OPERATION AND CALIBRATION

INSTRUCTIONS

FOR

DYNAMIC STRAIN GAUGE EXTENSOMETERS

2620-600 Series
Materials testing systems are potentially dangerous. Reading your instruction manuals and always using good judgement are your best safety precautions.

Materials testing involves inherent dangers from the high forces and rapid motion employed. Unexpected piston motion could injure an operator while installing specimens, during routine servicing, or at any other time personnel are working with the equipment. Unexpected piston motion can also damage the load cell, grips, fixtures, or valuable specimens. Observe all safety precautions and be aware of the possible dangers involved when operating and servicing testing systems.

OPERATOR SAFETY

Read the pre-installation handbook and instruction manuals carefully. Use the electric LIMITS feature at all times, setting the limit controls on the Controller Modules to prevent unexpected excursions of the actuator piston beyond the desired regions of operations.

Ensure that the test set-up to be followed, and the actual test to be performed on materials, assemblies, or structures, constitute no hazard to operating personnel.

GENERAL SAFETY

The following statements apply to all personnel working on Instron equipment.

1. SUPPLY VOLTAGES EXCEEDING 50 VOLTS

Instron designs do not permit operators to be exposed to voltages exceeding 50 volts under normal operation of the instrument. However, if any covers are removed from the instrument, care must be taken and all safety precautions applied when carrying out any servicing procedures. Also, if fuses are being changed, it is essential to disconnect the instrument from the main power source.

2. HIGH PRESSURE HYDRAULIC FLUID

Do not disconnect any hydraulic coupling without first shutting down the hydraulic pumping system and checking that stored pressure has discharged to zero. Tie down or otherwise secure all pressurised hydraulic hoses to prevent movement during system operation and to prevent the hose from whipping in the event of a rupture.

3. HIGH SPEEDS AND FORCES

The user of a materials testing system must be aware of its moving operating components which are, at times, potentially dangerous, due to high speeds and forces. No one should be permitted to operate a testing system who is unaware of its function or unskilled in its use.
4. DISINTEGRATING TEST SPECIMENS

The hazard from the test specimen is entirely the responsibility of the owner and user of the instrument. In particular, attention is drawn to the hazards of brittle failure, compressive buckling, failure of pressurised vessels, and explosive disintegration.

5. LOSS OF CONTROLLING AND FEEDBACK SIGNALS

The sudden loss of controlling and feedback signals which results from a disconnected or damaged cable causes an open-loop condition, which drives the piston rapidly to its extremes of motion. All electrical cables, particularly the load cell, LVDT, and other transducer cables must be protected from damage. Never route cables across the floor without protection, nor string cables overhead under excessive strain. Where cables are routed around corners and through wall openings, always use padding.

6. MEDIUM AND HIGH TEMPERATURE OVENS AND FURNACES

It is essential that a warning notice concerning high temperature operation be displayed whenever high temperature testing equipment is in use; special handling gear and protective clothing must be used under these circumstances. High temperature implies all equipment with a temperature exceeding 60°C (160°F). It should be noted that the hazard from high temperature can extend beyond the immediate area of the test.

7. ROTATING MACHINERY

The source of power for rotating machinery may be electrical, hydraulic, or pneumatic, or compressed gas. Disconnect the test instrument or equipment from its power source before removing any cover which gives access to rotating machinery, e.g. belts, gears, screws, or shafts.

8. HIGH PRESSURE COMPRESSED GAS

High pressure compressed gas is potentially dangerous. Adhere strictly to operating instructions. Do not release gas connections unless the gas supply has been disconnected, and any residual pressures have been reduced to zero.
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1.0 GENERAL DESCRIPTION

Instron Dynamic Strain Gauge Extensometers are accurate lightweight strain gauge units used for accurate direct measurement and closed-loop control of strain in cyclic high frequency materials testing applications. Tensile, compressive, low and high cycle fatigue testing, as well as straight line (ramp) testing may be performed with these devices.

They are designed for use with metals, rigid thermo-plastic and thermo-setting polymers and other materials exhibiting total strains up to ±50% of the original gauge length. Variations of gauge lengths and percentage strain levels may be achieved by the addition of gauge length extenders.

The extensometers have wide frequency response and high accuracy for use in both tension and compression and can be operated over an ambient temperature range of -80°C to +200°C (-100°F to +400°F). They are immersible in acetone, silicone, alcohol and other similar cooling/heating fluids.

The flexural element is a special alloy operating beam, with fatigue-certified foil gauges bonded to it and arranged in a fully active four-arm Wheatstone Bridge circuit. It is mounted in a light rigid frame and follows accurately the Strain amplitudes applied to it. Positive mechanical stops limit overtravel and an aluminium case protects the gauges and the associated wiring from mechanical damage.

A full kit of accessories is packed in a protective box together with the extensometer and includes all parts and special tools necessary for use.

Apart from their use under closed-loop strain control on all Instron servo-hydraulic testing instruments, the extensometers are suitable for direct measurement and readout of strain on most Instron static testing instruments. However, only the Model 1121 table model and the Model 1190 floor model instruments can be fitted with the Instron Load/Strain control accessory to permit strain-controlled testing to be achieved.

The initial gauge length of the particular extensometer is accurately and conveniently set by the insertion of a gauge length pin into a hole precisely located in the flexural beam, enhancing test repeatability and reducing the possibility of damage to the extensometer when not in use.

The extensometers are clamped to the flat or round specimens with special high-tear strength rubber bands or with tension springs. Replaceable tool steel knife-edges attached to the ends of both the fixed and flexurable beams bear against the specimen and prevent slippage. The design is such that although the clamping force is low, positive positioning of the extensometer on the specimen is assured without generating high localised stresses which can initiate fatigue cracks.

The extensometers can be quickly and easily calibrated, the method varies, depending upon the testing instrument and control console being used. A full description of all calibration procedures is detailed in a later section of the manual. To assist in certain of the calibration methods, a High Magnification Extensometer Calibrator (Catalogue No. 2602-004) supplied with a separate instruction manual 10-18-2 is available as an optional item.
2.0 SPECIFICATIONS

The four different models comprising the entire series of dynamic extensometers are described in Table 2.1. Specifications unique to each individual model are also given in this table, while general specifications for all models in the series are listed in Table 2.2. An electrical schematic diagram, applicable to all models, is shown in Figure 2.1.

Table 2.1 Individual Model Specifications

<table>
<thead>
<tr>
<th>Catalogue No.</th>
<th>Gauge Length</th>
<th>Max. Strain</th>
<th>Full Scale Range</th>
<th>Frequency Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>2620-601</td>
<td>12.5mm</td>
<td>40%</td>
<td>± 5mm</td>
<td>40Hz</td>
</tr>
<tr>
<td></td>
<td>with 12.5mm extension</td>
<td>25mm</td>
<td>20%</td>
<td>± 5mm</td>
</tr>
<tr>
<td></td>
<td>with 37.5mm extension</td>
<td>50mm</td>
<td>10%</td>
<td>± 5mm</td>
</tr>
<tr>
<td>2620-602</td>
<td>12.5mm</td>
<td>20%</td>
<td>± 2.5mm</td>
<td>60Hz</td>
</tr>
<tr>
<td></td>
<td>with 12.5mm extension</td>
<td>25mm</td>
<td>10%</td>
<td>± 2.5mm</td>
</tr>
<tr>
<td></td>
<td>with 37.5mm extension</td>
<td>50mm</td>
<td>5%</td>
<td>± 2.5mm</td>
</tr>
<tr>
<td>2620-603</td>
<td>10mm</td>
<td>10%</td>
<td>± 1.0mm</td>
<td>100Hz</td>
</tr>
<tr>
<td></td>
<td>with 15mm extension</td>
<td>25mm</td>
<td>4%</td>
<td>± 1.0mm</td>
</tr>
<tr>
<td></td>
<td>with 40mm extension</td>
<td>50mm</td>
<td>2%</td>
<td>± 1.0mm</td>
</tr>
<tr>
<td>2620-604</td>
<td>12.5mm</td>
<td>Not used without gauge length extender</td>
<td>+50% to -10%</td>
<td>+ 12.5mm to -2.5mm</td>
</tr>
<tr>
<td></td>
<td>with 15mm extension</td>
<td>25mm</td>
<td>+25% to -5%</td>
<td>+ 12.5mm to -2.5mm</td>
</tr>
<tr>
<td></td>
<td>with 40mm extension</td>
<td>50mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.2 General Specifications

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
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<tbody>
<tr>
<td>Linearity</td>
<td>0.15% of Range</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>0.1% of Range</td>
</tr>
<tr>
<td>Creep</td>
<td>0.05% of Range</td>
</tr>
<tr>
<td>Operating Force</td>
<td>150 Grammes</td>
</tr>
<tr>
<td>Output Sensitivity</td>
<td>2.5 mV/V ± 2%</td>
</tr>
<tr>
<td>Bridge Resistance</td>
<td>350 ohms</td>
</tr>
<tr>
<td>Balance</td>
<td>±2.5% Full Scale</td>
</tr>
<tr>
<td>Excitation</td>
<td>5 Volts Nominal, 10 Volts Maximum AC (RMS) or DC</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-80°C to +200°C (-100°F to +400°F)</td>
</tr>
<tr>
<td>Overtravel</td>
<td>Mechanical Stops</td>
</tr>
<tr>
<td>Gauge Length Setting &amp; Lock:</td>
<td>Removable Pin</td>
</tr>
<tr>
<td>Attachment</td>
<td>Tension Springs or Special high tear strength rubber bands</td>
</tr>
<tr>
<td>Weight (less cable and connector)</td>
<td>Less than 20 grammes</td>
</tr>
<tr>
<td>Specimen Sizes</td>
<td>Round - 3mm to 25mm diameter</td>
</tr>
<tr>
<td></td>
<td>Rectangular - 3mm to 12mm x 25mm</td>
</tr>
<tr>
<td></td>
<td>Square - 3mm to 12mm</td>
</tr>
</tbody>
</table>
General Specifications (Continued)

Compatibility:
The extensometers may be used on the following equipments:

8000 Series Servo-hydraulic Dynamic Machines
1270 Series Servo-hydraulic Dynamic Machines
1250 Series Servo-hydraulic Dynamic Machines
1330 Series Servo-hydraulic Dynamic Machines
1121 Series Static Table Model Testers
1122 Series Static Table Model Testers
1190 Series Static Floor-mounted Testers

Figure 2.1 Typical Extensometer Circuit Connections
3.0 OPERATING INSTRUCTIONS

CAUTION

Observe all handling precautions given in paragraph 3.1 to prevent damage to the extensometer.

3.1 HANDLING PRECAUTIONS

Although the extensometer is ruggedly constructed and need not be handled with any special care, rough handling and abuse may cause permanent damage.

Whenever the extensometer is out of its protective storage box, observe all the following handling precautions:

(a) Protect the extensometer from mechanical shocks. Do not allow it to drop, and do not allow tools and other equipment to strike it. Be careful about placing the extensometer on a flat work surface where the electrical connector, which is significantly heavier than the extensometer, can pull the extensometer onto the floor. Always use the magnetic cable cleat.

(b) Protect the extensometer from bending stresses. Do not try to exercise the flexural element beyond its mechanical stops when handling or installing. When operating the extensometer attached to a specimen, ensure the maximum expected strain for the sample under test does not exceed the full scale range of the extensometer in use. Always use the limit control feature of the Strain Conditioners to prevent damage to the extensometer in the event of specimen fracture or inadvertent errors in control settings.

(c) Always return the extensometer and its accessories to the protective box when not in actual use. This will prevent inadvertent damage to the extensometer and the loss of tiny accessories.

3.2 PREPARING FOR USE

Remove the extensometer from its storage box and install the gauge length pin. This will prevent damage to the extensometer while handling and will set the gauge length accurately when attaching the unit to a test specimen.

Select and install a gauge length extender to match the output characteristics of the extensometer to the particular specimen under test. Remove the upper knife edge by removing the two socket head cap screws securing the knife edge to the fixed (black) beam, using the ball-end hexagon wrench provided in the accessories kit. When installing a short extender (12.5mm or 15mm), orient the extender so that the wide, raised shelf on the end of the extender is toward the beam of the extensometer. Set the knife edge into the wide recessed shelf at the other end of the extender and secure the assembly to the extensometer beam using two long socket head cap screws inserted through the knife edge, all the way through the extender, and into the threaded holes of the beam. Tighten the screws snugly, but do not overtighten. The long extenders (37.5mm or 40mm) are installed in a similar manner, except that four short screws are used. Attach the knife edge to the extender before attaching the extender to the beam. Use the ball end of the hexagon wrench to tighten the two screws through the lower lip of the extender.
Inspect the extensometer for free operation, and ensure that the knife edges are aligned parallel with each other, and are not dulled or nicked.

**WARNING**

Do not operate the testing system in Strain Control with the extensometer disconnected. Loss of feedback signals from the extensometer will result in loss of closed-loop control, forcing the actuator piston to accelerate into its mechanical stops, endangering personnel and equipment.

Observe all the necessary precautions as detailed at Section 4.0 prior to connecting the extensometer electrical connector to the relevant receptacle on the instrument being used.

### 3.3 MOUNTING THE EXTENSOMETER

Extensometers are clamped to the specimen by special high tear strength rubber bands or tension springs, pulled tight enough to prevent knife edge slippage during testing. If heating of the specimen is expected during the test, then the springs should be used instead of the rubber bands. The extensometer is mounted on either the test specimen or the calibration fixture in exactly the same manner. The mounting sequence is illustrated in Figure 3.2.

When using the rubber bands as clamping devices, it may be necessary to double-loop the bands on smaller diameter specimens to obtain enough clamping force. Figure 3.1 shows an extensometer mounted with rubber bands.

**NOTE:**

Care must be taken not to nick or scratch the test sample with the hardened steel knife edges. Nicks and scratches, particularly on softer samples, can be caused by a clamping spring or rubber band that is too tight, and will result in the growth of fatigue cracks in the specimen that will render acquired test data meaningless.

A magnetic mounting cable cleat is provided in the extensometer kit of parts to support the extensometer cable. It should be positioned on the frame, adjacent to the extensometer assembly, such that the full weight of the cable is removed from the extensometer to prevent strain measurement errors.

A mechanical safety locking device is incorporated on the 25-way ‘Cannon’ connector wired to the extensometer cable. When inserting the connector, push firmly into the mating plug receptacle until the locking latches are heard to ‘click-in’.

**NOTE:**

The fixed receptacle section of this locking device is to be retro-fitted on all machines except table models. Special latching hooks are included in all extensometer kits, to be fitted under the mounting screws of the fixed receptacle, for all servo-hydraulic and floor-mounted static testing instruments.
Figure 3.1 Extensometer Mounted with Rubber Bands

(a) Install the gauge length pin.

(b) Orient the extensometer so that the fixed (black) beam is up and the electrical cable comes from the top of the extensometer.

(c) While holding the extensometer in the left hand, place it against the specimen and hook a clamping spring or rubber band to the far side of the upper knife edge.

(d) Hold the extensometer and the clamping device in place with the fingers of the right hand. Using the crochet hook, slip the near end of the clamping device over the other end of the knife edge. The extensometer will tend to rotate around the specimen, so ensure that the extensometer does not slip from the grasp.

(e) Install the lower clamping spring or rubber band in a similar manner.

(f) If the extensometer is being installed on flat specimens, ensure both knife edges are flat against the specimen. If one is not, the knife edges are not parallel, loosen the screws mounting the upper knife edge and, while gently pressing the extensometer against the specimen, tighten the screws.
(g) To prevent strain measurement errors, support the electrical cable so that the full weight of the cable is removed from the extensometer. Take up most of the slack in the cable and tape it to the load frame column or other fixed object. Leave a loop or some slack in the cable so that the extensometer is free to move without being pulled by the cable. This is especially important when operating the system in strain control, since cable movement and resulting extensometer vibration will cause erratic control.

(h) Gently withdraw the gauge length pin. Once the pin is out, do not move the extensometer on the specimen or the calibrated gauge length will be lost.
3.4 EXTENSOMETER SELECTION

The selection of an extensometer for a particular application will depend primarily on the nature of the material under test. The ductility or brittleness of the materials, and therefore its elasticity, will determine whether an extensometer with a large displacement or a small displacement should be used. Extensometer resolution must also be considered. When tests are conducted over just a small region of the material’s stress-strain curve, for example, extensometers with a low percentage of maximum strain for a given gauge length, will produce a higher output voltage for each increment of total displacement than will a unit with a high percentage of maximum strain. Conversely, highly elastic materials will require relatively large displacements and fine resolution is not a problem. Finally, frequency response in the extensometer may become a factor in certain cyclic testing applications. In general, extensometers with longer gauge lengths exhibit a somewhat higher frequency response, and it is often possible, because of overlapping range specifications for different models to choose an extensometer from a different range, to satisfy frequency response requirements.

Extensometers are rated by gauge length and maximum strain, but are constructed with a total displacement in mind (i.e. a 12.5mm 20% extensometer that has a full scale displacement of ± 2.5mm). These three factors are related by the expression:

\[ \frac{\Delta L}{L} \]

where \( e \) is the specimen strain per unit gauge length, \( \Delta L \) is the specimen elongation or extensometer displacement, and \( L \) is the initial gauge length. This expression is, of course, the standard equation defining specimen strain.

To relate this to the Instron line of extensometers, a typical extensometer calibrated in metric units is illustrated in Table 3.1. The table shows the effects of using the gauge length extenders, which, when used with the Strain Conditioner, combined with the Zero Suppression and Scaling accessory, allows a wide range of use and versatility with a single extensometer.

<table>
<thead>
<tr>
<th>System Range Switch Setting on ZSS Unit</th>
<th>Extensometer Range @ 10mm (L)</th>
<th>Extensometer Range @ 25mm (L) *</th>
<th>Extensometer Range @ 50mm (L) *</th>
<th>Full Scale Displacement (Δ L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 10mm (L)</td>
<td>e</td>
<td>%</td>
<td>e</td>
<td>%</td>
</tr>
<tr>
<td>100%</td>
<td>0.1</td>
<td>10%</td>
<td>0.04</td>
<td>4%</td>
</tr>
<tr>
<td>50%</td>
<td>0.05</td>
<td>5%</td>
<td>0.02</td>
<td>2%</td>
</tr>
<tr>
<td>40%</td>
<td>0.04</td>
<td>4%</td>
<td>0.016</td>
<td>1.6%</td>
</tr>
<tr>
<td>25%</td>
<td>0.025</td>
<td>2.5%</td>
<td>0.01</td>
<td>1%</td>
</tr>
<tr>
<td>20%</td>
<td>0.02</td>
<td>2%</td>
<td>0.008</td>
<td>0.8%</td>
</tr>
<tr>
<td>10%</td>
<td>0.01</td>
<td>1%</td>
<td>0.004</td>
<td>0.4%</td>
</tr>
<tr>
<td>5%</td>
<td>0.005</td>
<td>0.5%</td>
<td>0.002</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

* Note: - Gauge Lengths obtained using gauge length extenders
Figure 4.1 Extensometer Mounted in Calibration Fixture
4.0 CALIBRATION PROCEDURES

This section details the procedures for calibrating the extensometers in accordance with the type of testing instrument and control console in use. In general, calibration is effected by connecting the extensometer into the extensometer socket on the loading frame and accurately setting the strain channel output, observed on a digital readout or recorder display (chart motion or strain pen function of a multi-pen recorder) against a precise, known displacement of the extensometer. To assist in this operation, a High Magnification Extensometer Calibrator (2602-004) is available as an optional item. The calibration fixture, illustrated at Figure 4.1, consists of a large micrometer head, mounted on a stand frame, with two thumbscrew couplings holding various calibrator spindles corresponding to types and sizes of specimens to be tested. It enables the extensometer to be exercised over its mechanical displacement range and permits the accurate adjustment of an extensometer over very small distances for tensile or compressive calibration. The calibrator spindles are either closed up (with backlash eliminated) or spaced apart (to permit the moving spindle to be closed sufficiently to obtain full scale output) at the start of tensile or compressive calibration respectively. The hydraulic supply is not required for calibration purposes, either on dynamic instruments, or on static instruments with Load/Strain control and should be switched off before commencing the calibration procedures.

Mount the calibration fixture in a vertical position on the base platen of the load frame (refer to Figure 4.1 for attitude of mounting), this ensures that the extensometer is fitted in the correct operating attitude and affords maximum accuracy. Select and fit calibrator spindles suitable for the specimen to be tested. For tension calibration, adjust the calibrator to close-up separation between the spindles. For compression sense calibration, spindles should be spaced apart sufficiently for full scale output at full scale displacement.

The calibration fixture, although very accurate, does exhibit a small amount of mechanical backlash which could be of sufficient magnitude to affect calibration accuracy, particularly on the smaller (high resolution) system ranges. When calibrating in tension the initial setting of the calibrator is achieved by rotating the micrometer head clockwise to -0.01 mm below zero (graduation 490 on the dial). For compression calibration the dial must be set to +0.01 mm by rotating anti-clockwise to graduation 010. The extensometer may then be mounted on the fixture.

Note:-

Calibration is ordinarily carried out on the 100% range of the Strain Conditioner in use, and is so described in the following sub-sections, however, if most testing is to be carried out on another range and maximum accuracy is desired, the extensometer may be calibrated on the range in use.

4.1 ZEROING AND CALIBRATION WHEN USING TYPE 2150 CONTROL CONSOLE

This procedure is applicable only when operating with a Strain Conditioner Module 2130-027. It is assumed that the setting-up instructions for the Signal Conditioning Unit and the strain channel have been carried out in accordance with Section 4.0 of Manual 1-7-49-3A.

CAUTION

Before proceeding to calibrate the Dynamic Extensometer and before connecting the extensometer at the loading frame:-
Before proceeding to calibrate the Dynamic Extensometer and before connecting the extensometer at the loading frame:-

Ensure that the control console of the testing instrument is in the 'Start-up' mode and that the Strain Limit module and hydraulics are switched off.

2. The serviceability of the indicator lamps in the ON/OFF pushbuttons on the Limits Module should have been previously checked to ensure that the ON/OFF condition of the Limit Channels, particularly the Strain Limit section, are known.

3. If the extensometer to be used requires an extender to be fitted for the intended test(s), ensure that it is correctly assembled (Refer to Section 3.2) before commencing to calibrate.

4.1.1 To Zero and Calibrate

(a) Ensure the gauge length setting pin is inserted into the extensometer and plug the extensometer into the 25-way socket located at the rear of the loading frame. Ensure the locking latches are secured.

(b) Attach the extensometer using the special rubber bands or clamping springs, first to the upper spindle of the calibrator, then to lower spindle in a similar manner to that described in the mounting procedure at Section 3.3.

Ensure that the rubber bands or springs exert sufficient clamping force to prevent slippage, that the knife-edges on the extensometer (and extender when used) are parallel and that, by careful use of the magnetic mounting cleat, the extensometer cable is supported such that no cable strain is exerted on the extensometer.

(c) Check that the extensometer calibrator is still set to -0.01mm below zero for tension calibration or +0.01mm above zero for compression calibration.

REMOVE THE GAUGE LENGTH SETTING PIN

(d) Rotate the micrometer head of the calibrator to adjust the dial to 0.00mm exactly, thus taking up any backlash.

Do not overshoot when making this adjustment. If the set point is passed, however slightly, the micrometer dial must be rotated backwards beyond the set point and then advanced again to the correct setting.

(e) At the signal monitor channel, select the strain signal and monitor using the digital panel meter on the console meter channel. Note that peak monitor and zero suppression units, if fitted, must be switched off. The range switch on the strain conditioner channel should be at Maximum range (100%). SW1 on 2602-009 Amplifier p.c.b. at 'Dynamic'. Using the strain conditioner Balance controls, adjust for zero output, i.e. DPM reading 0.000 ±1 digit (if no meter channel is fitted, connect a DVM of suitable accuracy to the coaxial socket of an external 'Monitor' module).

Note:-

If recalibrating because of changing a transducer, carry out phase balance adjustment at this stage.
Note:- (Continued)

On the Universal Transducer Amplifier Board A1034-642 (Cat. No. 2602-009) locate TP3 (to the right of VR1 CAL) and connect to an oscilloscope set at 200mV/cm. Adjust the coarse and fine balance controls in conjunction with the PHASE trimmer (VR2 located nearest front panel) to give an optimum null on the oscilloscope trace at 0.000 ± 1 digit meter reading. Remove the oscilloscope lead from TP3.

(f) Rotate the micrometer head to give the rated strain for the extensometer in use (e.g. 2620-601 requires 2.5mm of movement for full scale output). To avoid backlash errors, carefully wind the calibrator to the maximum displacement point. Do not overshoot, then wind back.

(g) Select Oscilloscope trace to read strain channel signal. Adjust CAL trimmer (VR1) on the transducer amplifier p.c.b. to give a DVM reading of 10V ± 10mV. Check again that the noise level on the oscilloscope trace does not exceed 20mV peak to peak.

(h) Rotate the micrometer head to read 0.01mm above or the minimum displacement setting below, wind back to exactly zero (0.00), to overcome backlash, and check that strain signal on DPM reads 0.000, if not adjust Fine Balance.

It may be necessary to repeat steps (d) to (g) to ensure an accurate calibration.

Note that for a tension calibration, full scale DVM reading should be +10V ± 10mV and for compression -10V ±10mV.

4.2 ZEROING AND CALIBRATION WHEN USING THE TYPE 2160 (MINI-CONTROLLER) CONTROL CONSOLE (Floor-mounted or Desk-top version)

The test equipment recommended for calibration purposes includes:

(a) Test Standard Digital Voltmeter ±10V d.c. Resolution ±1mV

(b) Dual-trace Oscilloscope -  
   d.c. range = d.c. to 10MHz  
   a.c. range = 10MHz
   Sensitivity = 10mV per cm  
   Bandwidth = d.c. to 10MHz

(c) Extensometer Calibration Fixture, the use of the Instron High Magnification Calibrator Cat. No. 2602-004 is recommended.

This procedure is applicable only when operating with a Strain Controller Module Cat. No. 2130-029 and it is assumed that the Position Controller Module Cat. No. 2130-028 has been set up and the LVDT transducer in the hydraulic actuator zeroed and calibrated before commencing to zero and calibrate the Strain Channel. This is because the servo-amplifier in the Position Controller forms part of the strain servo loop.
Before proceeding to calibrate the Dynamic Extensometer and before connecting the extensometer at the loading frame:-

1. Ensure that the control console of the instrument is not in Strain Control and that the system hydraulic supply, which is not required when calibrating the extensometers, is switched off.

2. The serviceability of the Limit L.E.D.s should have been previously checked, particularly the Max. Limit and Min. Limit L.E.D.s, to ensure that they are lit when the relevant limit settings are reached.

3. To prevent the transfer to Strain Control whilst calibrating the extensometers, which could result in the system being in open-loop conditions, switch the ‘CONTROL’ switch (Strain Controller top panel) to ‘Inhibit’.

4. If the extensometer to be used requires an extender to be fitted for the intended test, ensure that it is correctly assembled. (Refer to Section 3.2) before commencing to calibrate

4.2.1. To Zero and Calibrate

(a) Ensure the gauge length setting pin is inserted into the extensometer and plug the extensometer into the 25-way socket located at the rear of the loading frame. Ensure the locking latches are secured.

(b) Attach the extensometer using the special rubber bands or clamping springs, first to the upper spindle of the calibrator, then to the lower spindle in a manner similar to that described in the mounting procedure at Section 3.3.

Ensure that the rubber bands or springs exert sufficient clamping force to prevent slippage, that the knife-edges on the extensometer (and extender when used) are parallel, and that, by careful use of the magnetic mounting cleat, the extensometer cable is supported such that no cable strain is exerted on the extensometer.

(c) Check that the extensometer calibrator is still set to -0.01mm below zero for tension calibration or +0.01mm above zero for compression calibration.

**REMOVE THE GAUGE LENGTH SETTING PIN**

(d) Rotate the micrometer head of the calibrator to adjust the dial to 0.00mm exactly, thus taking up any backlash. Do not overshoot when making this adjustment.

If the set point is passed, however slightly, the micrometer dial must be rotated backward beyond the set point and then advanced again to the correct setting.
NOTES:

1. The use of the Test Standard DVM enables greater accuracy to be obtained when calibrating the extensometers. The DVM is connected in parallel across the input terminals of the console panel meter (DPM).

2. On the Desk-top version of the Type 2160 Control Console, this may be achieved by connecting the DVM to the coaxial socket SK1 on the Selector Unit and positioning the SK1 rotary selector to 'Strain' and the associated toggle switch to 'Input' or 'Output' respectively as required by the calibration procedure. If required, the DVM rotary and toggle switches may be positioned in correspondence with the SK1 switch so that the Console DPM also reads the parameter being measured.

This method of DVM connection has the advantages of operator safety and convenience in that no electrical hazard is experienced and the console is not switched off when connecting the DVM with consequent warm-up delays.

3. (i) If, when using the Type 2160 floor-mounted control console, an External Monitor Selector Unit (optional one-ninth module) is fitted, the DVM may be connected to the coaxial socket of the External Monitor. To ensure that the DVM is connected in parallel and reads in correspondence with the Console DPM, it is then only necessary to ensure that the thumbwheel selector on the External Monitor, Data Channel Select button on the General Services Module (below Console DPM) and the relevant Strain pushbutton on the Signal Monitor Selector Unit are switched to coincide:-

   e.g. External Monitor thumbwheel switch - - 1
        Data Channel Select button - - 1
        Signal Monitor Selector - Strain 1 (blue, 3rd from RH)

and that the 'Input'/'Output' position of the Signal Monitor Selector toggle switch is selected in accordance with the requirements of the calibration procedure.

(ii) If no External Monitor Selector module is fitted on the floor-mounted control console, then the DVM must be connected directly across the Console DPM Input terminals.

[CAUTION]

The Console DPM is connected to the mains supply at 220/240 Volts (Brown and Blue wires to meter terminals 15 and S) and care must be exercised when connections are made in parallel with the DPM input terminals:-

   Signal Input (Hi)        A (GN)
   Signal Input (Lo)        10 (3K)

4. *Before proceeding further with calibration, ensure that:

   On Desk-top version - Peak Detector Selector is set to 'Off'
   On Floor-mounted version - Peak Monitor and Zero Suppression Units (if fitted) are set to 'Off'.

   *
(e) Connect the test standard DVM across the console DPM input terminals (in accordance with the notes on page 4.5 for the relevant console).

(f) Monitor 'Strain' output signal and adjust the strain controller 'Balance' control for a DVM reading of 0V ± 1mV.

(g) Set the Strain Controller 'Balance' control to mid-scale (i.e. approximately five turns from the end stop). Monitor on TP14 (controller top panel) using the oscilloscope and adjust VR12 (Phase) and VR13 (Bal) for the best a.c. null. Then adjust VR9 to remove any d.c. offset.

(h) Rotate the micrometer head on the calibrator, from the zero reference, in either a clockwise or counter-clockwise direction to displace the extensometer a sufficient amount to give a DVM reading greater than ±3.0V. Adjust VR10 (Demod) for a maximum DVM reading.

(i) Rotate the micrometer head to zero the calibrator (do not overshoot then wind back) and reset the 'Balance' control for a DVM reading of 0V ± 1mV.

(j) For a tension calibration, now rotate the micrometer head counter-clockwise from the calibrator zero up to the maximum (full scale) displacement of the extensometer in use, e.g. with a 2620-602 Dynamic Extensometer having a gauge length of 12.5mm ± 20% strain, rotate the vernier to read exactly 2.5mm (Again do not overshoot then wind back).

(k) Adjust VR11 (Cal f) to achieve a DVM reading of +10.000V ± 1mV. If range with VR11 is inadequate, adjust the range switch (Cal C) to a higher number to increase output.

If the Cal C switch position is changed, monitor the d.c. offset on TP14 (use the oscilloscope at 10mV/cm d.c.) and, if necessary, adjust VR9 (offset) to null any offset present.

(l) For a compression calibration the procedure is similar, but the vernier dial must be rotated clockwise to the full scale position and the full scale readout should be -10.000V ± 1mV.

All the trimming potentiometers mentioned in the calibration procedure, together with the test point TP14 and the range switch (Cal C), are to be found on the top panel of the Strain Controller.

4.3 ZEROING AND CALIBRATION WHEN USING THE INSTRON STRAIN DATA UNIT ON INSTRON STATIC INSTRUMENTS

This procedure is applicable only when operating with the Instron Static Testing Instruments fitted with an Instron Strain Data Unit and, where Strain Control is also required, fitted with one of the 2130 Series Load/Strain Control Systems.

It is necessary to ensure that the chart or pen response of the Instron chart recorder is an exact ratio of chart or pen movement to extensometer displacement.

Calibration is effected by connecting the extensometer cable at the rear of the L.H. column on Model 1121/1122 Frames and to the extensometer panel adaptor (A1070-9) for Model 1190 testing instruments. To assist in the accurate calibration of the extensometer, the use of the Instron High Magnification Calibrator Cat. No. 2130-004 is recommended.
Before proceeding to calibrate the Dynamic Extensometer at the Loading Frame:

1. If the extensometer to be used requires an extender to be fitted for the intended test, ensure that it is correctly assembled on the extensometer before commencing to calibrate (Refer to Section 3.2).

2. If the Strain Data Unit used contains an LVDT/Strain Gauge Switch, ensure that the switch is set to 'Strain Gauge'.

3. Ensure that the testing system hydraulics (if supplied) and the testing instrument amplidyne are switched off.

4.3.1 To Zero and Calibrate (Refer also to Manual 1-7-80-5A)

(a) Ensure that the gauge length pin is inserted into the extensometer and plug the extensometer into the 25-way socket on the tester (SK48 on Model 1121 or 1122 Table Model, Extensometer Panel and Cable Assembly A1070-9 on Model 1190). Ensure that locking latches, when fitted, are secured.

(b) Attach the extensometer using the special rubber bands or clamping springs, first to the upper spindle of the calibrator, then to the lower spindle in a similar manner to that described at Section 3.3.

Ensure that the rubber bands or springs exert sufficient clamping force to prevent slippage, that the knife-edges on the extensometer (and extender when used) are parallel and that, by careful use of the magnetic mounting cleat, the extensometer cable is supported such that no cable strain is exerted on the extensometer.

(c) Check that the micrometer head of the calibrator is still set to -0.01mm below zero for tension calibration (graduation 490) or +0.01mm above zero for compression calibration (graduation 010).

REPLACE THE GAUGE LENGTH SETTING PIN

(d) Rotate the micrometer head of the calibrator to adjust the dial to 0.00mm exactly, thus taking up any backlash.

Do not overshoot when making this adjustment. If the set point is passed, however slightly, the micrometer dial must be rotated backwards beyond the setpoint and then advanced again to the correct setting.

Note:- Calibration is normally carried out on the 10% range (position 1) of the Strain Data Unit and is so described in the following procedure. However, if most testing is to be carried out on another Strain range setting, and maximum accuracy is desired, the extensometer may be calibrated on the range in use.

(e) On the Strain Data Unit set the A - B polarity switch for forward movement of the chart paper or the required direction of strain pen travel.

For tension calibration - switch position ‘A’
compression calibration - switch position ‘B’

(f) Set the DEMOD ZERO switch to ON, the red indicator lamp on the front panel will be extinguished.
(g) When setting up for chart servo drive, depress the SERVO and CLUTCH pushbuttons on the Recorder control panel, unlock the DEMOD ZERO potentiometer on the Strain Data Unit, and if the chart servo system is unbalanced beyond the control limit, rotate the DEMOD ZERO potentiometer until control of chart movement is obtained.

(h) Rotate the DEMOD ZERO control counter-clockwise until the chart goes dead. Note this chart position and then turn the DEMOD ZERO control clockwise to move the chart 2mm (one square on the chart).

Lock the DEMOD ZERO control at this point.

(i) Release the CLUTCH pushbutton on the Recorder control panel and use the knurled disc provided for chart ‘Manual’ adjustment, to set the chart paper to a suitable graduation for zero position (Cursor lined up on a 5cm division line).

(j) Mark the chart to indicate this zero, then mark off in 50mm stages on the chart to the full scale chart displacement of 500mm. Mark both zero and 500mm graduation points very clearly.

Return the chart to the zero graduation mark by the ‘manual’ control disc and depress the ‘CLUTCH’ pushbutton.

(k) Turn the DEMOD ZERO switch to OFF. Set the range selector to 10 and allow the chart drive to balance against the extensometer.

(l) Adjust the COARSE and FINE BALANCE controls to reposition the chart at zero. Successively move the Range Selector through the more sensitive ranges (to Position 5, 2 then 1) and readjust the BALANCE controls for an accurate chart zero at each range position.

(m) Rotate the micrometer dial of the calibration fixture by an amount corresponding to 500mm of chart movement in accordance with the type of extensometer in use and magnification expected.

(n) If the chart does not move exactly 500mm, adjust the CALIBRATION control on the Strain Data Unit until correct chart displacement is obtained.

(o) Rotate the Calibration Fixture back to gauge length (zero extensometer displacement) and check that the chart returns to the zero reference mark.

If this zero position is not obtained, rebalance, using the FINE BALANCE control and repeat steps ‘m’, ‘n’ and ‘o’ to set maximum accuracy.

(p) Switch OFF the CLUTCH and SERVO pushbuttons

Chart Servo Calibration is now completed.

(q) If the extensometer is being calibrated for Strain Pen recording, the Zero, Balance and Calibration procedure is carried out using the Strain Pen pushbutton (usually Pen 2) on the Recorder to energise the pen motor and then zeroing and balancing at the zero chart graduation and calibrating for a pen movement to exactly full scale on the chart.
5.0 MAINTENANCE

5.1 ROUTINE MAINTENANCE

Routine maintenance is limited to keeping the extensometer clean and the moving parts free. No lubrication is required. All hydraulic fluid, dust, and other foreign matter should be kept off all parts, particularly under the cover. Commercial solvents, such as Chlorothene N.U. and Methyl Ethyl Ketone may be used sparingly with a soft brush or soft, lint-free cloth, but do not fully immerse the extensometer in solvent. Low pressure compressed air may be used cautiously for cleaning and drying, but do not direct the air stream directly into the cover.

Dullness and small nicks in the knife edges may be dressed using a fine whetstone, carefully preserving the edge bevel. When done on a powered wheel, cooling lubricant must be supplied to the sharpened edge to prevent heating and annealing.

5.2 REPLACEMENT PARTS

Since positioning and bonding of the strain gauges within the extensometer is extremely critical to the unit’s electrical characteristics, disassembly of the extensometer, and hence field repairs are impossible. All defective or damaged units must be returned to Instron Limited for repair or replacement. Damaged or lost accessories can be replaced, using the following list by contacting the nearest Instron Sales Office. The catalogue number of the extensometer must be specified, along with the part number and item description when ordering parts.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part No.</th>
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<tbody>
<tr>
<td>1</td>
<td>Gauge Length Pin</td>
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</tr>
<tr>
<td>2</td>
<td>Crochet Hook 1.25mm</td>
<td>80-9-5</td>
</tr>
<tr>
<td>3</td>
<td>M3 Allen Wrench 2.5mm</td>
<td>80-1-236</td>
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<td>4</td>
<td>Knife Edge</td>
<td>T1351-1007</td>
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<td>5</td>
<td>Gauge Length Extension, 12.5mm</td>
<td>T1351-1019</td>
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<tr>
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<td>Gauge Length Extension, 15mm</td>
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<td>Gauge Length Extension, 37.5mm</td>
<td>T1351-1017</td>
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<td>Gauge Length Extension, 40mm</td>
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<td>Tension Spring, 1-3/4 in. long</td>
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<td>Rubber Bands (packet of 50)</td>
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