HANDBOOK ©

CT6

5 kN TESTING MACHINE

For: -

COMPRESSION TESTING

and

3 & 4 POINT BEND TESTING

by
ENGINEERING
SYSTEMS (NOTTM) Ltd

Issue 5
Nov. 13

CONTENTS

DIAGRAMS & FIGURES

1 INTRODUCTION TO THE CT6

The Engineering Systems CT6 is a small vertical loading compression testing machine. The standard load range is 0 to 500 kg, but for more sensitive readings a 50kg or a 5kg load cell can be fitted, giving a resolution down to 1 gram. The machine is easy to use, compact, portable, and weighs 15kg. The CT6 can be used for 3 or 4 point bend testing with optional extra attachments.

1.1 FEATURES

- Automatic sizing of specimens
- Weigh balance, calliper, USB and RS232 interfaces are provided as standard
- Statistical Analysis of load, weight and thickness
- Load Cell ID allows load cells to be changed quickly and easily
- Firmware updates available online
- Test speed – digital adjustable between 0.1 and 50 mm/min
- Maximum load: 500 kg
- Crosshead travel: 50 mm
- 30 column printer with easy to change paper roll
- Choice of units: kg, kp, N or lb.
- Loading by Test button or Guard closure
- Automatic diagnosis of common faults

The diagram below shows the location of the main components of the CT6:

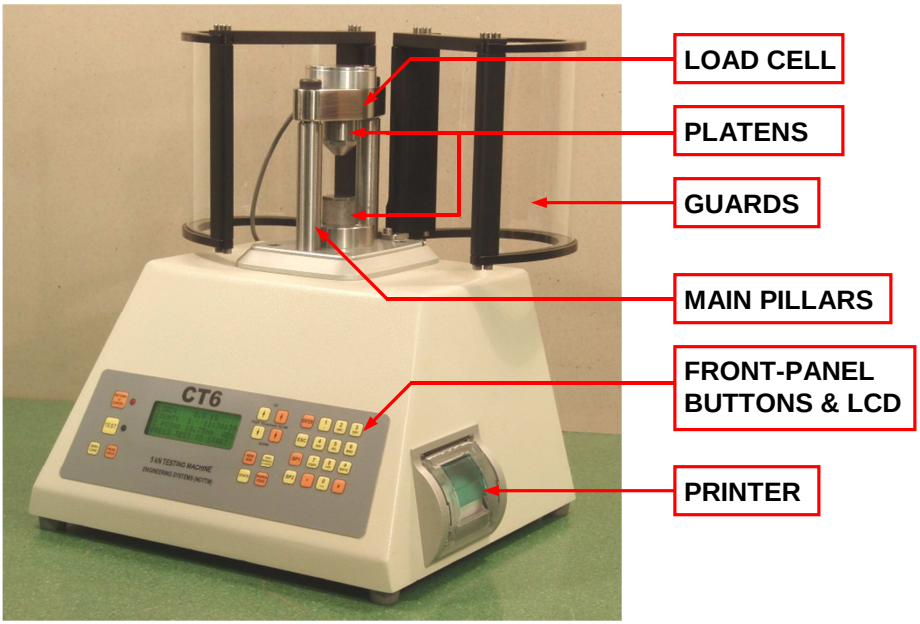

Figure 1 - Main Components of the CT6

The previous picture shows the machine set up for simple compression testing. It is controlled using the front panel keypad buttons and LCD. The description of these controls is described in section 2.

A guard pair is provided to control any flying test fragments. A test can only be started when the guard is closed; opening the guard during a test stops the test.

1.2 OPTIONAL ACCESSORIES

Shown on the right are some of the optional accessories that are available for the CT6. These include 500 and 5 kg load cells, a 3 or 4-point bend rig, a slide to catch debris and an acoustic sensor:

Figure 2 - Optional Accessories

1.3 TEST FIXTURES

The load cell is normally mounted on top of the moving pillars and has a central female thread that is used to connect the various attachments.
The load frame base loading area has various threaded holes to enable the attachment of accessories etc. For special applications, such as conducting tests in an environmental chamber, the load cell could be mounted on the base loading area.

1.4 3 & 4 POINT BEND TESTING

The picture opposite shows a three point bend testing fixture that has ∅2 mm lower non-roller contact points and a single ∅2 mm upper contact. The distance between the lower contacts is adjustable and has a minimum spacing of 4 mm. Other configurations, including roller contacts, four point bend etc. are available to order.

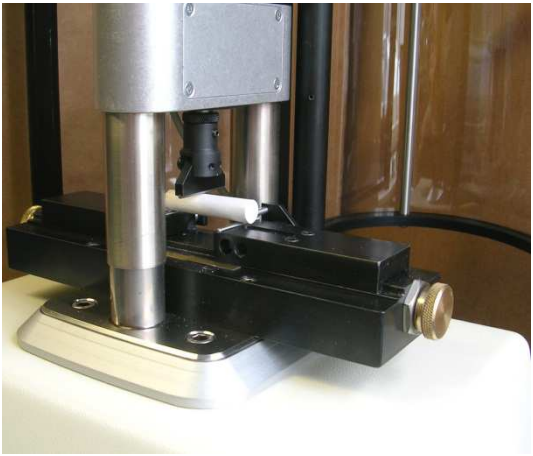

Figure 3 - 3-Point Bend Rig

1.5 FITTING THE 3 or 4 POINT BEND RIG

See Appendix B for fitting the 3 point bend fixture. Fitting instructions will be supplied separately if other configurations are supplied

1.6 FITTING THE ∅25 mm PLATENS TO THE 500 KG LOAD CELL FOR COMPRESSION TESTING

The upper platen screws directly into the load cell and should be lightly tightened using a 22 mm spanner. The lower platen is secured to the load frame base using the circular adaptor supplied. First screw the platen to this adaptor and tighten with the above spanner. This assembly is then attached to the base using the two M6 hexagon screws provided.

1.7 ACOUSTIC CRACK DETECTION

An acoustic sensor (available as an optional extra) can be connected to the CT6 for fracture or crack detection in hard materials. When connected, a test cycle can be ended when the acoustic level exceeds a set threshold by setting the fracture mode to ACOUSTIC or BOTH (see section 4.9). The sensitivity at which the acoustic sensor ends a test can be adjusted using the front panel buttons (see section 2.13), allowing this level to be set by 'trial and error' when adjusting the machine to test a new specimen.

1.8 GUARD

The guard pair are mounted onto the load frame base plate and the 'wings' rotate about separate pivots. Some functions of the machine are inoperative unless the guard is positioned to within a few degrees of closure. See section 2.3 for a more detailed description of using the guard.
Note:- The guard supplied may not be for all situations.

1.9 ADJUSTMENT OF THE GUARD

For setting up purposes the guard inoperative feature can be overridden by removing the guards (pull upwards) and substituting them with the guard simulator bar supplied with the machine.

1.10 REMOVAL OF THE CROSSHEAD/LOAD CELL

To remove the load cell, first unplug the connecting cable from the rear panel. Using a 5 mm Allen key, remove the two hexagon shoulder screws situated at the top of the vertical loading pillars.
Note: On larger testing machines, the crosshead is a beam that connects between the two loading screws or pillars. This is driven up or down by a motor drive system and the Load Cell is mounted at the centre of the crosshead, either above or below. Because the CT6 is a small machine a crosshead is not needed because the Load Cell itself connects between the

two loading pillars. Throughout the remainder of this handbook, the Crosshead/Load Cell will simply be referred to as 'Load Cell'.

1.11 TORQUE LIMITER

A torque limiter is incorporated into the drive system. The motor is connected to the ball screw drive via. a slipping clutch mechanism set to slip at approx. 600 to 700kg load. In the event of overload, this will prevent the ball screw and the motor gearbox from being damaged. However if either the 50 or 5kg load cell is installed, these will be damaged by a large overload.

1.12 PILLAR GUARDS

The main pillars and bearings are protected from the ingress of dust, dirt etc. by telescopic guards. The top sleeve can be lifted off when the load cell is removed and the bottom sleeve can be unscrewed by hand.

1.13 LOAD CELL OFF-CENTRE LOADING

The 500kg diaphragm Load Cells supplied with the CT6 are only partially compensated for off centre loading. Errors can be up to 5% if loading takes place at the edge of the ∅25 mm platen. Off-centre loading errors are much less for the 5, 10 & 50 kg load cells.

1.14 USING THE CT6 FOR THE FIRST TIME

Check that the mains supply voltage is correct. Refer also to section 3.1. Plug in the IEC/MAINS connector and switch on the rear panel mounted mains switch.

Initialisation starts and the LCD will show "CT6 5 kN TESTING MACHINE". The load cell will move to its topmost position and stop. Open the guards if necessary and **remove any specimen or debris in the loading area**, then shut the guards. The LCD will show the version number of the installed firmware, and the load cell will move downwards to the test position. The printer will print out the message shown on the right.

```
------------------------------
CT6 TESTER
(TIME / DATE)
Machine S/N: CT6-###
LPR: ###
------------------------------
------------------------------
Load Cell S/N: CT6-###-###
Capacity: # kg
------------------------------
```

Assuming a load cell is connected, it will be detected and a message printed showing its serial number. If the load cell isn't connected, connect it now. When the printing has finished, the LCD will show its default display with the current load and test count. Whenever possible, instructions are shown on the bottom line of the LCD as to which button to press next.

Note: LPR stands for Lost Passcode Reset. This is a security issue and the number indicates how many times a lost passcode reset has been performed. This number however, cannot be reset, and can be used to check if an unauthorised reset has been performed.

Mode of operation – see 2.1 overleaf.

Before a test can be conducted, the guards must be closed (or the guard simulator bar must be in position).

1.15 SETTING TEST PARAMETERS AND OPTIONS

Whilst the CT6 will perform a basic test using the settings as supplied, many extra options can be enabled or disabled, and test parameters such as test speed and fracture detect % can be altered. Explore the options in the setup menu (see section 4) and adjust them as required. Some of the settings that should be checked are: -

- Test Speed
- Guard Mode
- Load units
- Time and Date
- Fracture Mode
- Fracture Detect %
- Weigh balance and caliper
- Printing options
- Batch options
- Calibration reminder interval

The following chapters of this handbook describe the front panel controls hence setup menu and the rear panel connectors. Users should read these to become familiar with the CT6's functions and options. Please contact Engineering Systems if you need any further explanation of the machine operation or options available.

2 FRONT PANEL CONTROLS & MACHINE OPERATION

28 push button membrane switches are situated on the front panel; these control all the operations of the machine.
A printer is situated on the side of the machine.

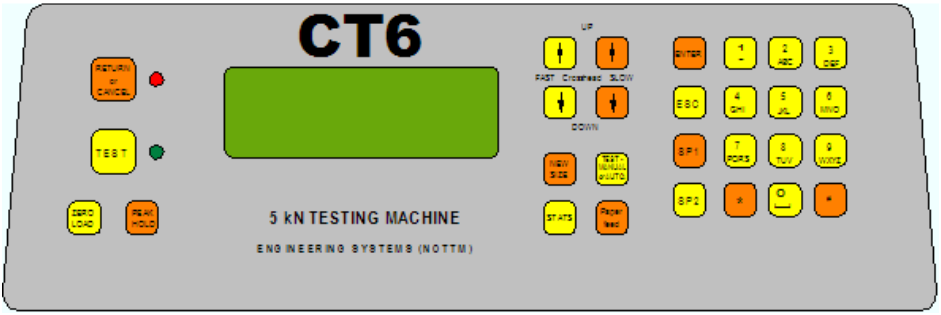

Figure 4 - Front Panel

2.1 LCD

The LCD shows information about the current operation of the machine, including results data, instruction messages and setup menus.
Main features of the LCD are: -

Load / Results Display: The load is displayed during a test or when the machine is idle. When the standard 500 kg load cell is fitted, the maximum load (hardness) is 500 kg and the resolution is 0.1 kg. In addition to reading in kg the units of load can be changed (see setup menu, section 4.6) to read in kp, Newton's or lbs. When enabled, weight & thickness are also displayed during and shortly after a test routine.

Manual or Count (Automatic**):**

Manual – shown on the LCD display as 'MANUAL':
In manual mode, the loading platen or test point should first be positioned close to the specimen by using the UP / DOWN buttons (see section 2.11). When the test routine starts the Load Cell moves downwards at test speed until a fracture is detected or the test is cancelled. The Load Cell then moves 1 mm upwards. In this mode the LCD will show 'MANUAL' whilst idle instead of the test count; however the test count is still incremented and shown after each test. Statistics can still be calculated and printed as normal.

Automatic – shown on the LCD display as 'COUNT':

In automatic mode the test routine operates as described in section 2.7; that is the specimen size is set using NEW SIZE, during a test the Load Cell moves fast downwards to the specimen then switches to test speed. After fracture occurs or the test is cancelled the Load Cell returns to the position set during the new size routine.

The test count is shown at the end of a test or when the machine is idle and shows the number of successful tests completed in the current batch. The tablet count counter is set to zero when the machine is switched on for the first time or after statistics have been printed. The counter is incremented each time a genuine fracture is detected. A genuine fracture can only occur during loading at test speed. If an oversized object is encountered during the fast forward plunger motion, the plunger will touch the object, return to its preset position, the tablet count will not be incremented, and a warning message will be shown.

The test count is saved when the machine is switched off and restored when it is next switched on.

Speed Display: The actual Load Cell speed, in mm/min, is shown during a test, and when the manual up/down buttons are used. The units mm/min are not displayed during a test because there is not enough space on the LCD

Z Position: The Load Cell position is shown both when the machine is idle and during a test. The range of the Load Cell's movement is approx. 50 mm, and the position is displayed in mm. Either absolute position (0 mm being the topmost Load Cell position), or a relative position from any point can be shown. This function can be changed using the ZERO LOAD button – see section 2.5.

Acoustic Level: When the acoustic sensor is enabled a bargraph is displayed on the bottom line of the LCD. This is scaled logarithmically and shows the current acoustic level. See section 1.7 for more details.

2.2 **TEST BUTTON** (yellow)

The CT6 is started using the TEST button. The exact test sequence depends whether the weigh balance, calliper and / or acoustic sensor are enabled (see section 4). The test mode must be set to 'automatic' and the sequence is as follows: -

- With the machine showing its default display (load, position and test count) press TEST. The display will now show 'WEIGHT:' and a flashing cursor if the weigh balance is enabled. If not proceed to the next step. Place the specimen on the balance, **wait for it to stabilise** and press TEST. The weight will be shown on the LCD.

- The LCD will now show ‘THICKNESS:’ and a flashing cursor if the thickness gauge is enabled. If not proceed to the next step. Place the specimen in the calliper jaws and press TEST. The thickness will be shown on the LCD.

If both the weigh balance and calliper are enabled the results will be consolidated onto the top line of the LCD to make room for the remaining test data.

- The display will now show ‘LOAD’ and a flashing cursor. Place the specimen on the platen or bend rig, close the guard and press TEST. The 2 wings of the guard must be closed to within a few degrees otherwise the machine will not start.
- When started, the motor drives the Load Cell downwards. If the guards are opened during testing, the machine will stop and automatically reverse the Load Cell direction. The test will also be cancelled if the maximum load or the maximum allowable travel is exceeded.
- Once the Load Cell reaches the specimen it will then reduce to the set test speed until a fracture is detected. If the acoustic sensor is enabled this can also stop the test (see section 1.7).
- Once a fracture is detected, the Load Cell will reverse to its preset return position (or 1 mm if manual test mode is selected, see section 2.1), the peak load will be printed (if the printer is switched on) and the test count incremented.

The test sequence can be cancelled at any point by pressing the RETURN / CANCEL button.

Note: - If neither the weigh balance nor calliper are enabled the load test will begin immediately the first time the TEST button is pressed.
The LCD will return to its default display approximately 15 seconds after a completed test. This shows the current load, time and tablet count. To return to this display immediately press ESC.
If the CT6 is unable to read data from the weigh balance or calliper, or if the units are set wrongly, an appropriate message will be shown on the LCD. Press TEST to retry or RETURN / CANCEL to cancel the test cycle.

2.3 GUARD

Whilst not a front panel control, the guard can be used to start a test instead of the TEST button. If the GUARD MODE is set to GUARD START then the test cycle can be started by closing the guards, allowing tests to be conducted without pressing any buttons. If the weigh balance or calliper are enabled, the TEST button must still be pressed to perform these tests first. The GUARD MODE can be set via the setup menu (see section 4).

Regardless of the GUARD MODE setting, testing will not start if the guards are open. 'CLOSE GUARD & RETRY' will be displayed on the LCD if the TEST button is pressed whilst the guards are open. Opening the guards during a test will cancel the test and the Load Cell will return to test position.

For setting up the machine or for performing individual tests it may be necessary to dispense with the guard (see section 1.9). However, using the machine in this manner might contravene local safety regulations.

2.4 RETURN / CANCEL BUTTON

The RETURN button can be used to cancel a test routine at any stage or to cancel a NEW SIZE or various other procedures. The red LED next to the RETURN / CANCEL button is lit when the Load Cell is moving upwards. After a test has been completed, RETURN / CANCEL can be pressed to cancel the last test result. The test count is decremented and a message is printed to indicate that the test results have been cancelled. The original test number is reused for the next test. The button can only be used to cancel the immediately previous result.

2.5 ZERO LOAD BUTTON

This button zeros the Load Display. The load is automatically zeroed when the machine is first switched on and each time a test is started.

The ZERO LOAD button can also be used to zero the Z Position display at the current position. Hold the button until the Z Position display changes to '0.00 mm'. 'REL' will be shown to indicate relative position mode. The Load Cell position displayed will now be relative to this point, so moving the Load Cell up from this point will show negative values. To return to absolute mode press and hold ZERO LOAD longer until 'ABS' is shown again. The displayed position will then be that relative to the topmost Load Cell position.

2.6 PEAK HOLD BUTTON

The peak hold function is automatically enabled at the start of each test; this allows the displayed load to increase but not to fall. The peak hold only becomes active once the minimum load (approx. 3 kg for a 500 kg load cell) is reached.
Normally peak hold is disabled when the machine is idle (i.e. when the display is not testing and is showing load, Z position and test count). However the peak hold can be toggled on or off during idle by pressing the PEAK HOLD button. 'P/H' will be displayed to the right of the load when the peak hold is enabled. Again, the minimum load has to be exceeded for the peak to be held. See Appendix A for a further discussion regarding fracture detect parameters.

2.7 NEW SIZE BUTTON

This button is used to start the automatic sizing procedure for a new batch of specimens.

Setting up for a new size: Have a 'new size specimen' ready for placement into the loading area. Press the NEW SIZE button; 'NEW SIZE' will be displayed on the LCD. The Load Cell will move upwards towards its topmost position. During this upward movement, place the new specimen onto the loading platform in line with the axis of the Load Cell. When the Load Cell reaches its topmost position, it changes direction and travels downwards at full speed until the load cell touches the specimen. The load cell detects the touch, and returns approximately 3 mm to its preset return position. If product details printing is enabled the LCD will prompt you to enter and product name, product ID and operator ID. Enter these using the alphanumeric keys (see section 2.14). The printer prints the message 'New Size Set' along with the product details if enabled. The new size sequence is then complete and the LCD shows its normal display. The machine is ready for testing the new batch of specimens.
It is not necessary to carry out this procedure if the new batch is the same size as the previous batch.

Note: - If small specimens are being sized, it is not necessary to wait for the Load Cell to travel to its topmost position; pressing the TEST button at any time during the upward motion will set the Load Cell moving downwards. Press the CANCEL button at any time before the load cell touches the specimen to cancel the new size routine.
If statistics data is available (test count 2 or greater), statistics will be automatically calculated and printed once the NEW SIZE procedure is complete. If there is only one test result, this will be discarded.

2.8 STATISTICAL ANALYSIS

When the correct batch size is reached and the STATS button is pressed, the statistical data is printed out on the printer. This data is also sent to the rear RS232 or USB output (depending which is currently selected) and the tablet counter is zeroed. The maximum batch size is 500. If the batch size reaches this, the statistical data is automatically printed out and the counter is 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.

Test No.	Weight (mg)	Thick (mm)	Hard (kg)

1	379	3.25	6.0
2	379	3.25	7.0
3	380	3.24	10.5
LAST RESULT CANCELLED			
3	379	3.25	6.9
4	380	3.24	6.7

BATCH STATISTICS

Batch No: 1
Batch Size: 4

Load Stats

Min: 6.0 kg
Max: 7.0 kg
Mean: 6.6 kg
Std. Dev: 0.4
Time: HH:MM DAY DD/MM/YY
Load Cell S/N: CT6-XXX-XXXXX
Calibration No: XXXXX

The printout shows that reading No. 3 was manually cancelled (see section 2.4). The result is overwritten by the next result, which is then called No.3. To change the Time & Date, see section 4.15.

Note: - To print statistical information the tablet count must be at least two. If there is insufficient data the LCD will show 'NO RESULTS' or 'ONLY 1 RESULT' as appropriate, and statistics will not be printed. If batch mode is enabled then statistics will automatically be printed out when the correct batch size is reached.

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)

Weight & Thickness Statistics:

Statistics can also be calculated for weight and thickness. By default only load statistics are calculated and printed, weight and thickness statistics can be enabled through the setup menu. See section 4.13 for further details.

2.9 TEST MODE (previously discussed in section 2.1)

Two test modes can be selected, automatic or manual. Pressing the TEST – MANUAL OR AUTO button toggles between the modes.

2.10 PAPER FEED

Pressing the paper feed button whilst the machine is idle (i.e. not during a test routine) will feed a short length of paper out of the printer. Press the button repeatedly to feed more paper.

2.11 UP / DOWN BUTTONS

These can be used whilst the machine is idle to manually move the Load Cell up or down. Pressing the 'fast' buttons moves the Load Cell at full speed, whilst the 'slow' buttons move the Load Cell at a much slower speed. Normally these would be used when the machine is in manual test mode (see section 2.1) to set the test position. Load Cell movement will stop when the top or bottom limits of travel are reached, or a load is detected during downward movement.

These buttons are also used along with ENTER and ESC to navigate the setup menu.

2.12 ENTER, ESC & SP2

These buttons are used to enter and navigate the setup menu, and for other functions as indicated. SP2 is reserved for future expansion of the CT6's functions.

2.13 ADJUSTING THE ACOUSTIC SENSITIVITY

When the acoustic input is enabled (fracture mode set to ACOUSTIC or BOTH – see section 4.9) the threshold at which a test is ended can be adjusted without the need to enter the setup menu. Press SP1 and use the UP / DOWN arrow buttons to adjust the level – the SLOW buttons adjust the value by 1, the FAST buttons by 10. Press ENTER to save the new setting, or ESC to cancel.

2.14 ALPHANUMERIC KEYPAD

The alphanumeric keypad can be used to enter product details after a NEW SIZE procedure (if the option is enabled) and may be used for other purposes in the future. The keypad is similar to that on mobile phones. Each key (1-9) has up to 5 characters on it. Press the key multiple times in quick succession to scroll through the characters. To move to the next character press a

different key or wait until the cursor moves to the next position. The characters assigned to each key are as follows:

1: (full stop) (comma) 1 **2:** A B C 2
3: D E F 3 **4:** G H I 4
5: J K L 5 **6:** M N O 6
7: P Q R S 7 **8:** T U V 8
9: W X Y Z 9 **0:** (space) 0 (zero)
***:** Special characters (? $ & etc) , decimal point when entering numbers
#: Caps lock – this toggles between lower case and upper case
ESC: Backspace (if all characters are erased this may cancel entry completely)
ENTER: Accepts the entry

2.15 REMOTE CONTROL OF THE CT6 FROM A PC

The CT6 can be also controlled from a PC using the supplied software. This mimics the front panel buttons, LCD and printer, allowing full control of the CT6 without touching the front panel.

To enable remote control, enter the setup menu (see section 4) and set the 'PC Data Mode' to 'Remote Control'. **The USB interface must be used when remote control is enabled.** For more information see the help file supplied with the software.

2.16 GRAPH PLOTTING

Using the PC software, a graph of load vs. position can be plotted during a test. To enable graph plotting set the 'PC Data Mode' to 'Graph Plotting'. This also enables remote control. Again, **the USB interface must be used**. 'Graph Plot Rate' can be adjusted to change the sample rate of the graph.

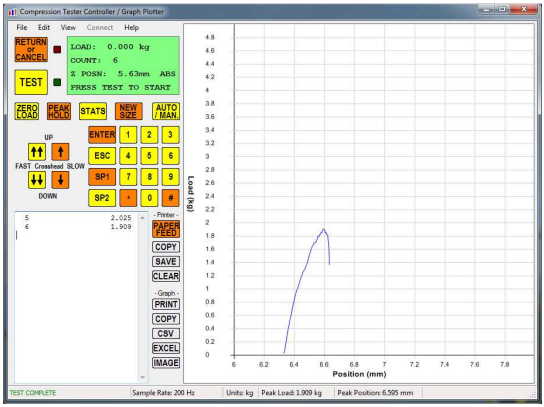

Figure 5 - Remote Control / Graph Plotting PC Software

3 REAR PANEL CONNECTIONS

The rear panel, shown below, has connections for mains power, the load cell, and other optional peripherals. The following sections explain these connections in more detail.

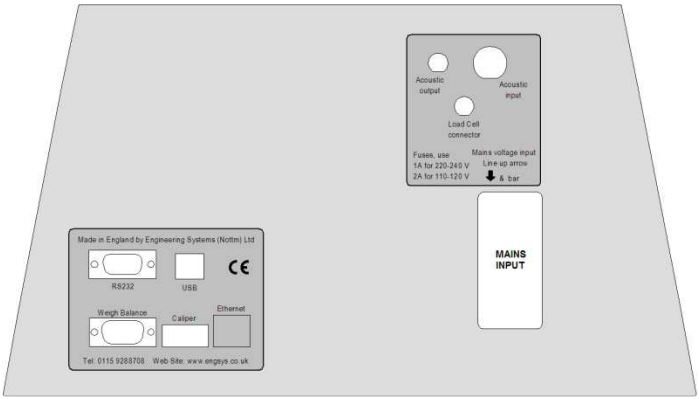

Figure 6 - Rear Panel

3.1 MAINS POWER INPUT

This comprises an IEC plug, rocker switch and push-in fuse / voltage selector. The machine is supplied with and IEC mains lead, which should be fitted with a 5A fuse where applicable.
The mains input voltage is normally supplied set to 220 - 240 VAC, this can be changed to 110 - 120 VAC using the following procedure:

- With the IEC lead disconnected, remove the fuse holder, complete with fuse. Remove the fuse from the holder.
- Reverse the orientation of the fuse holder such that the arrow on the fuse holder corresponding to the correct voltage aligns with the top left-hand bar on the inlet body.
- Insert the correct value fuse in the left-hand side of the holder and reinsert the holder.

For 220 - 240V operation a 1.6A SLOW BLOW (T) mains fuse should be fitted, for 110 - 120V operation this should be changed to a 3.15A SLOW BLOW (T) fuse. **Ensure the correct voltage and fuse is selected for your local power supply before connecting the machine to the mains.** If a 230 V supply is inadvertently used with a 110 V setting, the main transformer may get damaged and need replacing!

3.2 LOAD CELL CONNECTOR

The load cell should be connected here. Load cells will be automatically recognized when connected and will load the correct calibration factors or prompt for calibration if necessary. See section 6.7 for full details of the load cell ID function.

3.3 ACOUSTIC INPUT

An acoustic sensor, available from Engineering Systems as an optional extra, can be connected here. When enabled through the setup menu this can be used to detect the occurrence of cracks during testing.

3.4 ACOUSTIC OUTPUT

This analogue BNC output connector provides an amplified version of the acoustic load signal for connection to external equipment if required. The output range is approximately 0-3V.

3.5 RS232 DATA INPUT/OUTPUT

The 9 way 'D' type female connector provides an RS232 output, transmitting the same data as printed on the internal printer. Data is transmitted even when the internal printer is switched off.

The data is transmitted in the format: -

19200 baud, No parity, 1 Start bit, 8 Data bits, 1 Stop bit, No flow control.
The pin connections of the 9-way female ‘D’ connector are:

- Pin 2: RS232 output (TXD)
- Pin 3: RS232 input (RXD)
- Pin 5: GROUND

The remaining pins on the 9-way connector are not connected. The CT6 should be connected to a PC using a standard (straight) serial cable, NOT a null-modem cable.

3.6 USB DATA INPUT/OUTPUT

The USB type ‘B’ connector provides a USB interface for connection to a PC. Connection to a PC should be made using a standard USB 2.0 type ‘A’ to type ‘B’ cable.

With the cable connected and drivers installed the machine will be shown in Windows as a virtual COM port that can be accessed in the same way as the RS232 output, e.g. using HyperTerminal. A driver for the interface is installed with the supplied remote control / graph plotting software, or can be downloaded from Engineering Systems web site, www.engsys.co.uk.

DO NOT PLUG THE MACHINE INTO A USB PORT UNTIL THE DRIVER HAS BEEN INSTALLED!

Note:- By default the RS232 interface is selected. To use the USB interface it must be selected in the setup menu (see section 4). Only one of the interfaces (RS232 or USB) can be used at any one time.

3.7 RS232 / USB DATA FORMAT

By default the RS232 and USB output data is in the same format as the printer output; this can be viewed using HyperTerminal or a similar program. The output format can be changed in the setup menu (see section 4) to support remote control or graph plotting using the supplied software. The USB interface must be used for these functions.
Customised outputs are also available to suit individual requirements. Contact Engineering Systems for details.

3.8 WEIGH BALANCE

The RS232 output of a supported weigh balance can be connected here. A reading from the balance can be taken as part of the test routine and the results shown on the LCD and sent to the printer. The type of balance connected must be selected via the setup menu (see section 4). If no balance is connected then NO BALANCE should be selected for the balance type; readings from the balance will be omitted from the test routine. The balance must be set to display weight in milligrams (mg).

The pin connections of the 9-way male 'D' connector are:

- Pin 2: RS232 input (RXD)
- Pin 3: RS232 output (TXD)
- Pin 5: GROUND.

The connecting cable required will depend on the type of balance; for an Adam balance a null-modem female-female cable is required.

3.9 THICKNESS GUAGE (CALIPER)

A Mitutoyo type calliper can be connected here. To disable the calliper select 'NO CALIPER' from the setup menu (see section 4). Thickness measurements will then be omitted from the test routine.

3.10 ETHERNET CONNECTOR

This expansion space will allow an RJ45 Ethernet connection to be added to the CT6 in the future.

4 SETUP MENU

Settings and parameters are controlled through the menu system, accessible using the front-panel keypad. The menu is passcode protected to prevent unauthorised changes to settings.

To access the setup menu make sure the machine is idle (not in a test) and press ENTER. Enter the 4-digit passcode (the default is 1234, this can be changed once in the menu). If the code is correct, the setup menu will be displayed. If not, 'INCORRECT!' will be shown; press ENTER and type the code again, or press ESC to cancel.

If the passcode has been lost the setup menu cannot be accessed and neither can calibration be carried out !!
However it is possible to perform a passcode reset:
Details of how to perform a reset are supplied separately (with the machine), or can be obtained from Engineering Systems.

4.1 MENU NAVIGATION

The keys used to navigate around the menu are common throughout the menu. Use the up and down arrow keys to scroll through the menu items. Press ENTER to select a menu item. Press ESC to return to the next level up the menu structure, or to quit the top level of the menu.

Where a numerical value is being adjusted (e.g. batch size or fracture %) the SLOW UP / DOWN buttons change the value by 1. The FAST UP / DOWN buttons change the value by 10. Where settings show a flashing cursor, values can be directly entered using the numeric keys and decimal point ('.').

4.2 MENU STRUCTURE

The following table shows the layout of the menus. Refer to the section number in the table for an explanation of each menu item. **Note that some menus are only available when a load cell is connected!**

Top Level Menu		Next Menu Level		Next Menu Level
Print Options (4.3)		Printer Enable		On
				Off
		Results Print		On
				Off
		Startup Print		On

				Off
		Rotated Print		On
				Off
Batch Options (4.4)		Batches On / Off		On
				Off
		First Batch Size		Select Size (2-500)
		Other Batch Size		Select Size (2-500)
		Reset Batch Number		No
				Yes
PC Interface (4.5)				USB
				RS232
PC Data Mode (4.6)				Printer (ASCII)
				Remote Control
				Graph Plotting
Set Units (4.7)				Kg
				Kp
				N
				Lb
Set Test Speed (4.8)				Set Test Speed (0.1 – 50 mm/min)
Fracture Mode (4.9)				Load
				Acoustic
				Both
Graph Plot Rate (4.10)				Select Sampling Rate
Tablet Press (4.11)		Mode		Off
				Fixed Thickness
				Fixed Load
		Thickness		Set Thickness
		Max Load		Set Load
		Die Diameter		Set Die Diameter
		Die Thickness		Set Die Thickness
		Spacer Height		Set Spacer Height
Weigh Balance (4.12)				No Balance
				List of supported balances
Calliper (4.13)				No Calliper
				Mitutoyo Absolute

Product Details (4.13)				On
				Off
Statistics (4.14)				Load Only
				Load + Weight
				Load + Thickness
				All
Set Guard Mode (4.15)				Manual
				Guard Start
Set Date / Time (4.16)				Set Time & Date Routine
Show Clock (4.17)				On
				Off
LCD Backlight (4.18)				Off
				5 mins
				10 mins
				On
Calibration (4.20)	Enter Cal. Code	Calibrate		Calibration Routine
		Restore Calibration		Restore Calibration Routine
		Delete Load Cell		Load Cell Deletion Routine
		Calibration Reminder		Off
				6 Months
				1 Year
		Change Code		Change Calibration Code
Fracture % (4.21)				Select % (30-90%)
Low Limit % (4.22)				Select % (0.1-3%)
Change Passcode (4.23)				Change Setup Menu Access Code

4.3 PRINT OPTIONS

Printer Enable – Set this to 'OFF' to disable all printing. Data is still transmitted from the RS232 or USB port, and results are saved. Statistical data can still be printed if the printer is switched on again before the 'STATS' button is pressed.

Results Print – Enables or disables the printing of individual test results. Statistical analysis and other messages are still printed.

Startup Print – Enables or disables the message printed when the machine is switched on.
Rotated Print – Rotates printing 180 degrees to make it easier to read.

4.4 BATCH OPTIONS

Batches On / Off – Enables or disables the batch counting functions. With batch counting disabled the machine continues testing until the 'STATS' button is pressed or the tablet count reaches 500. Statistics are then printed; the tablet count is reset and the batch number incremented.
With batch counting enabled, the machine will continue testing until the set batch size is reached, and will then print statistics, reset the tablet count and increment the batch number.
First Batch Size – Sets the first batch size, between 2 and 500. Use the arrow keys to select the required number. This is the size of the first batch tested after the batch number has been reset.
Other Batch Size – Sets the size of other batches tested after the first one, again between 2 and 500.
Reset Batch Number – Clears all stored test results from memory and resets the batch number to 1. If batch counting mode is enabled the size of the next batch tested will be 'First Batch Size' (see above).

4.5 PC INTERFACE

Selects between the RS232 or USB interface. See chapter 3 for an explanation of the connections and data output format. Only one interface can be enabled at a time.

4.6 PC DATA MODE

Selects the required interface mode. The options available are: -
Printer (ASCII): Text output to the printer will also be sent to the PC interface in ASCII format. This mode is identical to the RS232 port functionality on older Engineering Systems machines. Software such as HyperTerminal can be used to view the printer output on the PC.
Remote Control: This mode can be used with the supplied controller / graph plotter PC software to control the machine from a PC and to remotely view the LCD and printer output.
Graph Plotting: This also provides the remote control functions in addition to enabling real-time load vs. position plotting during a test. In this mode the 'virtual LCD' on the PC software is disabled whilst the graph is being plotted.

Note: - To use any mode other than 'Printer (ASCII)' the USB interface must be selected, and the machine connected to the PC using a USB cable.

4.7 SET UNITS

Selects the load measurement units to use. Choices are Kilograms (kg), Kiloponds (kp), Newtons (N) or Pounds (lb). The choice of units can only be changed when the tablet count = 0 and the batch number has been reset, since statistical analysis cannot be performed on data of mixed units.

4.8 SET TEST SPEED

The test speed can be set between 0.1 and 50 mm/min. Selection is in steps of 0.1 mm/min between 0.1 and 1, then 1 mm/min between 2 and 50. Use the fast / slow up and down buttons select the desired speed.

4.9 FRACTURE MODE

This enables or disables the acoustic sensor, and selects what events will cause a test to end. The options are: -
Load – The acoustic sensor is disabled, and the bargraph is not shown. A test will only end when the load cell detects a fracture.
Acoustic – The bargraph is shown. The test cycle ends when an acoustic signal greater than the threshold level is detected.
Both – The bargraph is shown. The test ends when either the load cell detects a fracture or the acoustic sensor detects a signal above the threshold level.

In all modes the minimum load must be applied to the load cell before a fracture or acoustic signal can end the test. The threshold at which an acoustic signal ends the test can be adjusted without entering the setup menu. See section 1.7 for more details of the acoustic input.

4.10 GRAPH PLOT RATE

This sets the rate at which samples are plotted during a test when the 'PC Data Mode' is set to 'Graph Plotting'. Using the arrow buttons, the rate can be set to one of 11 values between 10 Hz and 2 kHz.

4.11 TABLET PRESS

These options allow the machine to be used as a tablet press to manufacture tablets. See section 7 for details of this function, and the options in this menu.

Note: - To use the machine for compression or 3 / 4 point bend testing ensure the tablet press function is disabled by setting 'Mode' to 'Off'.

4.12 WEIGH BALANCE

Selects the type of weigh balance connected to the machine. Choose the make and model of balance from the list, or select 'NO BALANCE' to disable weight measurement. If your balance isn't listed contact Engineering Systems to check if a firmware update is available to accommodate it.

4.13 CALLIPER

Enables or disables the Mitutoyo thickness measurement calliper. Select 'NO CALLIPER' to disable thickness measurement.

4.14 PRODUCT DETAILS

Enables the entry and printing of batch details after a NEW SIZE has been set. When enabled the machine will prompt the operator to enter a product name, ID and operator ID, which will be printed out and transmitted via RS232 / USB. Select 'OFF' if this option is not required. Details are entered using the alphanumeric keypad – see section 2.14.

4.15 STATISTICS

Enables or disables printing of statistics for weight and thickness. Options are 'Load Only', 'Load + Weight', 'Load + Thickness' or 'All' (load + weight + thickness). All statistics are printed together when the STATS button is pressed. Weight and thickness statistics will only be printed if a balance or caliper is enabled respectively. For example to print weight statistics, the STATISTICS option must be set to 'Load + Weight' or 'All', and the WEIGH BALANCE option must **not** be set to 'NO BALANCE'.

4.16 SET GUARD MODE

Set the guard mode to 'MANUAL' to start a test only by pressing the TEST button. Set the mode to 'GUARD START' to start the hardness measurement test when the guard is closed. See section 2.3 for full details.

4.17 SET TIME / DATE

Sets the time & date. The current time & date will be shown on the LCD, enter the new hour, minute, date, month & year using the numeric buttons. The seconds will automatically be zeroed, and the day of the week calculated. Press ENTER to save the new time and date, or press ESC to cancel without saving changes.

4.18 SHOW CLOCK

Shows or hides the clock on the display when the machine is idle. The time and date are still printed on the statistics, calibration and start-up print-outs.

4.19 LCD BACKLIGHT

This controls the behaviour of the LCD backlight. Select 'ON or 'OFF' to turn the backlight permanently on or off. Select 5 or 10 mins (minutes) to allow the backlight to stay on the selected time after a button is pressed, and then switch off to save power until further use.

4.20 CALIBRATION

The calibration menu can only be accessed by entering the calibration passcode. Enter this in the same way as the setup menu passcode. The default code is '1234' and can be changed once in this menu.
Calibrate – Start the calibration procedure. See section 6.1 for details
Restore Calibration – Allows a previous calibration to be recalled. See section 6.5.
Delete Load Cell – Allows details of a load cell to be deleted from the machine (see load cell ID, section 6.7). This can be used, for example, to remove details of a damaged load cell or if the wrong load cell is connected to the machine. If a load cell is deleted and then re-connected to the machine you will need to re-calibrate it before use.
Calibration Reminder – Enables or disables the calibration reminder and sets the interval. See section 6.8.
Change Code – Changes the calibration menu passcode. The procedure for this is the same as for changing the setup menu passcode, described in section 4.21.

4.21 FRACTURE %

This option allows the fracture detect percentage to be altered. Fracture is detected and the test is ended when the instantaneous load measured by the load cell falls below a preset % of the maximum load attained during testing. This % can be changed in the range 30-90%. Typical values are 60%-70%, the default being 70%. **The fracture % value is stored separately for each load cell**, so changing the value will only alter the setting for the currently connected load cell. Use the arrow keys to change the value. See appendix A for a further discussion of this.

4.22 LOW LIMIT %

This allows the minimum load at which a fracture can be detected to be adjusted as a percentage of the full-scale range of the load cell. The default setting is 0.6%, this equals 3 kg for a 500 kg load cell or 0.3 kg for a 50 kg load cell. This should only be adjusted in rare cases when testing difficult specimens that fracture below the default minimum load. **The low limit % is stored separately for each load cell**; changing the value will only alter the setting for the currently connected load cell. **Setting the load limit too low may cause false fractures, especially with low capacity load cells.** Care must be taken to check that detected fractures are genuine. See appendix A for more information.

4.23 CHANGE PASSCODE

Select this option to change the passcode used to enter the setup menu. Enter the old code, and then enter the new 4-digit code (the only characters allowed

in this code are between 0 & 9) as prompted on the LCD. Re-enter the new code to confirm it. If a mistake is made at any point press ESC and start again. If the new code and confirmed new code don't match, or the old code is incorrect, 'INCORRECT!' will be shown; press ENTER to start again, or ESC to cancel.

5 PRINTER

5.1 THE PRINTER

The printer is a 'thermal' printer. These printers had a bad reputation in their early years because of rapid fading of the printing. However, modern paper is very much improved and their print may well be more durable than from the traditional dot matrix printers. Another advantage is that ribbons are not required. The paper is very easy to change.
The printer prints the peak load at fracture as shown on the LCD. If required, specimen weight and thickness can also be printed. Printing occurs automatically at the end of a successful test cycle. The printer also prints out the statistical data when the STATS button is pressed or a set batch size is reached, as well as a variety of other messages such as new size details or calibration certificates.

Print options can be set, or the printer can be disabled completely, via the setup menu (see section 4). Paper can be fed though the printer by pressing the paper feed button whilst the machine is idle. Multiple presses of the button may be necessary.

5.2 PAPER ROLL REPLACEMENT

Pull the green lever on the printer mechanism gently upwards and hinge the printer cover open downwards. Remove the spindle from the old paper roll and insert a new roll with the paper unrolling from the top of the roll towards you, as shown in the picture below. Hold the end of the paper upwards against the side of the CT6 and close the printer cover by hinging it upwards and pushing it shut.

Be careful to press evenly and gently on both top corners of the printer cover when closing it to avoid damaging it.

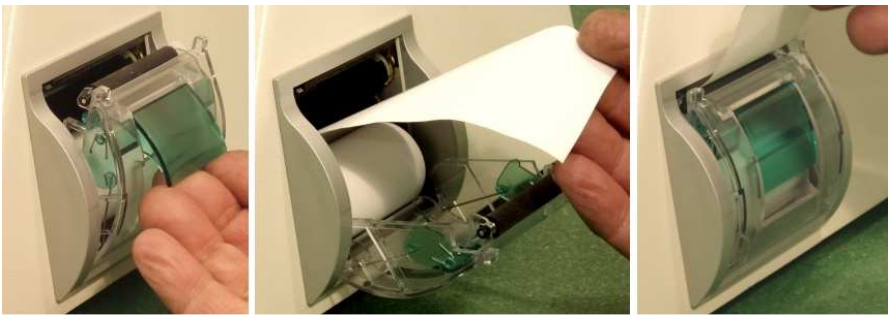

Figure 7 - Paper Roll Replacement

Use 57 mm wide x 25 metre, 48 mm maximum diameter thermal paper rolls.

The printer mechanism used is an EPM 205-MRS manufactured by APS. Paper rolls should be available from local suppliers worldwide.

For U.K. users paper rolls are available from:-

- Farnell Electronic Components Tel. 08701 200200, www.farnell.com, Order code 391-6170
- Able Systems Ltd. Tel. 01606 48621, www.able-systems.com, Order code 04-A05860TPR1

Details correct as of October 2009.

6 CALIBRATION

Before the CT6 is delivered, it is calibrated with dead weights. A calibration certificate accompanies each machine. The unit of weights used is kilograms (kg). The machine's displayed units can be changed to output in kg, kp, lb. or N (see section 4.6). Regardless of the units currently in use, the machine will change to kg during calibration and will revert to the selected units when finished. The displayed load will still be valid in the selected units.

Each load cell must be calibrated individually on the machine on which it is to be used. If a load cell has been removed and subsequently reinstalled, the CT6 recognises that load cell and the appropriate calibration factor is automatically restored when re-connected (see section 6.7).

6.1 DEAD WEIGHT vs. PROVING RING CALIBRATION

Load cells with capacities up to 50 kg are best calibrated by dead weight loading, using slotted weights and a calibrated hanger. Higher capacity load cells can be dead weight calibrated by ENGINEERING SYSTEMS, using a purpose built rig to test the 500 kg load cells to ASTM E4 standards.

Alternatively calibration of higher capacity load cells can be carried out using a proving ring, available as an optional extra. This ring is supplied in a polypropylene case along with extension pillars and two adaptors for use with the CT6. A calibration certificate is supplied with the ring.

The calibration routine will automatically select dead weight loading if the load cell capacity is 50 kg or less. For higher capacity load cells, either dead weight loading or proving ring calibration can be selected

6.2 CALIBRATION OF LOAD CELLS UP TO 50 kg CAPACITY

1. Remove the load cell from the pillars and place it upside down at the edge of a desk, such that the weight hanger can hang beneath it.
2. If you want a printed calibration certificate, ensure that the printer is switched on (see section 4.3).
3. Press ENTER and then enter the setup menu passcode. Use the UP / DOWN buttons to select ‘CALIBRATION’ and press ENTER. Enter the calibration passcode and select ‘CALIBRATE’.

Figure 8 - Dead Weight Calibration

4. The LCD will show the load reading. Don't worry if it isn't reading zero at the moment. Remove any load as instructed on the LCD then press ENTER. The load display should now read zero.

   IMPORTANT: - The calibration procedure assumes a calibrated weight hanger is used, i.e. the hanger weight is included in the applied dead weight. If an uncalibrated hanger is used the machine must be zeroed with the hanger applied. To do this, keep the hanger in place whenever instructed to remove the load.

5. Using a suitably shaped hanger (available from ENGINEERING SYSTEMS) and set of weights load the machine to 50 kg with the weights hanger resting on the loading platen, wait for the reading to stabilise then press ENTER.

   NOTE: - Up to this stage, the calibration can be cancelled by pressing ESC. From here onward, the calibration cannot be cancelled and must be completed.

6. Remove the weights and press ENTER. After a short delay the machine will store a new electronic load check value.
7. The calibration value will now be verified and a certificate printed. Load and then unload the platen as instructed on the LCD, pressing ENTER each time once the load has stabilised. Once complete the load cell linearity will be calculated and a hard copy printed, along with the new calibration number, time, date and firmware version.
8. 'Remove Hanger' will be displayed on the LCD. **Remove the hanger** and press ENTER. The calibration procedure is now completed.
9. Press ESC twice to exit the setup menu.
10. Re-fit the load cell to the pillars and then press ZERO to zero the load reading.

6.3 CALIBRATION OF LOAD CELLS OVER 50 kg CAPACITY

This procedure requires a proving ring (shown below on the right), available as an optional extra. Alternatively the CT6 and load cell(s) can be returned to ENGINEERING SYSTEMS for calibration by dead weight loading.

1. Remove the 2 guards by lifting upwards.
2. Remove the load cell and fit extension pillars, then replace the load cell onto the extensions. See section 1.10.
3. Remove the load cell platen and screw one concave adaptor piece into the load cell.
4. Remove the bottom platen and replace it with the other concave adaptor piece.

5. If you want a printed calibration certificate ensure that the printer is switched on (see section 4.3).
6. Press ENTER, then enter the setup menu passcode. Use the UP / DOWN buttons to select 'CALIBRATION' and press ENTER. Enter the calibration passcode and select 'CALIBRATE'. Select 'PROVING RING' and press ENTER.
7. Place the proving ring on the bottom concave adapter. Use the SLOW and FAST UP / DOWN buttons to move the load cell down until the proving ring is **loosely** held between the top and bottom concave adapters.
8. Zero the proving ring dial gauge.
9. Press ENTER to zero the load reading on the CT6.
10. Using the SLOW / FAST UP / DOWN buttons, load the proving ring until the dial gauge reads the same as the value on the proving ring certificate for the load cell capacity. E.g. for a 500 kg load cell, load to the 500 kg dial gauge reading. Press ENTER.

Figure 9 - Calibration Using a Proving Ring

NOTE: - Up to this stage, the calibration can be cancelled by pressing ESC. From here onward, the calibration cannot be cancelled.

11. Unload the proving ring until it is loosely clamped and press ENTER. **Be careful not to let the ring fall out of the adapters when doing this.** The CT6 will now store a new electronic load check value.
12. Follow the instructions on the LCD to load and then unload the proving ring in increments using the UP / DOWN buttons, pressing ENTER after each step. A calibration certificate will be printed.
13. **Hold the proving ring** and press FAST UP to remove it. Press ENTER once removed to return the load cell to the test position.
14. Press ESC twice to exit the setup menu.
15. Remove the extension pillars and concave adapters; refit the load cell and platens.

6.4 ELECTRONIC CALIBRATION CHECK

The CT6 incorporates an automatic calibration check routine that runs once a day for each load cell. The check will run when the machine is first switched on, or if a different load cell is connected that hasn't already been used that day. This connects a high stability resistor into the load cell circuit to give a simulated load reading.

During calibration, a reading is taken with the resistor in circuit. This simulated load is stored and compared to the reading obtained during the calibration check routine. This function can be used to give an **approximate** daily calibration check, and **should not** be taken as a definitive calibration value. Periodic calibration is necessary to ensure continued accuracy of the CT6. When first switched on, the machine will wait 30 seconds to allow voltages and temperatures to stabilise, then read the simulated load with the resistor in circuit. The simulated load and the difference between this and the value stored at the last calibration will be displayed on the LCD.

If the difference is greater than, say, 10 digits (1 kg for a 500 kg load cell) the calibration should be checked using a proving ring or by dead weight loading.

6.5 CALIBRATION NUMBER

The calibration number can be used to track the calibration certificate related to a printed set of test results, or check whether the machine has been calibrated without authorisation. Each time the load cell is calibrated the number is incremented. The number is printed after calibration, on statistical analysis data and when the machine is switched on. The number is unique to the specific calibration for that load cell on that machine, and will only roll over after 65,536 calibrations.

6.6 REVERTING TO A PREVIOUS CALIBRATION

In addition to the most recent calibration, 2 previous calibration values are stored for each load cell and can be recalled. This could be useful if, say, the machine is calibrated accidentally and the previous good calibration needs to be restored. The list of calibrations available can be accessed via the setup menu (see section 4). Select ‘CALIBRATION’ from the menu and press ENTER. Enter the calibration passcode and select ‘RESTORE CALIBRATION’. Use the up and down arrow keys to select the calibration value required. The value currently in use will be marked ‘(IN USE)’. Calibration values are stored by date, followed by a number allowing multiple calibrations on the same day. e.g. 21/06/08-2 would be the second calibration carried out on 21/06/2008.

Press ‘ENTER’ to confirm the choice and use the calibration value selected. The printer will print ‘CALIBRATION RESTORED’, along with the date as shown on the LCD, and the calibration number.

6.7 LOAD CELL ID FUNCTION

The CT6 recognizes each load cell using its unique serial number. When plugged into the machine, the load cell is detected and the machine tries to match it to a list of previously connected load cells. If the load cell has

previously been connected to that machine (and calibrated), the calibration factors for that load cell will be automatically restored, along with the low limit and fracture detect percentages. The load display will be adjusted to suit the capacity of the connected load cell. This allows for easy changing of the load cell without the need to re-calibrate each time.

If a new load cell is connected, the CT6 will prompt to calibrate the load cell. Press ENTER then enter the calibration passcode. Calibrate the new load cell either using a proving ring or by dead weight loading.

The CT6 can store details of up to 5 different load cells. If a 6th load cell is connected the machine will prompt to delete the data for an existing load cell before the new load cell can be calibrated. This can be done through the setup menu (see section 4.18).

6.8 CALIBRATION REMINDER

When a load cell is connected to the CT6, its serial number is displayed along with the date of its last calibration. Additionally a warning can be shown if the load cell is due for re-calibration. By default this is set to 1 year (the recommended calibration period), but can be change to 6 months, or disabled completely via the setup menu (section 4.18).

Normally the LCD will show the load cell serial number for 3 seconds after connecting the load cell, before returning to the default display. If calibration is due, 'CALIBRATION NOW DUE!' will be shown on the LCD. This message will remain until acknowledged by pressing ENTER. Re-calibrate the load cell as soon as possible when this warning is shown.

7 MAINTENANCE AND TROUBLESHOOTING

WARNING: - Removal of the bottom cover of the machine exposes single insulated mains voltage connections. Disconnect the IEC mains cable before removing these covers. 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 mains connections within the machine are confined to those between the IEC input module and the transformer; no mains voltages are present on the circuit board. DC voltages within the machine do not exceed 24V.

Be aware that static electricity 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 first touch an earthed metal appliance and try to hold them at their edges without touching tracks or components. It is advisable to wear an anti-static wristband whilst handling any boards or components.

Part numbers referred to in this section are show on the diagrams in chapter 10.

7.1 ROUTINE MAINTENANCE

- **Clean debris** regularly from the loading area of the machine. Debris build-up here could affect test results.
- **Routine mechanical maintenance** involves removing the bottom cover and cleaning any powder, dust etc. from the inside of the machine.
- **Grease the main pillars** occasionally, depending on usage as described in section 7.2.
- **Inspect** the load frame gearing and motor gearing approximately every 3 to 4 years, depending on usage, and lightly re-grease if necessary. Suggested grease is ROCOL MTS 1000.

If faults cannot be easily traced, contact Engineering Systems.

Users or customers are advised to contact Engineering Systems before any returns are made, as problems can often be solved by telephone, e-mail or fax. Also check the 'repairs' section of our website, www.engsys.co.uk. for details of common faults or known problems.

Please quote the machine serial number when contacting Engineering Systems. The serial number can be found on stickers on the rear panel and inside the machine.

7.2 GREASING THE MAIN PILLARS

This should only be necessary every 2 or 3 years. Move the pillars to the top of their travel using the FAST UP button. Remove the shoulder screws that hold the Load Cell onto the top of the main pillars. Lift off the top telescopic guard from each pillar and unscrew the bottom guard by hand. Apply a little ROCOL MTS 1000 (or equivalent) grease. This will lubricate the top pillar bearings. It would be advisable to check the bottom pillar bearings and gearing by removing the bottom cover.

7.3 REMOVING AND REPLACING THE BOTTOM COVER

Turn the machine onto its left hand side. Remove the 4 screws through the feet on the bottom of the machine and lift the bottom cover off.

Replacing: -
Refit the bottom cover by replacing the 4 screws through the feet, ensuring they are tight.

Check the operation of the machine.

7.4 SPECIFIC FAULTS (TROUBLESHOOTING)

Please check the following list of common problems before contacting Engineering Systems or attempting repairs:

- **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.
- **LCD or buttons do not light up:**
  - Check plug fuse (where applicable), wall socket and main lead
  - Check mains fuse, see section 8.5.
  - Check internal fuses, see section 8.6.
  - Check all fuses are of the anti-surge (T) or slow- blow type.
  - Check connectors and cables between the main board, power supply board, transformer and mains input. Ensure all ground wires are connected to the earth connection on the mains input connector.
- **Motor does not start:**
  - Check internal fuses
  - Check connections between main board, motor amplifier and motor
  - Check Load Cell limit switches and connector
  - Check encoder connector
- **Motor starts but no plunger movement:** Mechanical fault, Gears slipping. Tighten or replace gears as necessary.

Fuses blow at switch on:

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

- Ensure mains voltage is set correctly for your local power supply.

- **Load Display will not zero:**
  - Check load cell is not obstructed or touching anything
  - Fault with load cell; is there a possibility that the load cell has been overloaded? Check for linearity etc. with weights or proving ring.
- **Load Display reads full scale, 'NO LOAD CELL' or fluctuates wildly:**
  - Load Cell not connected.
  - Load cell cable damaged.
  - Load cell power supply fault.
  - Main board fault.
- **Load Display will not settle to a constant value:**
  - Main board faulty.
  - Load cell or connections faulty.
- **Printer not working correctly:**
  - Check the printer is turned on in the setup menu.
  - Make sure that the printer has paper and is loaded correctly.
  - Ensure the printer cable is connected to the main board.

TIME & DATE incorrect: Reset the clock via the setup menu (see section 4.15). If the time & date are again incorrect after the machine has been switched off the internal battery (should have ~ 10 year life) may need replacing. Remove the bottom cover and replace the battery (CR1616 coin cell) on the main board (part 23 on the diagram in chapter 9).

7.5 ERROR MESSAGES.

The CT6 will automatically diagnose a number of faults and errors. Error messages are shown on the LCD. The meaning of these and possible cure is shown below: -

MOTOR POWER ERROR	24V motor power supply is too low. Check fuses on power supply board.
PRINTER POWER ERROR	6.5V printer power supply is too low. Check fuses on power supply board.
BALANCE COMMS ERROR	Unable to communicate with the weigh balance. Check a balance is connected and switched on, and that the correct balance type has been selected in the setup menu.
BALANCE WRONG UNITS	The measurement units are incorrectly set on the weigh balance. Check the setting on the balance (refer to weigh balance handbook for instructions).
BALANCE OVERRANGE	The load on the balance is greater than the input range of the CT6 (59999mg). This is a

	limitation imposed by the storage and statistics calculation functions.
BALANCE NEGATIVE	Ensure the balance reading is positive and try again.
CALIPER COMMS ERROR	Unable to communicate with the calliper. Check the calliper is connected and switched on.
CALIPER WRONG UNITS	The measurement units are set wrongly on the calliper. Press 'in/mm' on the calliper to set the units to mm.
CALIPER OVERRANGE	The reading from the calliper is greater than 99.99 mm.
CALIPER NEGATIVE	A negative reading has been received from the calliper. Check that it is zeroed correctly.
NO LOAD CELL	A load cell is not connected. Connect a load cell to the socket on the rear of the machine. If a load cell is connected, then it or the connecting cable may be faulty.

7.6 FIRMWARE UPDATES

The operating firmware in the machine can be updated using a PC via a USB or RS232 connection. Contact Engineering Systems or visit www.engsys.co.uk to check if new firmware is available. Instructions for updating the firmware are supplied with the firmware updates.

8 REPAIR

WARNING: - Removal of the bottom cover of the machine exposes single insulated mains voltage connections. Only qualified personnel should be allowed to check for faults if any of the outer casings have been removed and the mains supply is connected. The mains connections within the machine are confined to those between the IEC mains input module and the transformer; no mains voltages are present on the circuit board. DC voltages within the machine do not exceed 24V.

The CT6 is built from mechanical and electronic modules. Instrument mechanics and / or electronic engineers should have no difficulty in replacing any of the major modules that are all available as spares.

Part numbers referred to in this section are show on the diagrams in chapter 9.

If faults cannot be easily traced, contact Engineering Systems, quoting the serial number.

8.1 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.

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 CT6 operates: -

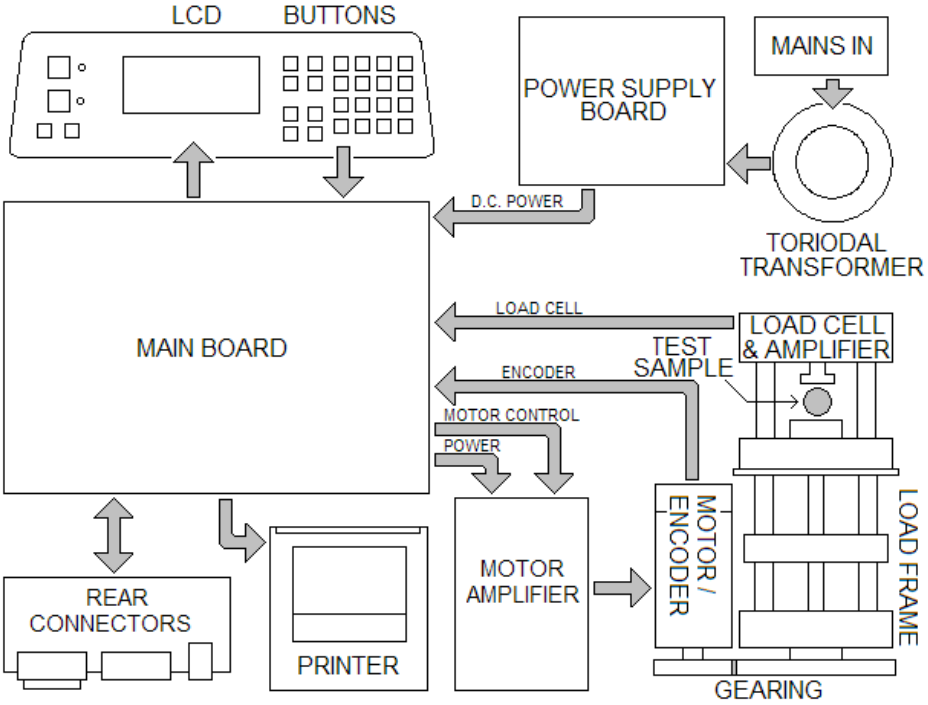

Figure 10 - Module Block Diagram

The diagram shows how dc power is supplied to the machine by the mains input (comprising IEC connector, fuse, switch, filter & voltage selector), transformer and power supply board. Applied load is measured by the load cell and fed to the main board, along with position signals from the motor encoder. The motor is fed by a motor amplifier module, controlled by signals from the main board. The front panel buttons, LCD and printer all connect to the main board, along with rear-panel mounted connectors for the load cell, acoustic sensor, balance, calliper and computer. Limit switches (not shown) are fitted at either end of the Load Cell travel to provide a zero position reference and to prevent overtravel, along with guard sensor switches.

The machine is MODULAR i.e. built of larger replaceable units onto which the many smaller components are mounted. There are a number of replaceable main modules fitted inside the main casing of the machine. Two types of faults can occur - MECHANICAL or ELECTRICAL, or sometimes a combination of the two.

The main replaceable modules are: -

- **MECHANICAL:** Load Frame mechanism, including the sub-modules, Motor + Encoder, Limit switches, guard sensors.
- **ELECTRICAL:** Toroidal Transformer, Mains Input Connector.

ELECTRONIC: Main board, Power Supply board, PC Interface board, Balance / Calliper Interface board, Motor Amplifier, Keypad.

8.2 FIRST STEPS IN FAULT FINDING

Start by checking the list of specific faults (section 7.4).

8.3 FURTHER STEPS IN FAULT FINDING

Consider whether the fault is likely to be electrical or mechanical. Faults can usually be isolated into small areas.

8.4 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 it may simply a matter of removing the case and screwing in a new printer mechanism. 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, by the edges only, of the boards should help reduce the risk of damage due to static discharge. AVOID AREAS IN THE VICINITY OF NYLON CARPETS etc, and where possible use an anti-static wrist strap when handling the boards or components.

8.5 MAINS FUSE

This is mounted on the rear panel. This fuse can be replaced by pulling out the fuse holder once the IEC mains connector has been disconnected. Replace with a 1.6A fuse for 220-240V or a 3.15A fuse for 110-120V, both 20 mm anti-surge (T) or slow blow type fuses. See section 3.1 for full details. **Take great care to replace the fuse holder in the correct orientation regarding voltage selection.**

8.6 INTERNAL FUSES

Two internal fuses are also situated on the Power supply board; these can be accessed by removing the bottom cover as described in section 7.3.

The values which should be installed are:-

- F20: 3.15A slow blow or anti-surge (T)
- F21: 5A slow blow or anti-surge (T)

8.7 MAINS FILTER

The mains voltage is filtered when it enters the machine. However, large power supply fluctuations or interference from other nearby electrical equipment switching on or off could cause the machine to malfunction. Additional filtering may be necessary.

8.8 CHECKING THE POWER SUPPLY VOLTAGES

Use a voltmeter to check that the voltages being supplied to and from the power supply board are correct. Test points are available at the input to and output from the power supply board. If the voltages measured are not correct and the fuses are intact disconnect the power supply board from the main board. If the voltages are now correct the fault is on the main board (or other components), if not the fault is with the power supply. In this case check the ac voltages from the transformer; if these are wrong and the mains fuse and plug fuse are intact the transformer is faulty. If these are correct, the power supply board is faulty.

If the fault is with not with the power supply check if any components on the main board and front board are hot. Note that some of the power supply components such as voltage regulators normally get warm, but generally not be too hot to touch.

The dc voltage test points on the power supply board are marked as follows. Refer to the wiring diagram for further assistance:

- GND: Ground, green / yellow wires
- 5V: Logic supply, purple wire
- 6.5V: Printer supply, pink wire
- 10V: Load cell / analogue supply, red wire
- 24V: Motor supply, orange wire

The input voltages from the transformer can be checked using the test points next to the connector from the transformer. Check for 7.5V ac and 17V ac on the 2 pairs of test points as marked on the board. Remember these voltages are ac, not dc, so set the voltmeter accordingly.
The dc voltages are also marked on the main board near to the connector from the power supply.

8.9 CONNECTIONS

Check, visually and by wiggling connections, that all electrical connections, plugs, sockets and board inter-connections etc. are properly connected. Check also for loose wires and poor soldered connections. Check for loose foreign

bodies, especially of metal, which may short out a circuit board. Check for continuity between connectors and boards.

8.10 BOARD CHANGING

If a board has failed, it may be that an internal supply voltage fault caused the failure; therefore, all power supply voltages should be checked 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 should be obtained from the Engineering Systems or the machine sent back for repair.

8.11 REPLACING THE MAIN CIRCUIT BOARD

The main electronic circuit board is mounted in the bottom part of the main casing.

Remove the bottom cover. Figures 10 & 11 in chapter 9 show the view from underneath the machine and identify the various components and connectors.

Carefully disconnect all cables connected to the main board, including the ribbon cable connecting to the keypad. It may be helpful to keep a note of the position of the connections. Some of the connectors have a small lever on the side, which must be pressed to enable disconnection.

Now remove the 4 nuts and washers around the perimeter of the board that mount it onto the main casing. Do not remove the 4 screws securing the LCD to the board. Lift the board from the mounting studs, checking for any connections that you might have missed disconnecting.

Fit the new board in the reverse order to removing the old one. Make sure the washers are re-fitted and that all connectors are re-fitted the correct way around.

Now refit the bottom cover and check that the machine works correctly. It will be necessary to re-calibrate the load cell(s) and re-set the time & date and any other settings via the setup menu. Any stored results will be lost.

8.12 REPLACING THE POWER SUPPLY BOARD

Remove the cover. The power supply is located on the side of the case near the transformer. Unplug the transformer connector (part 11) and the connection from the main board (part 12). Remove the 3 pozidrive screws securing the board. Remove the captive mounting screws from the board, taking care not to

lose the retaining washers, and fit them to the new board. To fit the new board reverse the above procedure.

8.13 REPLACING THE TRANSFORMER

Remove the bottom cover. Disconnect the mains wiring from the back of the IEC mains input connector (part 8) **noting the order and colour coding**. Remove the two screws securing the mains input connector to the rear panel and remove it to give access to the transformer. Unplug the transformer from the power supply board (part 11) and remove the fixing screw from the centre of the transformer. To fit the new transformer reverse the above procedure, ensuring the rubber washers are placed either side of the transformer. Refit the mains input connector and re-connect the wiring. The electrical safety of the machine should be re-tested.

8.14 REMOVING THE LOAD FRAME

Remove the load cell. Disconnect the motor, encoder, limit switch and both guard sensor connectors from the main board. Stand the machine upside down on blocks either side of the pillars. Remove the 4 fixing screws (part 6, a long series 3 mm allen key or hexagon driver is required) and carefully lift the load frame out, checking that none of the wiring is caught.

8.15 MECHANICAL FAULTS

These are usually easier to find than electronic faults. Unplug the mains supply and remove the bottom cover. 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. Whilst the bottom cover is removed, try connecting the mains supply (**note the warning about mains voltages)** and starting a test. Listen for, and isolate, any peculiar noises.

8.16 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 is not covered. Defective components or machines should be returned, at the customers expense, to the address on the back of this handbook 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.

Please quote the machine serial number when contacting Engineering Systems. This can be found on stickers on the rear panel and inside the machine.

9 PARTS

9.1 PARTS LIST AND DIAGRAMS

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

Numbers in this parts list refer to diagrams on the next page.

1. Rear-panel circuit boards
2. Motor controller
3. Geared motor & encoder unit (other side of gearwheel)
4. Printer module (Able Systems ASL EPM205-MRS)
5. Main board
6. Load frame mounting screws (4 off)
7. Load frame
8. Mains input connector
9. Toriodal transformer (Lintron TF27263)
10. DC fuses
11. Transformer secondary connector
12. PSU output connector
13. Power supply board
14. Guard switch connector (1 of 2)
15. Motor amplifier control connector
16. Encoder connector
17. Rear panel IO connector
18. Printer connector
19. Motor connector
20. Motor amplifier power connector
21. Limit switch connector
22. Guard switch connector (2 of 2)
23. Clock battery (CR1616)
24. Internal acoustic IO connector
25. Internal load cell connector
26. Keypad connector
27. Power supply board connector

Note: - Machines with serial number 035 or earlier used a different motor controller (part 2). Refer to handbook issue 4 for details of this.

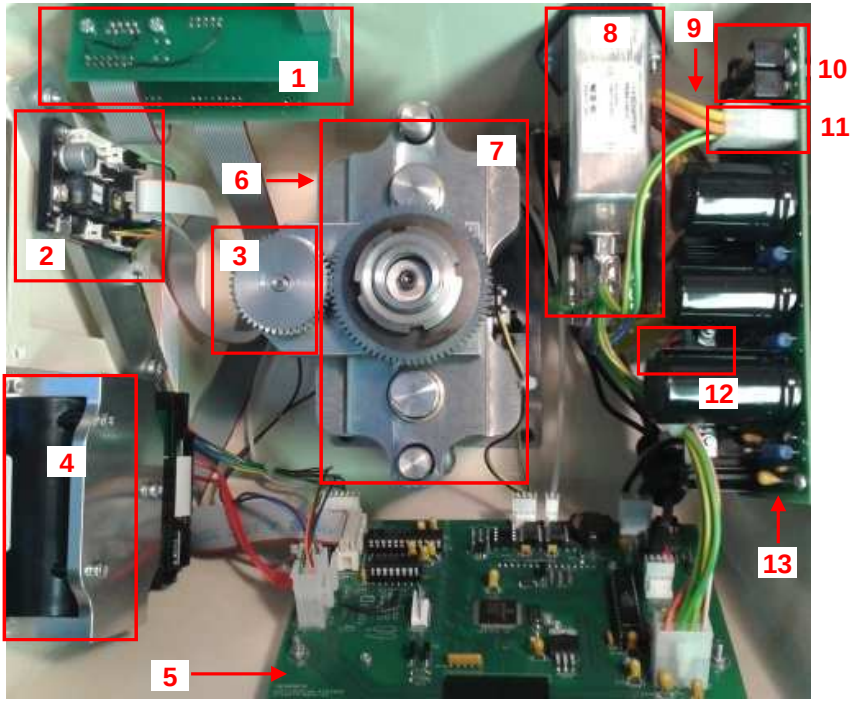

Figure 11 - Layout of Components within Machine

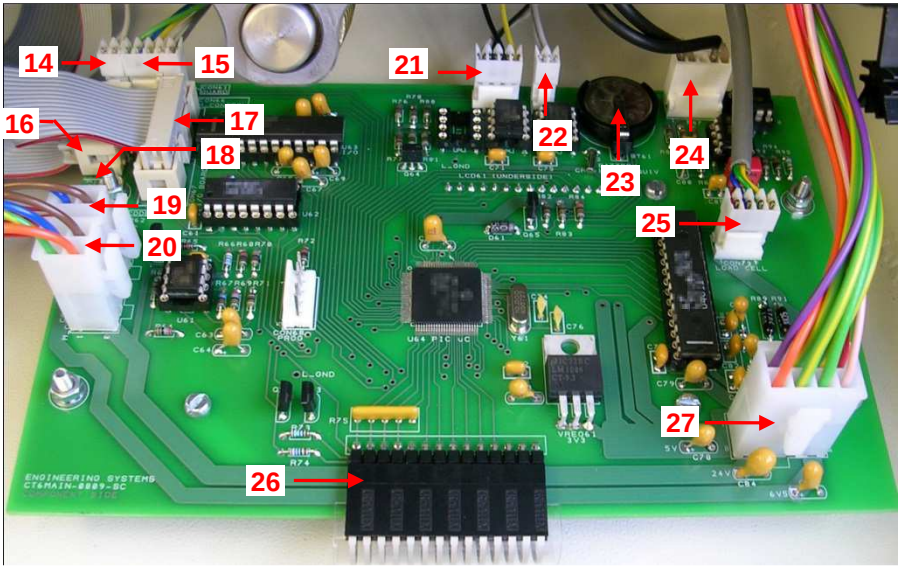

Figure 12 - Layout of Connectors on Main PCB

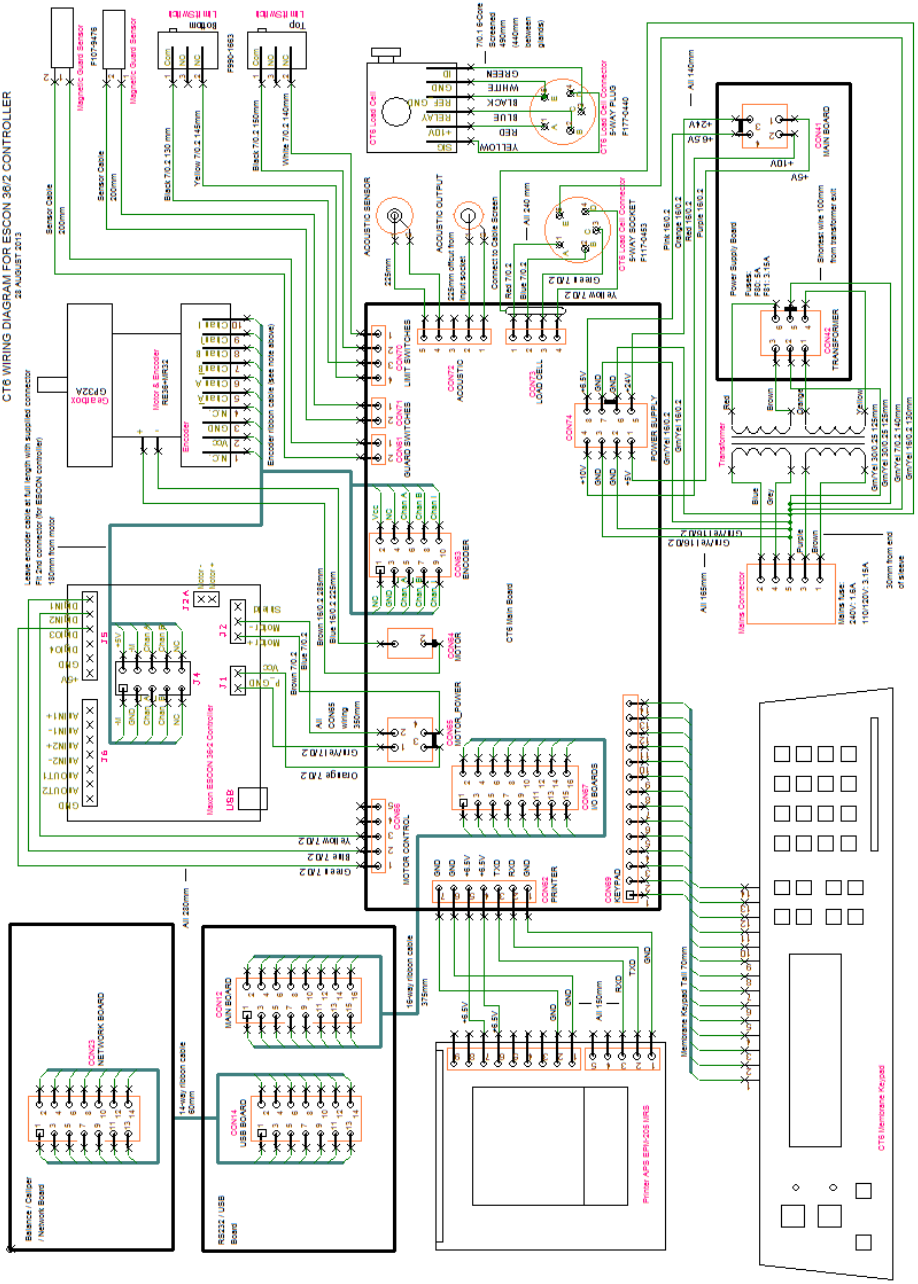

Figure 13 - Wiring Diagram

9.2 ELECTRONIC BOARDS FITTED

There are 4 printed circuit boards fitted inside the CT6 as well as one in the load cell, these boards are identified by a name and number, composed as follows: -

- The machine type, i.e. CT6
- The type of board, e.g. MAIN for the main PCB
- Numbers 'yy' giving the year the board was designed (e.g. 06)
- Numbers 'ww' giving the week the board was designed (e.g. 10)
- Letters 'ii' are the initials of the designer (e.g. SC)

Boards fitted: -

Main Board:	CT6MAIN-yyww-ii
Power Supply board:	CT6PSU-yyww-ii
USB / RS232 Interface board:	CT6IO-yyww-ii
Balance / Calliper Interface board:	CT6NET-yyww-ii

The toroidal transformer fitted is manufactured to Engineering Systems specifications. Toroidal transformers are more efficient, smaller, and give less electromagnetic interference than conventional transformers.

Toroidal Transformer: Lintron TF27263

9.3 TOOLS, PARTS AND SPARES SUPPLIED

Tools, parts and spares supplied with the CT6
5 mm hexagon (Allen) wrench
Small Screwdriver
Lower adapter plate, ∅30 mm
2 x Paper rolls

Tools supplied with a 3 or 4 point bend rig
1.5, 2.5 & 3 mm hexagon (Allen) wrenches
2.5 & 3 mm hexagon ball drivers
3pt Setting block

Tools supplied with a 500 kg load cell
22 A/F open end wrench spanner

Appropriate platens for compression testing will be supplied with load cells.

10 SPECIFCATIONS OF STANDARD CT6 WITH 5 kN LOAD CELL

Choice of 4 output units	Kilogram (kg), Kilopond (kp), Newton (N) or Pound (lb)
Maximum load	500 kg, 500 kp, 5000 N or 999.9 lb respectively
Load resolution	0.1 kg, 0.1 kp, 1 Newton or 0.1 lb respectively
Minimum detectable fracture load	3 kg
Width between pillars	60 mm
Load Cell travel	55 mm
Test Height	Depends on pillar extension length Maximum extension of 300 mm
Load indication	Display on front LCD, Internal printer
Inputs & Outputs	USB & RS232 PC interfaces Ethernet (option) Mitutoyo digital calliper Adam milligram balance or other balances with RS232 Load cell Acoustic sensor Acoustic signal output
Test Speed Range	0.1 – 50 mm/min.
Fast down and return speed	50 mm/min
Calibration	Dead weights in kg or proving ring.
Power requirements	110/120 VAC 3.15 A or 220/240 VAC 1.6 A (External selection via fuse holder)
Machine dimensions	310(w) x 270(d) x 375(h)
Machine weight (without accessories)	15 kg
Shipping size	390 x 350 x 390 or 460 x 430 x 480
Shipping weight approx.	20 kg

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

Designed and Manufactured in Nottingham, England by: -
ENGINEERING SYSTEMS (NOTTM) Ltd
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 A

FURTHER CONSIDERATION OF THE % FRACTURE DETECT SETTING AND LOW LIMIT.

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.)

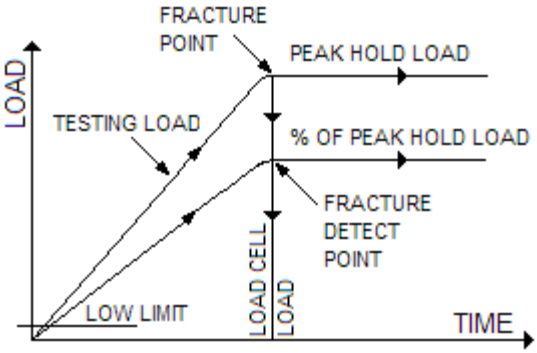

Figure 14 – Fracture Detect

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 e.g. convex, may have to be considered.

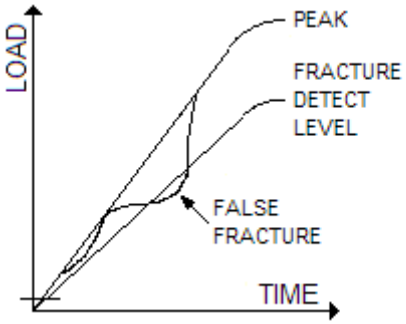

Figure 15 - False Fracture

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.

CHANGING THE FRACTURE % SETTING.

See section 4.19 for details of changing the fracture detect percentage using the setup menu.

LOW LOAD LIMIT

A low load limit is included below which fractures are not detected. This is to prevent false fractures occurring the start of the test when the difference between the current and peak load readings is very small. This limit defaults to 0.6% of the load cell capacity, i.e. 3 kg for 500 kg load cell or 0.3 kg for a 50 kg load cell. On rare occasions when testing difficult specimens it may be necessary to adjust this via the setup menu, see section 4.20 for details.

APPENDIX B

SETTING UP THE 3-POINT BEND RIG

The 3-point bend rig comprise of:

- Two point contact base unit.
- One point upper contact + load cell adaptor.
- Setting block

The two lower contact bars are adjustable for width. Specimen stops for length and width are provided. Provision is made for adjustment of the top contact bar for parallel and right-angled adjustment relative to the bottom contacts. A setting block is provided to aid setting of the correct contact widths and position relative to the centre line.

The bold numbers in brackets below refer to the diagram at the end of this appendix.

The base of the bend rig is screwed to the CT6 top plate with four M4 hexagon screws (**2**).
Brass knobs (**1**) at end of the sliding blocks (**9**) adjust the spacing of the 2-point bars (**8**) that are attached to these sliding blocks. The sliding blocks are secured by four (two each end) M3 hexagon clamping screws (**3**). These screws should be tight when in normal use and loosened for adjusting the bar spacing. The gold coloured rule (**5**) is provided as a guide to setting the spacing of the bars, the inner end of the block is 2 mm from the centre of the Ø2 mm bar, i.e. if the sliding blocks are touching each other, then the 2-point bar spacing is 4 mm and this is the minimum possible spacing.
Specimen stops (length and width) are provided and are adjustable.
The single length stop (**4**) is at the left hand end and can be adjusted with a 2.5 mm hexagon ball driver. The two width stops (**6**) are positioned at the rear but are adjustable via two (1 each stop) hexagon screws situated in the front of the sliding block (**7**), use a 3 mm ball driver for adjustment. There is no clamping facility on these width adjusters.

The upper (3rd point) of the bend rig is in two parts - the load cell adaptor (**10**) and the adjustable Ø2 mm one point contact top bar (**12**). Use the UP / DOWN buttons on the CT6, position the Load Cell/Load Cell at a suitable height and make sure the adaptor is screwed into the load cell. The adjustable contact should be slid onto this adaptor and secured using a 1.5 mm hexagon key (**11**). It is important to position the contact bar at right angles to the axis of the two lower bars. As previously, position the Load Cell at a suitable height and use

the setting block to help in this setting. The horizontal alignment of the top bar is adjustable and can be set by tightening the two screws on the top bar blade. This should bring the top bar into parallel alignment with the bottom contacts. Again, the setting block can be used to help this setting.

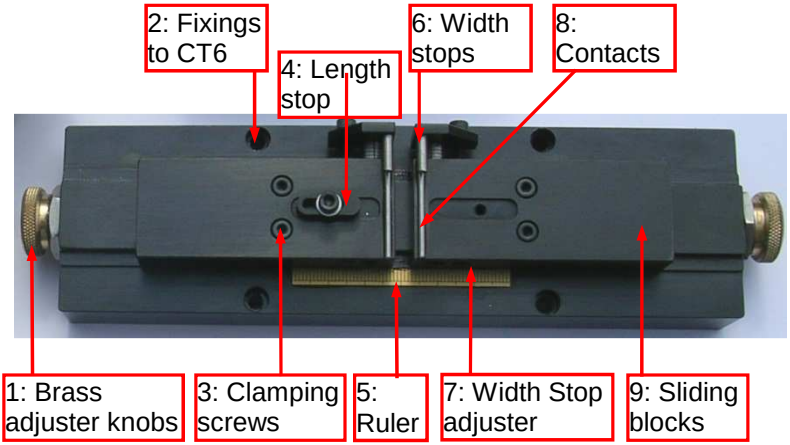

Figure 16 - Bend rig base

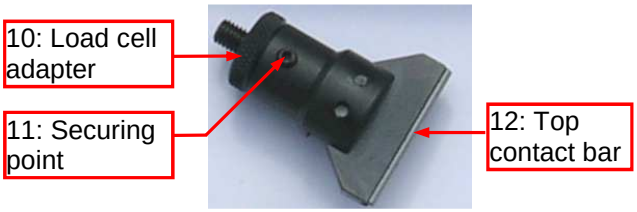

Figure 17 - Bend rig upper contact

APPENDIX C

SETTING UP THE CIRCUIT BOARDS FOR THE CT6

This procedure is for setting up the circuit boards during manufacture, and should not be used for setting up an existing machine. This appendix is included solely for completeness.

- Ensure that the motor controller has been programmed.
- Connect the transformer connector to the power supply board but leave all other connectors unplugged. Do not fit any ICs to their sockets.
- Fit the mains fuse in the IEC connector and switch on. Check the AC voltages on the transformer connector.
- Switch off and insert the fuses on the power supply board. Switch back on and check the DC voltage at the test points on the power supply board.
- Switch off and connect the power supply board to the main board. Switch back on and check the DC voltages on the main board. Check the LCD is showing black squares in at least one row, and the motor controller shows a flashing red LED.
- Switch off and insert all ICs. Switch on and re-check the DC voltage on the main board.
- Load the bootloader firmware via the programming connector.
- Load the main firmware via the USB or RS232 interface.
- Switch off and install the RTC RAM battery on the main board. Connect all remaining connectors. Connect a load cell to the rear-panel connector. Insert a paper roll into the printer if not done already. Switch the machine back on.
- Select the correct motor controller and press ENTER. The diagnostic routine will run to check that all hardware is working. Follow the instructions on the LCD. When the diagnostic routine is complete, the machine will restart.
- After starting up as normal the LCD will show a message warning that the RTC RAM contents are invalid. Press TEST and use the keypad to set the time & date when prompted (see section 4).
- The load cell will be detected, and a message will be displayed asking to calibrate it.
- Press ENTER. Enter the calibration passcode ‘1234’ and press ENTER again. Carry out the pre-calibration procedure as described in chapter 6 to set the load range, but skip the certification stage by repeatedly pressing ENTER until it is complete. Discard the printed calibration certificate.

- Once the normal idle display shows press ENTER and enter the passcode ‘1234’.
- Press and release the PAPER FEED button. Press and release the TEST button then press ENTER to enter the manufacturers menu.
- Select ‘SET SERIAL NO’ and press ENTER. Enter the machine serial number using the numeric keys, and then press ENTER.
- Select ‘SET BRAND’ and press ENTER. Select the required brand and press ENTER again.
- Select ‘CYCLE LOAD CELL’ and press enter to start the load cell cycling routine. Press RETURN on the front panel when finished to stop load cell cycling.

Press ESC to exit the manufacturers menu. Press ENTER and enter the passcode ‘1234’ to re-enter the setup menu. Select ‘CALIBRATION’ and again enter the passcode ‘1234’. Select ‘CALIBRATE’ and perform a full calibration.

SETTING THE TORQUE LIMITER

A special tool is required and the correct setting is 2.5 Nm.
At 200 mm, the force required is 12.5 N or 1.3 kg

APPENDIX D

NOTES

The CT6 is

Designed and Manufactured in Nottingham, England

by

ENGINEERING SYSTEMS (NOTTM) Ltd.
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