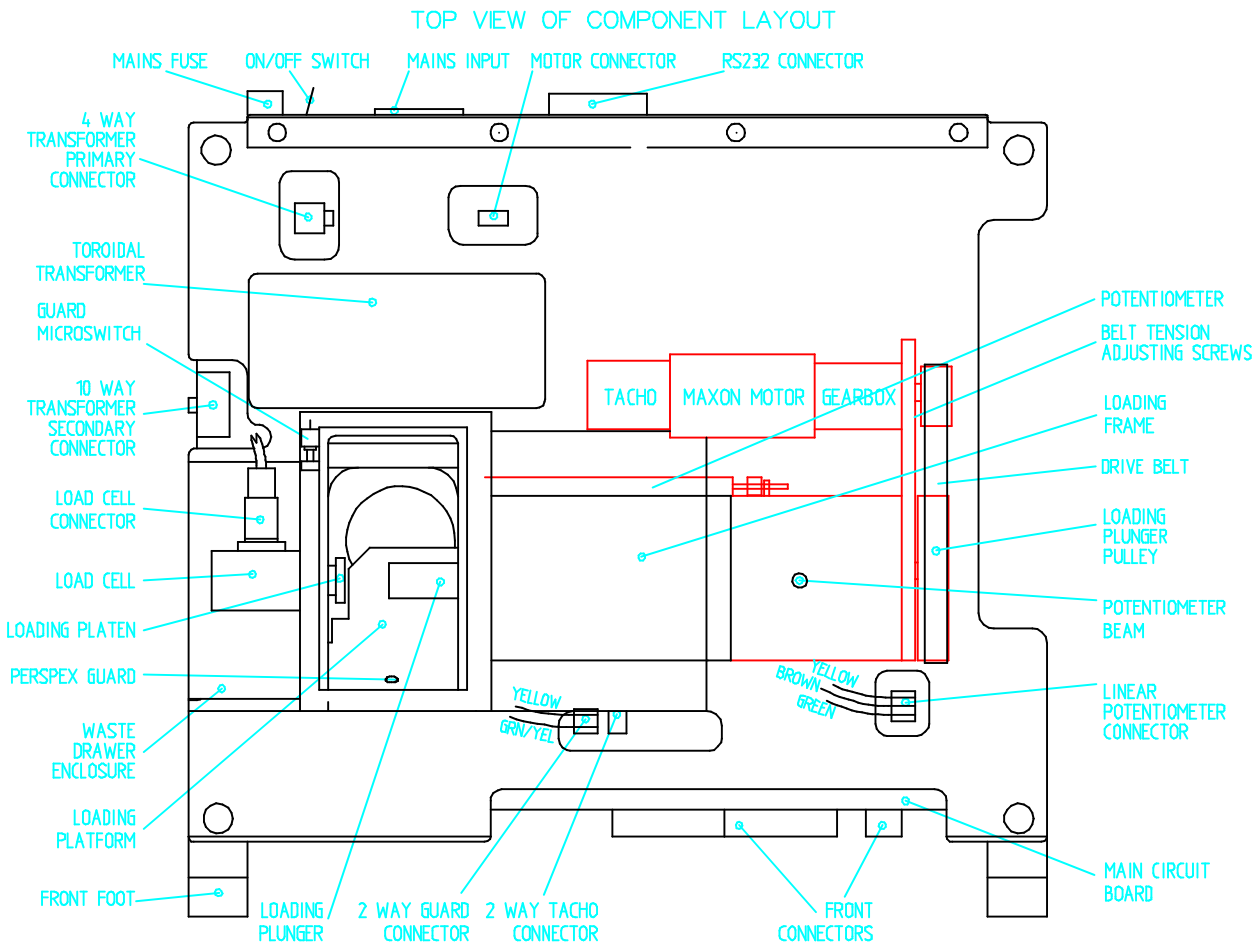

TOP VIEW OF COMPONENT LAYOUT
MAINS FUSE
ON/OFF SWITCH
MAINS INPUT
MOTOR CONNECTOR
RS232 CONNECTOR
4 WAY TRANSFORMER PRIMARY CONNECTOR
TOROIDAL TRANSFORMER
GUARD MICROSWITCH
10 WAY TRANSFORMER SECONDARY CONNECTOR
LOAD CELL CONNECTOR
LOAD CELL
LOADING PLATEN
PERSPEX GUARD
WASTE DRAWER ENCLOSURE
LOADING PLATFORM
FRONT FOOT
LOADING PLUNGER
2 WAY GUARD CONNECTOR
2 WAY TACHO CONNECTOR
FRONT CONNECTORS
MAIN CIRCUIT BOARD
TACHO
MAXON MOTOR
GEARBOX
POTENTIOMETER
BELT TENSION ADJUSTING SCREWS
LOADING FRAME
DRIVE BELT
LOADING PLUNGER PULLEY
POTENTIOMETER BEAM
LINEAR POTENTIOMETER CONNECTOR
YELLOW
BROWN
GREEN
YELLOW
GRN/YEL

Figure 7

ENGINEERING SYSTEMS C50 WIRING DIAGRAM

9/1/98 C50.WIR-9740

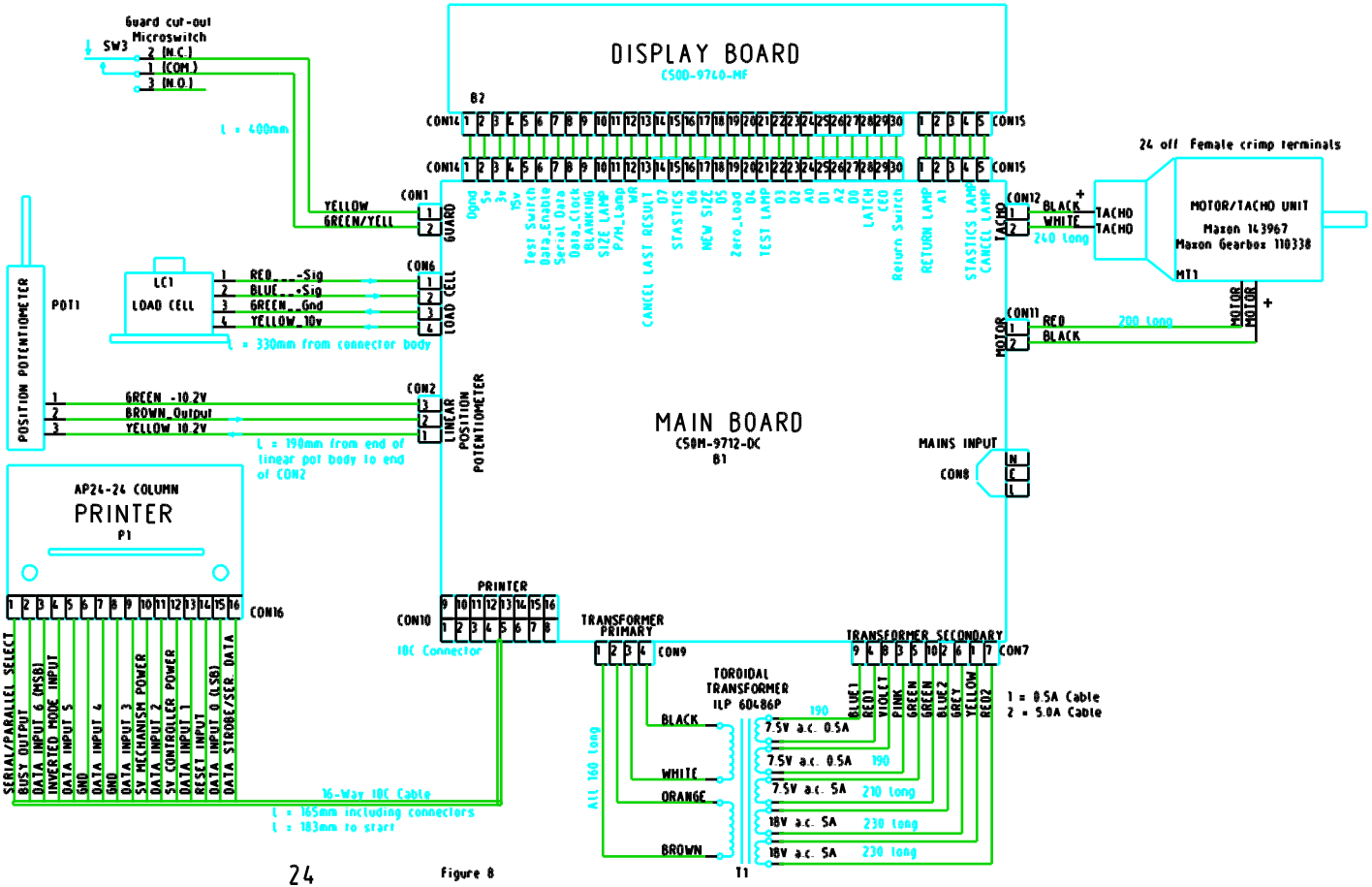


Figure 8

C50 FRONT PANEL

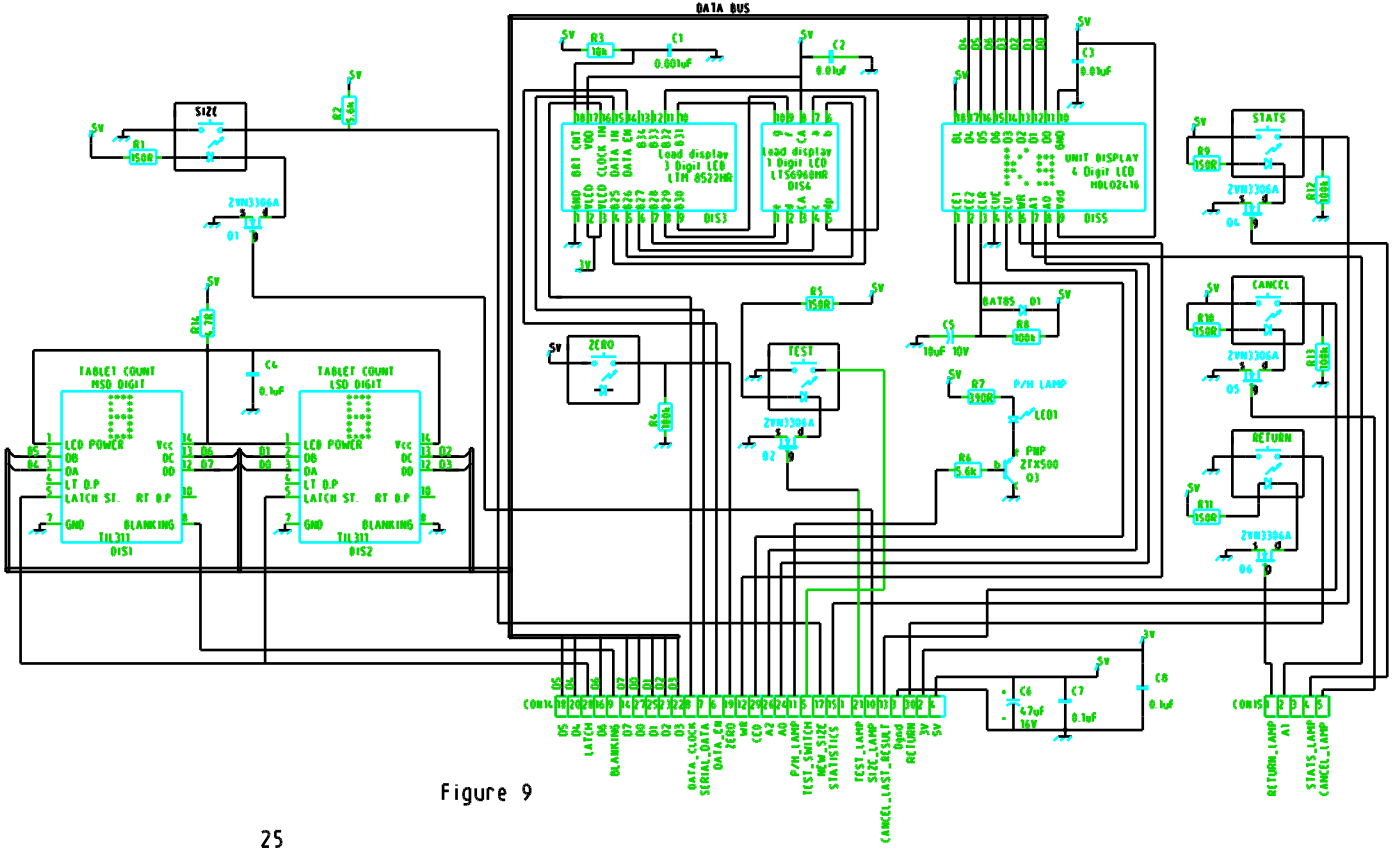


Figure 9

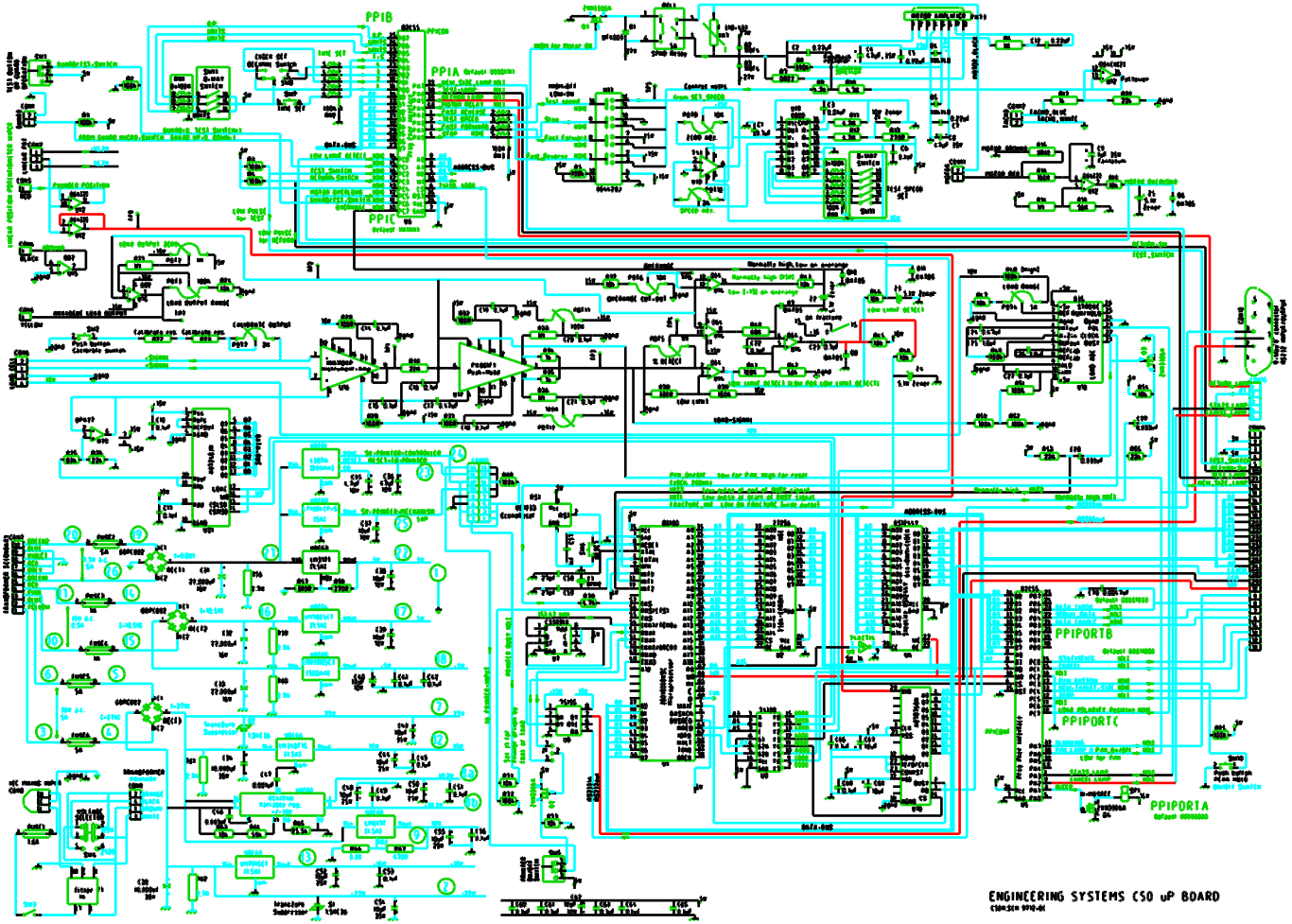

PPIB
PPIA
PPIC
PPIPORTB
PPIPORTC
PPIPORTA
ENGINEERING SYSTEMS C50 uP BOARD

Figure 10

6.3 ELECTRONIC BOARDS FITTED

There are 2 electronic boards boards fitted to the C50 machine, these boards are identified by a name and number. The name is self explanatory, the number is composed as follows:-

C50 stands for Compression 50kg Load Cell
The letter, e.g., D is for the board type i.e. Display
Numbers, e.g. 9712 give the date on which the board was designed or last updated. i.e. Week 12, 1997
The letters, e.g. DC are the initials of the designer of the board

Boards fitted:-

Main Board	C50M.PCB-xxxx.xx
Display board	C50D.PCB-xxxx.xx

In addition there is an EPROM situated on Main board. If software upgrades become available this can be changed.

The toroidal transformer which is fitted, is designed and manufactured to Engineering Systems specifications. Toroidal transformers are more efficient, smaller and most important, give less electromagnetic interference than a conventional transformer. The penalty is a higher unit cost.

Toroidal Transformer.....6D486P

6.4 MACHINE SERIAL NUMBER

The serial no. is to be found on the topside of the base plate and can be seen when the waste drawer is removed. This number should be quoted in any correspondence regarding the machine.

6.5 LOAD CELL SERIAL NUMBER

This is printed on the load cell

6.6 SPARES SUPPLIED

Printer ribbon
5 x Paper rolls

7. REPAIR and MAINTENANCE

If the machine needs to be dismantled first switch off the mains and remove the IEC/MAINS lead.
Be aware that static electricity, which can be present in the human body can damage sensitive electronic components.
Do not work on the electronic circuit boards in the vicinity of nylon carpets etc.
If the electronic boards have to be removed try to hold the them at their edges and not by their tracks or components.

7.1 REMOVING BOTTOM COVER AND MAIN CASE

Remove the waste draw and turn the machine to rest on its left hand side.
Unscrew the 4 rubber feet and remove the bottom cover.

Remove the printer by removing the 2 screws below the printer which attach the printer to the box. Gently pull the printer out until the printer connector is visible and then remove this connector.

Disconnect the ribbon connectors which join the main board (underneath the baseplate) to the front board (mounted behind the front of the Main Case). The connector pulls out from the front board, some care is needed to disconnect the cable otherwise the leads may get bent on assembly. If they do get bent, they should be straightened out with a small pair of pliers. The Main Case is attached to the Main Frame by 4 hexagon (Allen) screws. Unscrew the 2 hexagon (Allen) screws which are located one on each of the front foot mounting pillars.
Replace the machines 4 rubber feet and turn the machine to its normal upright position.
Unscrew the screws from the rear foot mounting pillars.
Lift the main case upwards so that it clears the machine, taking care not to damage or dislodge the printer connecting cable.

For reassembly it should be noted that the case fits between the baseplate and the rear bottom back panel.

Refit the Main Case and Bottom Cover, taking care that the printer connector is fitting down the slot on the side of the base plate.

Refit the ribbon connectors to the printer connector and replace the Bottom Cover.

Check the operation of the machine.

7.2 REPLACING THE MAIN CIRCUIT BOARD

The main electronic circuit board is mounted underneath the aluminium alloy base plate which is contained within the outer casing.
Remove the bottom cover and main case as described in section 7.1 .
Figure 7 on page 23 shows the view from above the machine and identifies the various components and connectors.
Remove all 7 connectors shown in the diagram. Some of the connectors have a small lever on the side which must be pressed to enable disconnection.
Now turn the machine upside down and remove the 3 pozi-drive screws which mount the board onto the aluminium base plate. The board can now be removed but taking care not to trap the load cell lead and connector.

Fitting the new board is the reversal of removing, but be sure to remember to connect the earth connector when fixing the central pozi-drive mounting screw. Make sure all 7 connectors and the front board ribbon connectors are re-connected and the correct way round.
Now refit the main case remembering to reconnect the printer and taking great care when re-connecting the ribbon connectors. It may be necessary to put one's fingers behind and in front of the ribbon cable whilst pushing it home. Make sure that it is fully into the socket.

Refit the bottom cover and check that the machine works correctly. Because the new main board controls the load cell operation, it will be necessary to calibrate the board as described in Section 3.
Further adjustments, although not essential, should also be carried out. The potentiometers which will need adjusting will be Pot 1 (digital display zero adjustment), Pot 4 (digital display output range) and Pot 6 (overrange cut-out). The adjustment of all these potentiometers is also described in section 3.

7.3 REMOVING THE LOAD FRAME AND CHANGING THE LOAD CELL

Remove the main board as described in section 7.2 .
Unscrew the 4 hexagon screws which attach the load frame to the baseplate.
Unscrew the two Load cell rubber seal retaining grub screws.
Unscrew the 2 hexagon load cell retaining screws and remove the load cell/rubber seal assembly, again taking care not to damage the rubber seal.
The new load cell can now be installed and the reverse procedure should be followed for assembly.
Calibrate the load cell as described under CALIBRATION PROCEDURE.

WHEN THE LOAD CELL HAS BEEN CHANGED, THE OVERRANGE CUT-OUT LEVEL MUST BE ADJUSTED, OTHERWISE THE LOAD RATING OF THE LOAD CELL MAY BE EXCEEDED.
See section 3.17 for adjustment details.

7.4 FAULTS/SYMPTOMS/CURES etc.

Sometimes faults are very simple to cure!
Faults such as - 'nothing happens when the machine is switched on' can sometimes be cured by anyone who knows how to change a fuse.
However, more serious faults can sometimes occur and the machine can either be returned to ENGINEERING SYSTEMS for repair or the following notes may help to make an in-house repair possible.

7.5 FIRST STEPS IN FAULT FINDING.

Digital Displays do not illuminate when switched on.

Check mains fuses, Machine 1.6A Slow blow, square pin plug 5A for 220-240V a.c.

Check internal fuses (underneath the machine).

Motor does not start when motor button pressed.

Check internal fuses

7.6 ERROR MESSAGES.

Some error messages are output on the printer.
FWD MOTOR DRIVE ERROR indicates that the plunger is not travelling, as it should be, towards the loading platen when the TEST button is pressed.
REV MOTOR DRIVE ERROR indicates an error in the opposite direction.
These errors probably mean that the motor drive amplifier (PA73) and/or the IC's U11 & U6 on the main circuit board could be blown.

However the ability to cure the more subtle or elusive faults requires some understanding of how the machine works. The following diagram shows, in outline, how the C50 operates :-

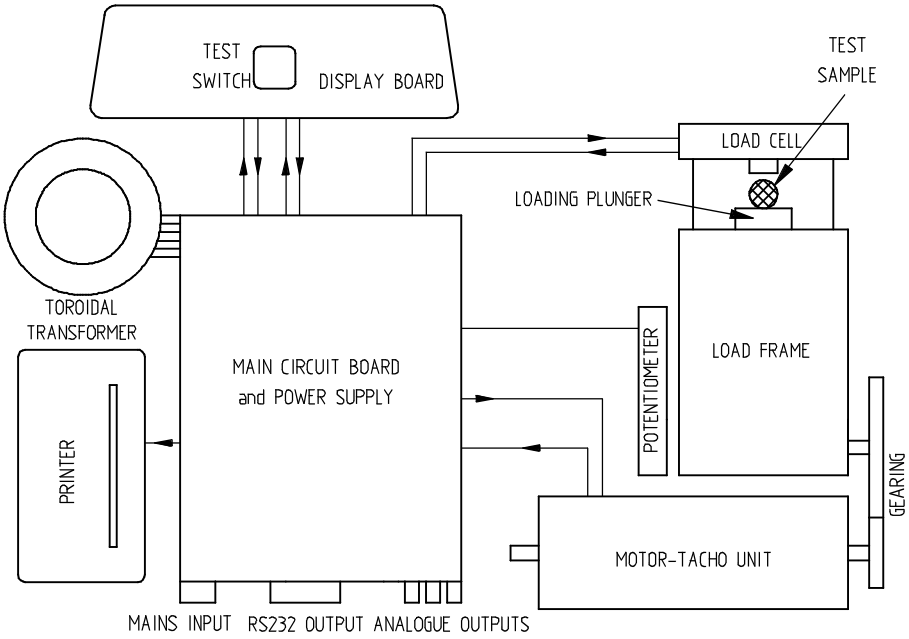


Figure 11

The preceding picture is not quite the whole story as low voltage d.c. POWER has to be supplied to the various components and boards. The following diagram completes the picture.

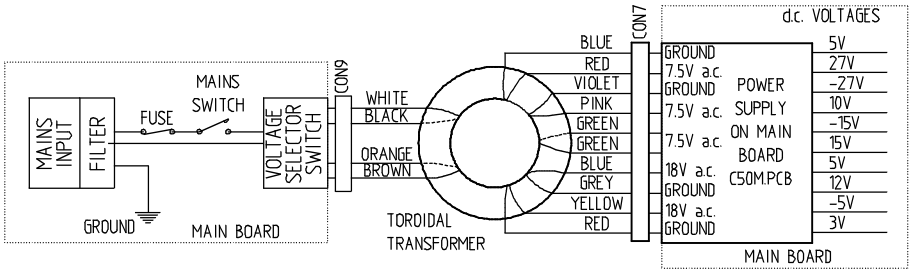


Figure 12

This diagram reads left to right, and shows how the mains input voltage is FILTERED, FUSED, TRANSFORMED and finally RECTIFIED & STABILISED by the Power Supply into the required d.c. VOLTAGES.

The machine is MODULAR i.e. built of larger easily replaceable units onto which the many smaller components are mounted. There are approx. 6 easily replaceable main modules which are fitted above and below the BASEPLATE to which the wiring and other fixed (but replaceable) items are attached. There are basically two types of faults which can occur - MECHANICAL or ELECTRICAL.

The main replaceable modules are :-
MECHANICAL Load Frame mechanism, including the sub-modules,
Motor + tacho, Load Cell, Linear Positioning Potentiometer.
ELECTRICAL Toroidal Transformer.
ELECTRONIC Main board, Display board, Printer.

7.7 SECOND STEPS IN FAULT FINDING
Is it likely to be electrical or mechanical? Faults can usually be isolated into small areas.

7.8 ELECTRICAL & ELECTRONIC FAULTS
One does not necessarily need to be an expert in electronics to cure 'modular electronic faults'. For example, if the printer is not working correctly but the RS232 output is working correctly, then it is most likely that the printer is faulty, which is just a case of removing the main casing and plugging in a new printer. However, fault finding is not always plain sailing and to cure those subtle faults an awareness of electronics will be needed.
Personal STATIC DISCHARGE can damage some of the electronic circuitry and care should be observed when handling the electronic boards. Ideally static free areas should be used, but in practise this is not always possible. Minimum handling, of the edges only, of the boards should help to overcome the static discharge problem. AVOID AREAS IN THE VICINITY OF NYLON CARPETS etc.

7.9 GENERAL ELECTRICAL FAULTS

7.10 FUSES - Check the fuses as described below.

7.11 THE MAINS FUSE is mounted on the rear panel . This fuse can be replaced by pushing and unscrewing the fuse retainer. Use a 1.6A fuse for 220-240V and a 2.5A fuse for 110-120V, both 20 mm, anti-surge type (T) or slow blow type fuses.

7.12 FIVE INTERNAL FUSES are also fitted and they are accessible, without having to remove the bottom cover, on the underneath of the machine. To gain access to these fuses turn the machine upside down or turn to rest on its side. The fuse No's. and values are marked on the bottom cover.

The values which should be installed are:-
Fuses 2, 5 and 6 - 5A slow blow or anti-surge (T)
Fuses 3 and 4 - 1A slow blow or anti-surge (T)

7.13 MAINS FILTER
The mains voltage is filtered when it enters the machine. However possible disturbances to the smooth running of the machine could be caused by large power supply fluctuations or by other nearby electrical equipment being switched on and off. Additional filtering may be necessary.

7.14 POWER SUPPLY - Check the voltages. Are the correct voltages being supplied to, and being supplied by, the power supply board? A voltmeter will be needed to check this. The wiring diagram and figure 10 give the a.c. input and d.c. output voltages which should appear on part of the main board. Cure - replace the main board or the toroidal transformer

7.15 CHECKING THE POWER SUPPLY VOLTAGES
To aid diagnostics the various d.c. voltages are indicated, at various points, on the main board tracks. If the voltages measured are not correct, either a faulty 'power supplied' component could drag the power supply voltage(s) low or a power supply component itself could be faulty. If a faulty 'supplied' component is present within the main board or display board the component may get hot indicating a fault within that component. Note that some of the power supply components such as voltage regulators normally get warm or hot.

There are also 25 numbered test points situated at the power supply end of the board. To check the d.c. voltages connect between GROUND and the relevant TEST POINT. To check the a.c. voltages connect between the relevant TEST POINTS.

No.1 is GROUND (0 Volts).

d.c. Voltages are :- 7. is 27V, 2. is -27V, 12. is 15V, 13. is -15V,
8. is 12V, 9. is 10V, 17. is 5V, 18. is -5V, 24. is 5V, 25. is 5V,
22. is 3V.

a.c. Voltages are :- 10. & 11., also 14. & 15. are 15V,
3. & 6., also 4. & 5. are 36V, GROUND & 20., also GROUND & 19. are 7.5V

FUSES continuity Fuse 2. is 19 & 20, Fuse 3. is 11 & 14,
Fuse 4. is 10 & 15, Fuse 5. is 5 & 6, Fuse 6. is 3 & 4.

7.16 CONNECTIONS

Check, visually and by wiggling, that all electrical connections, plugs, sockets and board inter-connections etc. are properly connected. Check also for 'loose' wires and loose soldered connections anywhere. Check for loose foreign bodies, especially of metal, which may short out a circuit board. Check for continuity between connectors and boards.

7.17 BOARD CHANGING

It may be that an internal supply voltage fault caused the failure, therefore it would be prudent to check all power supply voltages before changing boards. If it is suspected that a fault lies within a particular board, replace it with a spare board (module). However if a spare is not available and an electronics workshop is available, it may be possible to repair boards 'in house'. Otherwise a spare will have to obtained from the manufactures or the machine sent back for repair.

7.18 MECHANICAL FAULTS

These are usually more easy to find than electronic faults. Unplug the mains supply and remove the outer cover(s). A close visual inspection quite often reveals the fault which may be minor and easy to cure, or major and disastrous! Check the tightness of all 'nuts & bolts' etc., check the gears for tightness. Now with the main casing removed, but connected with a Front Connector Adapter, try connecting the mains supply and pressing the start button, listen for, and isolate any peculiar noises.

7.19 SPECIFIC FAULTS

MACHINE malfunctions when switched ON after switching OFF.
A gap of at least 5 seconds must be left between switching the machine OFF and ON again.
MOTOR starts but no plunger movement - mechanical fault, Gears slipping.
MOTOR will not start
Are the speed switches set to 0 mm/min? if so the motor will not run when in the TEST SPEED mode
Faulty main board.
Faulty motor amplifier.
Faulty Motor
Has the plunger travelled to far forward or to far back? if so, the plunger can be released by turning the 60 tooth pulley situated at the right hand end of the loading frame.

MOTOR DRIVE FAULTS

Usually this is a fault with the power amplifier (drives the motor) and not the motor itself.

Cure: Fit a new power amplifier and 2 other associated electronic components. These components all plug into sockets and are directly accessible when the bottom cover has been removed (4 screws). This repair is relatively easy and does not involve any other tools than a screwdriver. We can supply the spare parts.

FUSES blow on switch on

Check that anti-surge (slow blow) fuses are being used.

DISPLAYS do not light up

Check fuses especially the 5A fuse on the power supply board. These fuses must all be of the anti-surge (T) or slow- blow type. Check the two 15 & one 5 way connectors between the display and the main board.

Bad connection between the Main Board and the Display board.

LOAD DISPLAY will not zero.

Check load cell platen is not obstructed.

Fault with load cell, is there a possibility that the load cell has been overloaded? check for linearity etc. with weights.

LOAD DISPLAY reads 49.99 - load cell not plugged in or leads damaged.

Main board fault.

DISPLAYS will not settle to a constant value

Main board faulty.

Load cell or connections faulty.

LOAD DISPLAY jumps up a few digits when peak/hold is switched on

Incorrect internal adjustment of trimmers on peak hold chip on Main board.

TEST BUTTON Flashes when machine is first switched on

See section 2.3

Test button, Return & New Size lamps all flash when the TEST button is pressed:- Guard mode is set and tests are started by lowering the guard, this disables and renders the TEST button inoperative.

PRINTER not working correctly

Is the rear panel printer switch switched ON?

Check that the internal printer connector is connected correctly.

Make sure that the paper is not trapped inside the printer body.

New printer rolls become difficult to feed into the mechanism.

or, Printer will not print.

Either the printer electronics or the mechanism has stopped working.

Cure: Fit a new printer, or a reconditioned printer, or send us your old printer for repair. All available from Engineering Systems.

TIME & DATE incorrect This chip is situated on the Main board and incorporates the RAM. If the time is incorrect - adjust as described in Appendix 3. If the time is again incorrect the next time the machine is switched on, then the clock has reached the limit of the internal battery life (10 years)? Cure :- renew the 'clock chip'. The part no. is DALLAS DS1244Y-70.

NOTE: the various internal trim adjustments, on the main board, are set before leaving the manufacturers. These settings should never alter - but - if for any reason they change, the operation of the machine will be upset. Section 3 in this handbook gives details of the majority of adjustments which can be made. If malfunction is still suspected, return the Main board to Engineering Systems for complete re-adjustment.

7.20 REPAIR

WARNING:- Whilst there is mains voltage present on the main board, it is covered and it is not possible to touch the tracks carrying this voltage.
However a large d.c. potential voltage exists as there are +27 Volts & -27 Volts present on the board.
Only qualified personnel should be allowed to check for faults if any of the outer casing has been removed and the mains supply is connected.
The C50 is built from modules both mechanical and electronic. Instrument mechanics and/or electronic engineers should have no difficulty in replacing any of the major modules which are all available as spares and are detailed in the spares price list.

If faults cannot be easily traced, contact Engineering Systems.

7.21 ROUTINE MAINTENANCE

Empty the Waste Drawer (left hand side of the machine) **regularly.**
The small space between the bottom of the plunger and the loading platform can become filled with powder etc. and in severe cases could slow down or stop the motor from operating. A thin steel strip (similar to a feeler gauge) should occasionally be used to clear out this region.

Powder etc. can sometimes build up between the loading platform and the load cell platen. This could affect the accuracy of the test results. This area should occasionally be cleared, using the same tool as above.
Routine mechanical maintenance involves removing the outer casings and cleaning any powder, dust etc. from the inside of the machine.
The load frame toothed belt tension and should be inspected after a period (2 - 3 years, depending on usage).
If faults cannot be easily traced, contact Engineering Systems.

7.22 GUARANTEE & SERIAL No.

The guarantee operates for one year from delivery date and covers parts and labour only. Malfunction due to misuse or accidental damage are not covered. Defective components or machines should be returned, at the users expense, to the address below where they will be examined and wholly or partially replaced if necessary.

Users or customers should contact Engineering Systems, before any returns are made, as problems can often be solved by telephone or FAX.

The Serial No. can be found on the top side of the base plate and is visible when the waste drawer is removed. This number should be quoted in any correspondence regarding the machine.

7.23 MOTOR-BALL SCREW, TOOTHED BELT ADJUSTMENT

The Loading plunger (ball screw) is driven from the Motor via. a toothed belt. Adjustment may be necessary after a period of time. Adjustment is by three M3 screws which are situated at the end of the motor. Loosen the screws and move the motor until the belt has just a little slack. Do not over tension otherwise this will result in a noisy drive.

8. SPECIFICATION OF STANDARD C50 MACHINE

Choice of 4 output units	Kilogram (kg) or Kilopond (kp) or Newton (N) or Pound (lb) all instantly switchable
Maximum loads (Hardness)	50kg, 50kp, 500N or 99.99lb respectively
Load resolutions	0.01kg, 0.01kp, 0.1N or 0.01lb respectively
Minimum detectable fracture load.	0.3kg
Load indication	4 digit display, Internal printer output, RS232 output.
Analogue outputs	(4mm sockets) of Load and Loading Plunger position.
Test speed range	1 to 31 mm/min.
Fast forward and fast return speed	140mm/min.
Maximum tablet diameter	36mm
Calibration	Dead weights in any of the above units and internal calibration switch.
Power requirements	110/120V a.c. 2.5A or 220/240V a.c. 1.6A (Internal selection switch)
Machine dimensions	Width 300mm, Depth 290mm, Height 180mm
Machine weight	12kg
Shipping size	420mm x 380mm x 340mm
Shipping weight	16kg

ILLUSTRATIONS & SPECIFICATION NOT BINDING TO DETAIL AS IMPROVEMENTS MAY BE INCORPORATED FROM TIME TO TIME.

The C50 is :-

Designed and Manufactured in Nottingham, England by:-
ENGINEERING SYSTEMS (NOTTM)
1 Loach Court, Radford Bridge Road,
Nottingham. NG8 1NA. ENGLAND
Tel: (0115) 928 8708 Fax: (0115) 928 8715
E-mail: info@engsys.co.uk Web: www.engsys.co.uk

APPENDIX 1

Further consideration of the % fracture detect and low limit settings. (see also section 3.16) The following graph shows the relationship between Low Limit load, % Fracture Detect, Peak Hold load, Test Load, Load Cell Load and Fracture point during a typical test. (Time is proportional to test speed.)

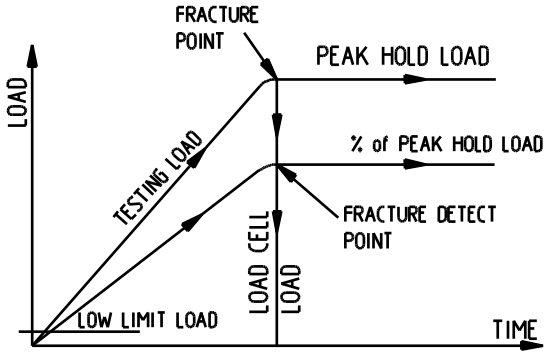


Figure 13

On loading the peak held load follows the load cell load up to the point of fracture, at this point the load cell load drops to zero (unless the test object is spongy or crumbly) and the peak held load remains constant. Fracture is detected by the electronic circuitry when the load cell load drops below the % peak hold load line (or setting).

The usual % setting for this 'line' is 60-70% but the material properties of some test objects may demand a revised setting before meaningful test results can be obtained.

When using the machine for general purpose testing, the following discussion may prove useful :-

Soft crumbly objects may require a lower % setting because the testing load may drop momentarily (causing a fracture detect) during loading, due to localised surface crumbling prior to the object fracturing or substantially failing. Some experimentation will be required to obtain a satisfactory % setting for these 'difficult' materials. A fracture may not be detected at all if too low a % setting is used, the test object may just be gradually crushed into a powder. Different platen geometries i.e. convex, may have to be considered.

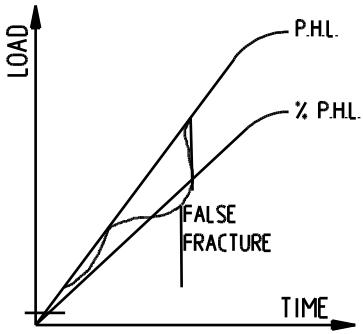


Figure 14

Hard objects in compression may fracture but leave some of the fractured test object in the test position between the loading platens. If the % setting is too low a fracture will not be detected. If the setting is too high, small departures of the load cell load from the peak held load, especially at the start of a test, (see Low Limit Fracture Detect Suppression, 3.13) will give a fracture detect and the test will be halted.

CHECKING THE % SETTING.
With the bottom cover removed and the machine resting on its LHS, set pot 5 so that TP4 reads approx. 70% of the reading on TP3 when the calibrate button is pressed.

ALTERNATIVE SETTING METHOD:-
Connect a digital voltmeter into the load cell output terminals (see Fig. 3). Check that the voltmeter gives the same numerical reading as the load display when the calibrate button is pressed.
Press the TEST button, when test speed is reached slowly depress the load cell by hand to obtain a reading of say 5kg. Gradually release the pressure on the load cell until the motor stops. At this point (and without further releasing the load on the load cell) note the reading now shown on the voltmeter. Comparison of the peak hold load and the digital voltmeter reading gives the % fracture detect setting.
Note : some practice may be required before consistent percentages are obtained.

APPENDIX 2

SETTING UP THE MAIN BOARD FOR THE C50

This is the procedure for setting up the main board during manufacture. This procedure should not be used for setting up an existing board. The instructions given in chapter 3 should be followed for existing boards.

Set Test Mode Switch to PANEL SW.

Install the main circuit board into machine, without any IC's installed, plug in the 2 transformer connectors and make sure that the ground connector is in position. Check that the a.c. voltages are correct, insert the d.c. fuses and check all the d.c. voltages.

Insert the IC's and re-check the d.c. supply voltages after insertion.

Plug in the Motor, Tacho, Linear Pot, Guard & Printer connectors.

With the PEAK HOLD disabled (unlit), adjust Pot12 so that TP3 is equal in voltage to TP2.

Adjust Pot11 so that TP3 is the same when the Peak Hold is enabled or disabled.

Adjust the load range by hanging on weights and adjusting Pot4.

Set POT2 (ZERO) so that the Analogue Load Output TP7 = zero.

Set Pot3 (Output Range)so that the numerical (i.e. ignoring the decimal point) Analogue Load Output corresponds to the Load reading when the calibrate button is pressed.

Set Pot5 so that TP4 reads approx. 70% of the reading on TP3 when the calibrate button is pressed.

Set the Maximum Load Cut Out using Pot6.
To set to 49 kg. :-
Use the formula CUTOUT = (49 x R)/C
Where C= Load reading when the Calibrate switch is pressed.
and R= corresponding reading on TP2.
Set the calculated CUTOUT voltage onto TP6 by adjusting Pot6.
Note :- the calibration button must not be pressed at this stage.

TEST SPEED RANGE ADJUSTMENT (POT 12)

Set the speed by timing the rotation of the loading plunger pulley. One revolution of this pulley gives 1mm of plunger movement.

The pulley can be seen either when the main casing is removed or, if the printer is removed, the pulley can be sufficiently viewed to time and count the revolutions.

First set the speed (rear DIL switches all down) to zero. Then, when running at test speed, set POT9 so that the pulley does not rotate.

Using the New Size button, set up for maximum size. Now, set the speed to 20 mm/min (the 16 & 4 DIL switches up) then press the Test button. Whilst in test speed adjust POT10 so that the pulley is rotating at 1 revolution in 3 seconds (20 revs/min). Check that the speed is also correct at 6 mm/min i.e. one pulley revolution in 10 seconds.

LOAD CELL AND PLUNGER TRAVEL CYCLING

This is only for use during manufacture (for running in) and testing.

With the machine switched off, press the ZERO and NEW SIZE switches on the front panel at the same time, switch on the machine by the mains switch, still keeping the two switches on the front pressed until the printer starts printing. The plunger will then cycle at fast speed or load the load cell to its maximum allowable load at test speed if an object is placed in front of the load cell. After 100 cycles the printer will print how many cycles, if any, including loading the load cell.

To stop the cycling routine press the CANCEL switch.

APPENDIX 3

RESETTING THE TIME & DATE CLOCK

With the bottom cover removed, press the black push button switch (SW9, situated next to the blue 10 way rotary switch) and then, with SW9 still pressed, press and release the black push button RESET switch (SW6), wait until the printing has finished before releasing SW9; this activates the clock resetting routine. The printer switch on the rear panel must also be switched on. The printer will print out the time and date at this point.

The new time and date are input into the clock in a sequence of 13 operations. Each operation involves setting the 10 way rotary switch to the correct position and then pressing the push button switch SW9. After each push the printer prints out the latest change in setting.

The clock does not update the time whilst in the reset mode. The clock restarts after the last operation in the reset cycle.

The sequence of setting the clock is :-

Minutes, 10's Minutes;
Hours, 10's Hours (24 hr. clock);
Day (1=Mon., ... 7=Sun.);
Date, 10's Date;
Month(1=Jan.), 10's Month;
Year, 10's, 100's & 1000's Years.

These are set in order. To change the time; activate the clock reset as described above. Allow the printer to print out the current time and date. Set the 10 way rotary switch (SW8) to the units of minutes and push the push button switch (SW9). The printer now prints the new time. Continue the sequence, setting the decimal switch to the ten's of minutes and pressing SW9, repeat this cycle until the sequence of 13 operations has been completed. The final printed output is the newly set time and the machine is then ready for use.

e.g. The clock is to be completely reset to:- 2.30pm, Monday 5th June 2004
The best way to avoid making a mistake is to write out the numerical data in reverse i.e.

2004	June	5th	Monday	24hr time	Minutes
2004	06	05	1	14	30

The data string is presented to the clock in order, starting with 0, followed by 3 then 4 etc. and toggling each value into the clock after the previous printing has stopped.

QUICK METHOD FOR RESETTING THE MINUTES & HOURS

The minutes and the hours can be changed without having to remove the bottom cover and completely reset the clock. When the machine is first switched on, the Statistics and the Cancel button are reconfigured to be able to update the hours and minutes. The procedure is:-

To increment (increase) the minutes, when the machine is first switched on, the Statistics button must be pressed i.e. press Statistics and then the ON switch; the time & date are printed and as long as the button continues to be pressed, the minutes will gradually be incremented & printed. Release the button when the minutes are correctly set.

To decrement the minutes, Follow the above procedure but use the Cancel button instead of the Statistics button
If the Cancel (decrement) button is pressed before the Statistics (increment) button is released and the Statistics (but not the Cancel) button then released! the minutes will be decremented for as long as the Cancel button is pressed. - And Visa-versa -.

To increment the hour, When the machine is first switched on, wait until printing of the title commences and then press the Statistics button. Hold the button down (a few seconds) until the printing has completely stopped. Release the button, printing will then continue for a short period and the hour will have been increased by 1. It is only possible to increase 1 hour at a time by this method. Larger increases can be achieved by completely resetting the clock or by switching the machine off and on and repeating the above procedure a number of times.

To decrement the hour, Follow the above procedure but use the Cancel button instead of the Statistics button.

When the printing of the title has finished, the Statistics and Cancel button revert to their normal use and cannot (without the machine being switched off or the internal reset button being pressed) subsequently be used for changing the time.

APPENDIX 4

How to start using the C50 without reading the Handbook

Key Features are:-

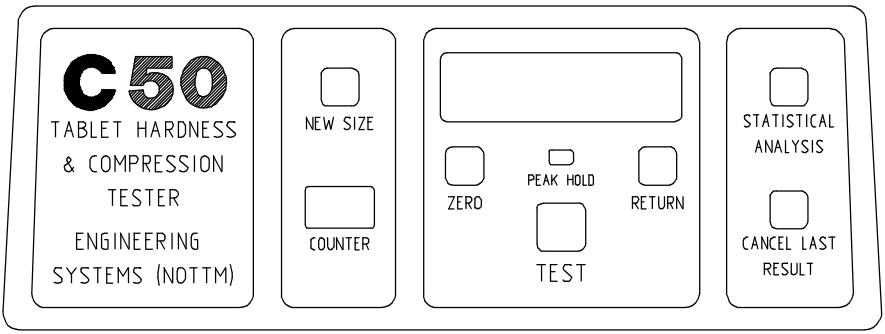
Automatic sizing of new tablets
Maximum load (Hardness) 50kg.
Maximum jaw opening of 36mm

Discovering the C50

The machine's controls are situated either on the front panel (non adjustable controls) or the rear panel (adjustable controls).
For normal use, only the front panel membrane switches (buttons) are used.
When the machine is first delivered the rear panel default settings are:-

Load Output in kg.
Test Speed of 6mm/min.
Test Mode Switch set to (Front) Panel (i.e. TEST) Switch.
Printer is ON.

The front panel looks like this:-



Switching on the C50

Check that the mains supply voltage is correct.
Plug in the IEC/MAINS connector to the rear of the machine.
Switch on the rear panel mounted mains switch. (This is a small chrome plated toggle switch located between the mains input and the fuse holder)
The LOAD DISPLAY should illuminate and show 88.88; this checks that all the display segments are working.
The COUNTER should show a count of 00

The printer should now print out the message

C50 TESTER

TIME xx:xx
DAY xx-xx-xxxx

When the printing has finished the LOAD DISPLAY should change from 88.88 to 0.00, and the machine will be ready to use. If the display is not exactly zero press the ZERO button. If the TEST button flashes, read the handbook (section 2.3)

Setting up for a new size Have a 'new size tablet' ready for placement onto the loading platform. (The loading platform is situated underneath the Perspex guard) Lift up the Perspex guard and press the NEW SIZE button, the loading plunger will return i.e. move to the right and to the extremity of its travel. During the return motion, place the new tablet onto the loading platform and in line with the axis of the plunger. When the plunger reaches its extreme reverse position, it immediately changes direction and travels at its FAST FORWARD speed whence it approaches and pushes the tablet up to touch the loading platen. The plunger will then stop and reverse, by approximately 5mm, to its preset return position. The printer prints out NEW SIZE When the printer has finished printing, the sizing sequence is complete and the machine is ready to test the new tablet size.

Testing the first tablet Place a tablet onto the loading platform and in line with the plunger, lower the guard and press TEST. The plunger will fast forward up to approximately 0.2mm of the tablet and then change to the set test speed (6 mm/min.). When the plunger reaches the tablet, loading commences and the digital load display can be seen to increase. Fracture is detected automatically and the plunger stops and reverses to its preset return position. At this stage the test result is printed out on the printer. Further tablets from the batch can be tested by placing a new tablet onto the loading platform and pressing the TEST button.

End of batch, Statistical Analysis When at least 2 tablets have been tested, press the STATISTICAL ANALYSIS button. The statistical data will be printed out. When the printing is complete, the COUNTER is automatically re-set to zero and a further batch of tablets can be tested.

Next Batch If the next batch of tablets is a different size, then the NEW SIZE procedure will have to be followed, if they are the same size as the previous batch then no resetting of the size is required.

APPENDIX 5

5. NOTES:-