**Electromagnetic Compatibility**

Where applicable, this equipment is designed to comply with International Electromagnetic Compatibility (EMC) standards.

To ensure reproduction of this EMC performance, connect this equipment to a low impedance ground connection. Typical suitable connections are a ground spike or the steel frame of a building.

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General Safety Precautions

Materials testing systems are potentially hazardous.

Materials testing involves inherent hazards from high forces, rapid motions and stored energy. You must be aware of all moving and operating components which are potentially hazardous, particularly the actuator in a servo-hydraulic testing system or the moving crosshead in an electromechanical testing system.

Whenever you consider that safety is compromised, press the Emergency Stop button to stop the test and isolate the testing system from hydraulic or electrical power.

Carefully read all relevant manuals and observe all Warnings and Cautions. The term Warning is used where a hazard may lead to injury or death. The term Caution is used where a hazard may lead to damage to equipment or to loss of data.

Ensure that the test set-up and the actual test you will be using on materials, assemblies or structures constitutes no hazard to yourself or others. Make full use of all mechanical and electronic limits features. These are supplied for your safety to enable you to prevent movement of the actuator piston or the moving crosshead beyond desired regions of operation.

The following pages detail various general warnings that you must heed at all times while using materials testing equipment. You will find more specific Warnings and Cautions in the text whenever a potential hazard exists.

Your best safety precautions are to gain a thorough understanding of the equipment by reading your instruction manuals and to always use good judgement.
Warning

Disconnect the electrical power supply before removing the covers to electrical equipment.

Disconnect equipment from the electrical power supply before removing any electrical safety covers or replacing fuses. Do not reconnect the power source while the covers are removed. Refit covers as soon as possible.

Disconnect power supplies before removing the covers to rotating machinery.

Disconnect equipment from all power supplies before removing any cover which gives access to rotating machinery. Do not reconnect any power supply while the covers are removed unless you are specifically instructed to do so in the manual. If the equipment needs to be operated to perform maintenance tasks with the covers removed, ensure that all loose clothing, long hair, etc. is tied back. Refit covers as soon as possible.

Shut down the hydraulic power supply and discharge hydraulic pressure before disconnection of any hydraulic fluid coupling.

Do not disconnect any hydraulic coupling without first shutting down the hydraulic power supply and discharging stored pressure to zero. Tie down or otherwise secure all pressurized hoses to prevent movement during system operation and to prevent the hose from whipping about in the event of a rupture.
Warning

Shut off the supply of compressed gas and discharge residual gas pressure before you disconnect any compressed gas coupling.

Do not release gas connections without first disconnecting the gas supply and discharging any residual pressure to zero.

Use protective shields or screens if any possibility exists of a hazard from the failure of a specimen, assembly or structure under test.

Use protective shields whenever a risk of injury to operators and observers exists from the failure of a test specimen, assembly or structure, particularly where explosive disintegration may occur. Due to the wide range of specimen materials, assemblies or structures that may be tested, any hazard resulting from the failure of a test specimen, assembly or structure is entirely the responsibility of the owner and the user of the equipment.

Protect electrical cables from damage and inadvertent disconnection.

The loss of controlling and feedback signals that can result from a disconnected or damaged cable causes an open loop condition which may drive the actuator or crosshead rapidly to its extremes of motion. Protect all electrical cables, particularly transducer cables, from damage. Never route cables across the floor without protection, nor suspend cables overhead under excessive strain. Use padding to avoid chafing where cables are routed around corners or through wall openings.
Warning

Wear protective clothing when handling equipment at extremes of temperature.

Materials testing is often carried out at non-ambient temperatures using ovens, furnaces or cryogenic chambers. Extreme temperature means an operating temperature exceeding 60 °C (140 °F) or below 0 °C (32 °F). You must use protective clothing, such as gloves, when handling equipment at these temperatures. Display a warning notice concerning low or high temperature operation whenever temperature control equipment is in use. You should note that the hazard from extreme temperature can extend beyond the immediate area of the test.

Take care when installing or removing a specimen, assembly or structure.

Installation or removal of a specimen, assembly or structure involves working inside the hazard area between the grips or fixtures. Keep clear of the jaws of a grip or fixture at all times. Keep clear of the hazard area between the grips or fixtures during actuator or crosshead movement. Ensure that all actuator or crosshead movements necessary for installation or removal are slow and, where possible, at a low force setting.
Warning

Do not place a testing system off-line from computer control without first ensuring that no actuator or crosshead movement will occur upon transfer to manual control.

The actuator or crosshead will immediately respond to manual control settings when the system is placed off-line from computer control. Before transferring to manual control, make sure that the control settings are such that unexpected actuator or crosshead movement cannot occur.

Keep clear of the operating envelope of a robotic device unless the device is de-activated.

The robot in an automated testing system presents a hazard because its movements are hard to predict. The robot can go instantly from a waiting state to high speed operation in several axes of motion. During system operation, keep away from the operating envelope of the robot. De-activate the robot before entering the envelope for any purpose, such as reloading the specimen magazine.
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Typical 4400 floor model

Typical 4400 table model
Chapter 1
Introduction

Outline

- Purpose..................................... Page 1-2
- Description. .............................. Page 1-3

This chapter introduces you to the Model 4400 materials testing system. It details the purpose of the testing system and describes the main components of the system.
Purpose

The Instron 4400 Series of materials testing systems are designed to test specimens and components in tension, compression, shear and flexure, meeting international standards for those tests.

The systems are designed for high productivity and low operator error. The Control Console lets you set up tests easily and you can perform repetitive tests simply by loading new specimens and pressing the ▲ or ▼ button.
Description

The Instron 4400 Testing System comprises a load frame into which a specimen of the test material is mounted and a control console. The load frame applies a tensile or compressive load to the specimen, while the control console provides calibration, test setup and test operating controls. The control console is compact enough to mount directly on the load frame, eliminating the need for a separate support table or workbench.

Load Frame

The 4400 Series load frame provides a rigid mounting structure capable of applying a load to a specimen by means of a moving crosshead. A loadcell mounted in the frame provides accurate measurement of the forces applied to the specimens. There are two types of 4400 load frame: table-top and floor-standing. Both types operate in the same way, although the frame controls may be positioned differently.

Control Console

The Series 4400 Control Console contains the main control panel for the system. The console also has provisions for an IEEE-488 General Purpose Instrument Bus (GPIB) which allows remote supervisory control of test procedures through a programmable computer.

Optional Strain channels can be fitted to the console to allow the use of extensometers or other strain measurement devices.
Chapter 2
Function of Controls

Outline

- Control Panel ................................ Page 2-2
- Emergency Stop button ....................... Page 2-13
- Jog Controls ................................. Page 2-14

This chapter details the function of the controls on your 4400 testing system.
Figure 2-1. Control Panel
# Panel Sections

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<thead>
<tr>
<th>Item</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1 Display section</td>
<td>Displays test data, either instantaneous or fixed values at peak or break.</td>
</tr>
<tr>
<td>2 Limits section</td>
<td>Lets you set maximum and minimum limits of load, extension and strain and the actions at those limits, and set an action for Break.</td>
</tr>
<tr>
<td>3 Main section</td>
<td>Lets you set up the parameters to control your test.</td>
</tr>
<tr>
<td>4 Test controls</td>
<td>Lets you start and stop your test and return the crosshead to the start point.</td>
</tr>
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Display Section

Figure 2-2. Control Panel - Display Section

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1 Display screens</td>
<td>Four-digit numerical displays show values of load, extension, and strain. Shows “- - - -” when transducer is uncalibrated, shows “EEEE” when transducer is over-ranged.</td>
</tr>
<tr>
<td>2 RESET PEAKS</td>
<td>Resets the stored peak values to the current values while the test is running.</td>
</tr>
<tr>
<td>3 PEAK BREAK</td>
<td>Sets the load display to show the peak load attained, and the extension and strain displays to show the values at specimen break. The indicator illuminates when the key is active.</td>
</tr>
<tr>
<td>4 BREAK key</td>
<td>Sets the displays to show the values at specimen break. The indicator illuminates when the key is active.</td>
</tr>
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</table>
5 **PEAK key**  Sets the displays to show the values occurring at the point of the peak load during a test. Indicator illuminates when the key is active.

6 **TRACK key**  Sets the displays to show the instantaneous values occurring throughout a test. Peak and break values are still recorded even though tracking is active. The indicator illuminates when the key is active.
Limits Section

1. MAX and MIN keys
   - Press to display the limit value in the variable display screen shown in Figure 2-4. Use the numeric keypad to enter a new value. Press a CROSSHEAD ACTION key to assign a crosshead action to the limit.

2. Status Indicators
   - Illuminate red to indicate that an action other than OFF is set for that limit. Flash red when a STOP or RETURN action occurs.

3. BREAK key
   - Press to set a crosshead action at break using the CROSSHEAD ACTION keys.

4. CROSSHEAD ACTION keys
   - Set the action that occurs when the limit is tripped or the specimen breaks.

---

Figure 2-3. Control Panel - Limits Section
Main Section

1. Numeric keypad
   Use to enter:
   1. Manual calibration signal value
   2. Crosshead speed value
   3. Area compensation value
   4. Limit values
   5. Preset point values
   6. S1 functions
   +/- key sets tension values (+) or compression values (-)

Figure 2-4. Control Panel - Main Section
Variable Display

Four-digit numerical display shows values of system variables entered with the numeric keypad.
- Shows “- - - - ” when system is uncalibrated.
- Shows “EEEE” when the display overflows.
- Shows “LOSS” when memory reset to default.
- Shows “IEEE” when IEEE bus is active.

GL RESET key

Press to set the current crosshead position as the gauge length (starting) position.

AT GL indicator illuminates when crosshead is at gauge length position.

AREA key

Enter the specimen cross-sectional area if you want to load display to show stress values.

TESTING AREA key

Defines the load frame testing area as above or below the crosshead. The BELOW XHEAD or ABOVE XHEAD indicator lights to indicate the current selection. You must press the S1 key first to activate this selection.

LOAD and STRAIN keys

CAL keys initiate the calibration procedures for the relevant transducer. BAL keys set the relevant transducer to zero. The relevant indicator illuminates during the calibration or balance operation. A flashing indicator means that an error has occurred during the operation.

SPEED key

Press to enable entry of a speed value using the numeric keypad.

S1 key

Enables or disables system options, as follows:
[S1] [0] [ENTER] System reset, clear memory.

[S1] [1] [ENTER] System reset, retain memory.

[S1] [2] [ENTER] Diagnostic routine, for use only by Instron personnel.

[S1] [3] [+] Energy printout. The +/- key toggles between enabled (SL 3) and disabled (SL-3).

[S1] [4] [+] Preset point printout. The +/- key toggles between enabled (SL 4) and disabled (SL-4).

[S1] [4] [1 or 2 or 3] [Value] [ENTER] Set preset point option. Set the values for Preset Point 1 or 2 or 3.

[S1] [5] [+] Set energy integration variable and preset point independent variable. The +/- key toggles between extension (SL 5) and strain (SL-5).

[S1] [6] [+] Autoprint. The +/- key toggles between enabled (SL 6) and disabled (SL-6).

[S1] [7] [+] Grip control enable and disable.

[S1] [8] [+] Print cycle count and pip count. The +/- key toggles between enabled (SL 8) and disabled (SL-8).

[S1] [8] [3] Display cycle count or pip count.

[S1] [+] Toggles between pip count (S8 3) and cycle count (S8-3).

[S1] [8] [1] Set cycle limit.

[S1] [9] [ENTER] Firmware version number display

IEEE 488 key Press to enable computer control.
**PRINT key**
Press to obtain a report of the current test, or the last test if no test is running.

**METRIC, ENGLISH, and SI indicators**
Illuminate to show current unit system as set by the mm/IN/SI switch on the rear of the console.

**LOAD indicator**
Illuminates when a load overrange occurs. The testing machine will stop automatically if this happens to protect the loadcell.

**TRAVEL indicator**
Illuminates when the crosshead operates the mechanical travel limit in either direction. Further travel in the relevant direction is inhibited.

**MOTOR indicator**
Fault indicator which is lit steadily for the following conditions:
1. Motor drive enabling sequence (approx 5 seconds duration)
2. Motor drive cannot be enabled
3. Load frame cannot be identified
4. Load frame power supply failure
5. Crosshead second level travel limit tripped
6. Emergency Stop switch tripped.

The indicator flashes for the following conditions:
1. Drive motor overheats
2. Drive loop failure (stall, etc.)

The **MOTOR** status indicator will remain on (steadily or flashing) after the fault condition is cleared, except after the 5 second enable sequence. Perform the key sequence [S1] [1] [ENTER] to restore to a standby (off) condition.
Control Panel

**TIMER** indicator  Illuminates if the CPU malfunctions. Shutting down and restarting the system generally clears this condition.

**POWER** indicator  Illuminates if the power supply fails. Shutting down and restarting the system generally clears this condition.
### Test Controls

![Diagram of Test Controls]

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<td>STOP key</td>
<td>Stops the crosshead</td>
</tr>
<tr>
<td>RTN key</td>
<td>Returns the crosshead to the gauge length position.</td>
</tr>
<tr>
<td>▲ key</td>
<td>Starts the test, with the crosshead moving in the up direction.</td>
</tr>
<tr>
<td>▼ key</td>
<td>Starts the test, with the crosshead moving in the down direction.</td>
</tr>
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*Figure 2-5. Test Controls*
Emergency Stop button

Press the load frame Emergency Stop button to stop the crosshead at its current position. Use this button whenever a condition develops during a test that jeopardises the safety of the operator, or could result in damage to the specimen or test fixtures.

Turn the button clockwise to reset the switch. To reset the system you need to either switch the power off then on again, or enter [S1] [0] [ENTER] or [S1] [1] [ENTER] to re-enable the crosshead drive motor.

Figure 2-6. Emergency Stop button
Jog Controls

The load frame is fitted with a crosshead jog control panel. Depending upon the frame type, this may be a handset as shown below in Figure 2-7, or a panel fitted to the load frame. Both work identically.

Press the rocker switch in the **UP** direction to move the crosshead up. If you continue to hold the button, the crosshead speed increases to maximum in a few seconds.

Press the rocker switch in the **DOWN** direction to move the crosshead down. If you continue to hold the button, the crosshead speed increases to maximum in a few seconds.

Releasing the button stops the crosshead.

Figure 2-7. Crosshead Jog Controls
Chapter 3
Operation

Outline

- Pretest Procedures ............................... Page 3-2
- Setting Up A Test.............................. Page 3-16
- Cycle Count and Pip Options .............. Page 3-37

This chapter details the procedures necessary to set up your testing system.

“Pretest Procedures” are those necessary to start up your system and set up the load frame.

“Setting Up A Test” details the procedures necessary to set up the various control panel functions to run a test.

“Cycle Count and Pip Options” details the optional procedures necessary to run the test for a preset number of cycles or to use an event marker.
Pretest Procedures

Pretest Checks
Prior to the start of each test, check the following:

☐ Ensure that all cable connections are secure.
☐ Check that the load cell is the correct capacity for the tests you wish to perform.

Turn Power On
To apply power to the complete testing system, set the main power switch on the load frame to ON. You must allow a warm-up period of at least 15 minutes to assure load cell stability. This warm-up period is also necessary whenever you change the load cell.

Self-Test Procedure
The Series 4400 system runs a self-test when you apply power. Monitor this routine closely, as it provides assurance of the reliability of the system before you start testing.

(a) Turn the system on.

(b) All Front Panel indicators illuminate, including the control switches and backlit status indicators, and all displays show -1.8888 for up to 10 seconds.

(c) All indicators go out and all displays are blank for up to 5 seconds.

(d) The four-character self-test result shows on the main panel display for up to 5 seconds, then disappears. If a result remains on the display, then you cannot operate the system and corrective maintenance is required.
Pretest Procedures

**Note**  You can repeat the Self Test Routine by pressing the Reject key (REJ) on the keypad during the time when the Self Test Result shows on the Main Panel Display. This action may allow a Self Test Routine to pass a second time.

If the system still fails, contact your local Instron Service Department.

**System Reset At Initial Power Up**

When you initially power up the system, it will remember the last test parameters used. If you wish to use a new set of test parameters you should enter a system reset sequence at the end of the self-test routine to ensure that system data storage is at the default state.

To reset the system, press [S1] [0] followed by [ENTER].

The Main Panel Display shows LOSS after this sequence, indicating that previously stored conditions and data are lost.

**Setting Crosshead Height**

Set the crosshead height by using the jog handset or jog panel to raise or lower the crosshead to the correct height to install the specimen between the grips. If you press the G. L. RESET key on the Control Panel to set the zero position into the system memory this enables the crosshead to return to this position at the end of the test, ready for another.
Installing a Load Cell

There are several methods of mounting a load cell onto a 4400 Series testing system, depending upon the type of 4400 load frame and the load cell you wish to use.

Mini Tester

The load cell is mounting using eight screws around the circumference of the load cell, as shown in Figure 3-1. There are two dowel pins in the base of the machine. The load cell cable plugs into the rear of the control panel.

Figure 3-1. Installing a load cell onto a mini-tester
2530 Series static load cells onto 4411 testing machines

The load cell is seated in a locating ring, and secured with one long screw through the moving crosshead. There is a dowel pin in the crosshead for loadstring clevis pin alignment.

Refer to Figure 3-2 below.

Figure 3-2. Installing a static load cell onto a 4411
"Top Hat" load cells

These can be mounted in either of two ways, as shown below in Figure 3-3.

The load cells can either be mounted through the crosshead, or bolted against it using either three or six bolts, depending upon the frame model.

Figure 3-3. Installing "Top Hat" load cells
“Sandwich” load cells

These load cells are mounted beneath the crosshead, and either held in place with a pilgrim nut and draw bar, or with six bolts as shown in Figure 3-4.

---

Figure 3-4. Installing “Sandwich” load cells

To use a pilgrim nut and drawbar, follow the procedure below:

1. Ensure that all mating faces are clean.
2. Screw the short thread of the drawbar fully into the load cell flange.
3. Offer up the load cell assembly to the underside of the crosshead.
Caution

Ensure that the load cell is pushed squarely from below to prevent mis-aligning the load string.

4. Lightly grease the base of the pilgrim nut and screw onto the drawbar. The stressing screws must be released.

5. Re-tighten the pilgrim nut using the tommy bar.

6. Tighten the stressing screws in the order 1, 3, 4, 2 until the shim gap equals that of the shim thickness within a tolerance of 0% to 10% at all points.

7. Release the stressing screws fully.

8. Re-tighten the pilgrim nut.

9. Repeat steps 6, 7 and 8 until there is no noticeable rotation of the pilgrim nut when tightened.

10. Tighten the stressing screws until the correct shims can be inserted, and fit the shims.

11. Release the stressing screws until they are finger-tight.

To remove the load cell:

1. Screw down the stressing screws, in the order 1, 3, 4, 2 until the shims can just be removed from the pilgrim nut.

2. Remove the shims and release the stressing screws.
**Warning**

Support the load cell from below before attempting to remove the pilgrim nut.

1. Support the load cell.

2. Unscrew the pilgrim nut using the tommy bar, then lower the load cell assembly clear of the crosshead.

*Figure 3-5. Pilgrim Nut assembly*
Low Profile Load Cells

Low profile load cells are bolted directly to the underside of the crosshead using four bolts as shown below in Figure 3-6.

Figure 3-6. Installation of Low Profile load cell
Load String

The load string is all of the components you install between the moving crosshead and the baseplate or fixed crosshead. This includes the grips, attachment kits and the specimen. A proper connection between each component is essential for accurate test data. Any backlash in the load string components will degrade the integrity of test results for reverse stress or compression testing.

Clevis Pin Couplings

A clevis pin coupling is typically used for attaching the grips to a 4400 Series test system. Figure 3-7 illustrates a typical loadstring using clevis pin couplings. A male shank connects to a female clevis socket, which connects to either the load cell or to the baseplate. A clevis pin couples the shank and socket together. A locknut ensures that there is no end play in the grip to load frame connection.

Threaded Couplings

Figure 3-8 illustrates a threaded coupling. The attachment kit uses a female clevis socket which threads into the actuator or load cell. You eliminate any end play by initially applying a tension preload using a dummy specimen, then tightening a locknut against the load cell and the grip locknut against the grip adapter.

Preloading the Load String

Most tension components (except self-aligning couplings) may be preloaded. A preloaded loadstring will not only eliminate all backlash, but will maximise the stiffness of the loadstring and prevent locknuts working loose. Preloading is essential if conducting “reverse-stress” testing.

To preload the load string, you will have to install a specimen capable of withstanding a tensile load 10 to 15 % greater than the highest load you will be applying during your test.
Figure 3-7. Typical Clevis Grip Installation
**Equipment**

You need the following items:

- a pre-loading specimen capable of withstanding a tensile load 10 to 15% greater than the highest test load.
- spanner wrench, (1/4 in.)

Check for the following before you preload the grips:

- The attachment kits are installed but loose.
- The **LOAD** channel indicates a zero load.
Procedure

(a) Fit the pre-load specimen.

(b) Set the control electronics for a tensile load 10 to 15% greater than the highest load you will be applying during your test.

(c) Using the spanner wrench, turn each locknut against the mounting device (load cell or baseplate clevis).

(d) Set the electronic controls for a zero load.

(e) Remove the specimen.

You must remove the load string preload before removing the grips from the system. To remove the load string preload, you will have to re-install the pre-load specimen and reverse the above procedure.
Selecting Operating Units

The 4400 Series testing systems can be operated in either English units (inches and pounds), metric (millimetres and kilograms) or SI (millimetres and kN), depending upon the position of the switch shown in Figure 3-9 below.

You should normally set the units switch before turning the system on. When power is applied, the units selected are shown by the units indicator on the main panel. If this has been changed, the main panel display shows “LOSS”.

Figure 3-9. Operating Units switch
Note: You must re-calibrate the load and strain channels and reset the electronic limits if ”LOSS“ appears on the display.

If you change units while the system is powered up, the units indicator will not change. You must perform one of the following to make the units change valid:

- Turn the main power off then on.
- Enter the system reset sequence: press [S1], then [0] then [ENTER].
- Enter the “warm start” sequence: press [S1] then [1] then [ENTER].

The main display will show “LOSS”.

Note: You must re-calibrate the load and strain channels and reset the electronic limits.

**Strain Units**

The position of the DIP switch shown in Figure 3-9 must be altered to change the default strain units setting from % to mm or inches, depending upon the system units set.

Note: Series IX software needs the strain units set to %.
Setting Up a Test

Calibrating and Balancing Load

Calibration

Calibrate the load cell and any optional strain transducers at least once a day.

Do not calibrate until power has been on for at least 15 minutes.

---

Action | Result
---|---
1 Press **LOAD CAL** key | Main panel display shows cell maximum capacity. **LOAD CAL** indicator illuminates.
2 Press **ENTER** key | After 6 seconds: **LOAD CAL** indicator goes out. Main panel display goes blank. **LOAD** display shown **0000**.
Setting Up a Test

Balancing

Re-balance the load cell each time you replace grips or fixtures.

Make sure there is no load applied to the load cell other than the weight of the grips or test fixtures.

Do not balance until power has been on for at least 15 minutes.

Action | Result
--- | ---
1 | Press LOAD BAL key
2 | Press ENTER key

After 3 seconds:
LOAD BAL indicator goes out.
Calibrating and Balancing Strain

There are several different methods of calibrating and balancing the strain channel, depending upon the type of extensometer to be used.

Self-identifying extensometers

Set the extensometer to gauge length.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Press STRAIN CAL key</td>
</tr>
<tr>
<td>2</td>
<td>Press ENTER key</td>
</tr>
</tbody>
</table>

Clip the extensometer onto the specimen and perform the following procedure to balance the extensometer.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Press STRAIN BAL key</td>
</tr>
<tr>
<td>4</td>
<td>Press ENTER key</td>
</tr>
</tbody>
</table>
Figure 3-10. Example of a self-identifying extensometer
Manual Calibration

Fit the extensometer to the calibration fixture and set the extensometer arms to gauge length.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Press STRAIN BAL key</td>
<td>STRAIN BAL indicator lights.</td>
</tr>
<tr>
<td>2. Press ENTER key</td>
<td>After 3 seconds: STRAIN BAL indicator goes out.</td>
</tr>
</tbody>
</table>

Set the calibration fixture so that the extensometer arms are at full scale.

3. Press STRAIN CAL key | STRAIN CAL indicator lights. |
Enter the Full Scale value of the extensometer in either mm, inches or %, depending upon which units are selected for the Strain channel.

Press ENTER key

Enter the calibration point value (same as the Full Scale value) of the extensometer.

Press ENTER key

Return the calibration fixture to the extensometer gauge length and repeat steps 1 and 2 to re-balance the strain channel, if required.
**Calibrating a Long Travel extensometer in %**

Note that the 4400 system must be set to % units for Strain.

1. Press **STRAIN BAL** key  
   **STRAIN BAL** indicator lights.

2. Press **ENTER** key  
   After 3 seconds:  
   **STRAIN BAL** indicator goes out.

3. Press **STRAIN CAL** key  
   **STRAIN CAL** indicator lights.

4. Press **0** on the keypad

5. Press **ENTER** key

6. Press **STRAIN CAL** key

7. Diagram showing the keypad and button locations.

---

**Setting Up a Test**

3-23
7. Enter the Full Scale value of the extensometer in %, based on the gauge length setting and a maximum travel of 250mm.


9. Enter the calibration point value (same as the Full Scale value) of the extensometer.
10. Press ENTER key

To re-balance the extensometer:

11. Press the STRAIN BAL key

12. Press ENTER key

Figure 3-11. Long Travel Extensometer
Calibrating a Long Travel extensometer in mm or inches

Note that the 4400 system must be set to mm or inch units for Strain.

Set the extensometer arms to the gauge length.

**Action** | **Result**
---|---
1. Press STRAIN CAL key | STRAIN CAL indicator lights.
2. Press ENTER key | After 3 seconds: STRAIN CAL indicator goes out.

**Balancing**

Set the extensometer arms to the gauge length on the specimen.

3. Press STRAIN BAL key | STRAIN BAL indicator lights.
4. Press ENTER key | After 3 seconds: STRAIN CAL indicator goes out.
Calibrating a DC output extensometer e.g. Optical extensometer

The 4400 console must be set to % strain units and the output of the extensometer must be in %.

Output zero from the extensometer.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press STRAIN BAL key</td>
<td>STRAIN BAL indicator lights.</td>
</tr>
<tr>
<td>Press ENTER key</td>
<td>After 3 seconds:</td>
</tr>
<tr>
<td></td>
<td>STRAIN BAL indicator goes out.</td>
</tr>
<tr>
<td>Output full scale from</td>
<td></td>
</tr>
<tr>
<td>the extensometer and</td>
<td></td>
</tr>
<tr>
<td>hold this output.</td>
<td></td>
</tr>
<tr>
<td>Press STRAIN CAL key</td>
<td>STRAIN CAL indicator lights.</td>
</tr>
<tr>
<td>Enter the Full</td>
<td></td>
</tr>
<tr>
<td>Scale value of the</td>
<td></td>
</tr>
<tr>
<td>extensometer.</td>
<td></td>
</tr>
</tbody>
</table>
Press ENTER key After 3 seconds: STRAIN CAL indicator goes out.

Enter the calibration point value (same as the Full Scale value) of the extensometer.

Press ENTER key

Output zero from the extensometer.

Press STRAIN BAL key

Press ENTER key After 3 seconds: STRAIN BAL indicator goes out.

---

Figure 3-12. Optical Extensometer
Setting the Displays

Note: When you are using Area and it is set to a value other than 1.000, the load display shows real load divided by the cross-sectional area value you have entered. This gives you the reading in terms of stress.

Action Result

Press TRACK key Displays show instantaneous values of load, extension and strain during the test.

or

Press PEAK key Displays show values of load, extension and strain that occur at the peak load point of a test.

or

Press BREAK key Displays show values of load, extension and strain that occur at the specimen break point.
Press **PEAK BREAK** key
Load display shows the peak load value, extension and strain displays show the values that occur at the specimen break point.

Press **RESET PEAKS** key
During a test, resets stored peak values to current values, then updates the values at the next peak load.
Setting the Gauge Length Position

Setting a gauge length position ensures that all your tests start from the same point and with the same initial distance between the grips or fixtures.

**Action**

1. Use the **JOG keys** (described on page 2-14) to move the crosshead to the desired starting point.

2. Press **GL RESET** key.

**Result**

1. Gauge length position established.

2. Gauge length position entered in system memory.

   **AT GL** indicator lights.
Setting Transducer Limits

Calibrate the load and strain channels before you set their limits.

You must reset limits if you change the system operating units.

When Area is in use, the load limit values are based on

\[
\text{real load (stress), not actual load.}
\]

\[
\text{cross-sectional area}
\]

---

Action Result

1. Press the key for the required limit; MAX. or MIN. for LOAD, EXTENSION or STRAIN.  
   Relevant indicator lights. 
   Current limit value displayed.
Setting Up a Test

2. Use the numeric keypad to enter the new limit value. Displayed value flashes.

3. Press the ENTER key. Displayed value stops flashing.

4. Press an ACTION key for the limit. Action and Status indicators light for the selected limit and action.

Note: When entering negative values for limits such as in a compression test, the MAX value is always the least negative e.g. to set limits of 1 kN and 2 kN compressive load, MAX is set to -1 kN and MIN is set to -2 kN.
Mechanical Limit Stops

The mechanical crosshead travel limits stops are an additional safety feature which you should use. If a system failure prevents the crosshead from stopping automatically at gauge length or another electronic limit, the travel limit stops will be contacted by the crosshead actuator bar, a limit switch will open and the crosshead will stop.

Set the upper limit stop to a point just beyond the expected maximum travel in the UP direction for tension testing, or just before the gauge length when compression testing.

Set the lower limit stop to a point just beyond the expected maximum travel in the DOWN direction when compression testing, or just before gauge length when tension testing.

Figure 3-13. Mechanical Limit Stops
Setting Crosshead Speed
You can change the crosshead speed at any time before or during a test.

**Action** | **Result**
--- | ---
1. Press the **SPEED** key | The current speed value is displayed.
2. Use the numeric keypad to enter the new speed value. | Displayed value flashes.
3. Press the **ENTER** key | Displayed value stops flashing.
Setting Area
Pressing the Area key lets you enter a value for the cross-sectional area of your specimen and thus displays the load signal in terms of stress (load/area).

You enter cross-sectional area values in scientific notation; for example, an area of 0.156 cm$^2 = 1.56 \times 10^{-1}$ cm$^2$ and is entered as 1.56E-01.

Caution

Determine the maximum allowable stress for the load cell in use to avoid overloads when using Area.

Determine load limit settings in terms of stress to avoid overloads when using Area.

Action | Result
--- | ---
1. Press the AREA key. | SET indicator lights. The current area value is displayed.
Use the numeric keypad to enter the new area value.

Press the ENTER key.

If number entered is not 1 and exponent is not E00, the ≠1 indicator lights. Displayed value changes to show E and two digits.

Use the numeric keypad to enter the new area exponent value.

Press the ENTER key. Displayed value stops flashing. Value entered in Step 2 appears.

*Note* Pressing ENTER while the AREA SET indicator is lit toggles the display between the area value and its exponent value.
Setting Cycle Count/Pip Display

You can set the system to display the number of crosshead cycles or the number of pip events in a test.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Press the S1 key</td>
<td>Display shows SL.</td>
</tr>
<tr>
<td>2 Press the 8 key</td>
<td>Display shows SL 8 (enabled) or SL-8 (disabled).</td>
</tr>
<tr>
<td>3 Press the 3 key</td>
<td>Display shows S8 3 (pip count) or S8-3 (cycle count).</td>
</tr>
<tr>
<td>4 Press the +/- key</td>
<td>To toggle between pip count and cycle count displays.</td>
</tr>
</tbody>
</table>
Setting Cycle Count/Pip Count Printout

You can set the system to print the cycle count and pip count of the test.

Action Result

1. Press the S1 key
   Display shows SL.
2. Press the 8 key
   Display shows SL 8 (enabled) or SL-8 (disabled).
3. Press the +/- key
   To toggle between enabled and disabled states.
Chapter 4
System Options

Outline

• Recording Devices............................ Page 4-1
• Preset Point and Energy Options................. Page 4-6

This chapter details setting up the optional functions on your testing system. You can set up preset points at which the system reports the values of load and energy. You can also set the system to count the number of test cycles and to capture data when a manual event (PIP) is triggered from a simple switch closure.
Recording Devices

There are three different types of recording device which can be used with your 4400 system. These are described in the following sections.

**Strip Chart Recorder**

The optional strip chart recorder produces a plot of an input signal, load or strain, against time. The 4400 system does not provide any control functions for the recorder; it merely supplies an analog data signal which is scaled and plotted by the recorder.

The recorder can have either one or two input channels. If it has one input channel it should always be Load. If the recorder has two channels, Strain should always be applied to Channel 2.

**X-Y Plotter**

The optional X-Y plotter is another type of recorder that plots two variables against each other. Unlike the strip chart recorder, the X-Y plotter’s chart remains stationary and plots are made with a moving pen. Load versus Strain, Load versus Extension and Load versus Time are common plots that can be produced with this recorder.

The X-Y plotter has single-range X and Y axes which required -10 to +10 Vdc input signals for full scale. The load signal is applied to the Y axis and is automatically ranged to full scale. The X axis can be set to track an extensometer’s signal or the recorder’s internal timebase. An event marker can also be used through a PIP contact on the rear panel.

As for the strip chart recorder, the 4400 system does not provide any control functions for the recorder; it merely supplies an analog data signal which is scaled and plotted by the recorder.
**Dot Matrix Printer**

The optional dot matrix printer provides a hard copy record of test parameters and results. The printer features up to 80 characters on a line, printing at a rate of about 100 characters per second. The printout includes the name, value and units of several parameters.

To obtain a printout at any time, press the PRINT key.

To obtain a printout automatically at the end of a test, enter the key sequence shown below.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Press the <code>S1</code> key</td>
<td>Display shows <code>S1</code>.</td>
</tr>
<tr>
<td>2 Press the <code>6</code> key</td>
<td>Display shows <code>SL 6</code> (enabled) or <code>SL-6</code> (disabled).</td>
</tr>
<tr>
<td>3 Press the <code>+/-</code> key</td>
<td>To toggle between enabled and disabled states.</td>
</tr>
</tbody>
</table>

*Note* All crosshead commands are locked out during a printout.
Printout Format

The printer output consists of up to nine lines and five fields, depending upon parameters and actions selected below:

Line 1  indicates the current active units for Load, Extension, Strain and Energy. If Strain is not used the Strain field (No. 4) is omitted.

Line 2  lists Peak data.

Line 3  lists Break data. If specimen break did not occur line 3 is omitted.

Line 4  lists Preset Point 1 data. If Preset Points are suppressed lines 4, 5 and 6 are omitted.

Line 5  lists Preset Point 2 data. If Preset Points are suppressed lines 4, 5 and 6 are omitted.

Line 6  lists Preset Point 3 data. If Preset Points are suppressed lines 4, 5 and 6 are omitted.

Line 7  Crosshead speed and Area.

Line 8  Energy (total). If Energy is suppressed the Energy field (No. 5) and line 8 are omitted.

Line 9  Cycle Count / Pip Count.

Printer Units

The units that appear on a printout depend upon the selection of operating units as described on page 3-14. The printed units for Strain depend upon the extensometer used and the strain operating mode.
### Extensometer type

<table>
<thead>
<tr>
<th>Extensometer type</th>
<th>Strain mode</th>
<th>Strain units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-identifying</td>
<td>Percent Displacement (English) Displacement (metric)</td>
<td>% mils mm</td>
</tr>
<tr>
<td>Non self-identifying</td>
<td>All</td>
<td>SN (ratio of reading between zero and full-scale)</td>
</tr>
</tbody>
</table>

Besides the operating units, the printed units for Energy and Preset Points depend upon the independent variable (extension or strain) and, if strain is used, the extensometer type (self-identifying or not). The units that appear in the Energy field printout and for Total Energy are shown below:

<table>
<thead>
<tr>
<th>Extension</th>
<th>Extensometer type</th>
<th>Energy units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>Not applicable</td>
<td>lb x Extension inches/area (Notes 1 and 3 below)</td>
</tr>
<tr>
<td>Metric</td>
<td>kgf x Extension mm/area</td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>kN x Extension mm/area</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. When a non-self-identifying loadcell is used, "LD" prints instead of "lb", "kgf" or "kN".
2. If Strain 2 is the active channel "S2" prints instead of "S1".
3. The units for Energy and Total Energy prints showing division by "A" only when Area is set equal to 1.000.
4. When a non-self-identifying extensometer is used "SN" prints instead of "mm" or "mils".
Preset Point and Energy Options

These functions are only available when you are using a dot matrix printer.

Setting Preset Point Channel

You can set the channel, extension or strain, that you wish to use to establish preset points during your test.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Press S1 key</td>
<td>Display shows SL.</td>
</tr>
<tr>
<td>2 Press 5 key</td>
<td>Display shows current channel: SL 5 (extension) or SL-5 (strain).</td>
</tr>
<tr>
<td>3 Press +/- key</td>
<td>Toggles between SL 5 (extension) or SL-5 (strain).</td>
</tr>
</tbody>
</table>
### Setting Preset Point Values

You can set up to three separate preset points on the selected channel at which the system calculates load and energy.

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Press S1 key</td>
<td>Display shows SL.</td>
</tr>
<tr>
<td>2. Press 4 key</td>
<td>Display shows SL 4 (energy print enabled) or SL - 4 (energy print disabled).</td>
</tr>
<tr>
<td>3. Press 1 or 2 or 3 key</td>
<td>Select Preset Point 1, 2, or 3. Display shows current value.</td>
</tr>
<tr>
<td>4. Use the numeric keypad to enter the new limit value.</td>
<td>Displayed value flashes.</td>
</tr>
<tr>
<td>5. Press ENTER key</td>
<td>Displayed value stops flashing.</td>
</tr>
</tbody>
</table>
Setting Preset Point Printout

You can set the system to print the load and energy values at the preset points.

Action | Result
---|---
1. Press S1 key | Display shows SL.
2. Press 4 key | Display shows SL 4 (enabled) or SL-4 (disabled).
3. Press +/- key | To toggle between enabled and disabled states.
**Setting Energy Printout**

You can set the system to print the total energy value of the test.

1. **Action**: Press S1 key  
   **Result**: Display shows SL.

2. **Action**: Press 3 key  
   **Result**: Display shows SL 3 (enabled) or SL-3 (disabled).

3. **Action**: Press +/- key  
   **Result**: To toggle between enabled and disabled states.