Manual No. M10-1125-1 (C)

Instron
Universal Testing Instrument

Model 1125

Operating Instructions

INSTRON

Materials testing systems are potentially dangerous, therefore observance of the following safety precautions and awareness of the possible dangers involved is essential.

OPERATOR SAFETY

Carefully read installation instructions and operating manuals; observe all WARNINGS and CAUTIONS.

Ensure that the test set-up to be followed, and the actual test to be performed does not present a hazard to personnel. Common sense and good judgment are the best safety precautions.

GENERAL SAFETY

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

1. 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.

2. 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 pressurized vessels, and explosive disintegration.

3. SUPPLY VOLTAGES EXCEEDING 50V

Instron designs do not permit operators to be exposed to voltages exceeding 50V 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.

4. ROTATING MACHINERY

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

5. 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 (165°F). It should be noted that the hazard from high temperature can extend beyond the immediate area of the test.

6. HIGH PRESSURE COMPRESSED GAS

High pressure compressed gas is potentially dangerous. Operation instructions must be strictly adhered to. No gas connection should be released unless the gas supply has been disconnected, and the system pressure and any stored pressure, such as in hydraulic accumulators, have been reduced to zero.

7. 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.

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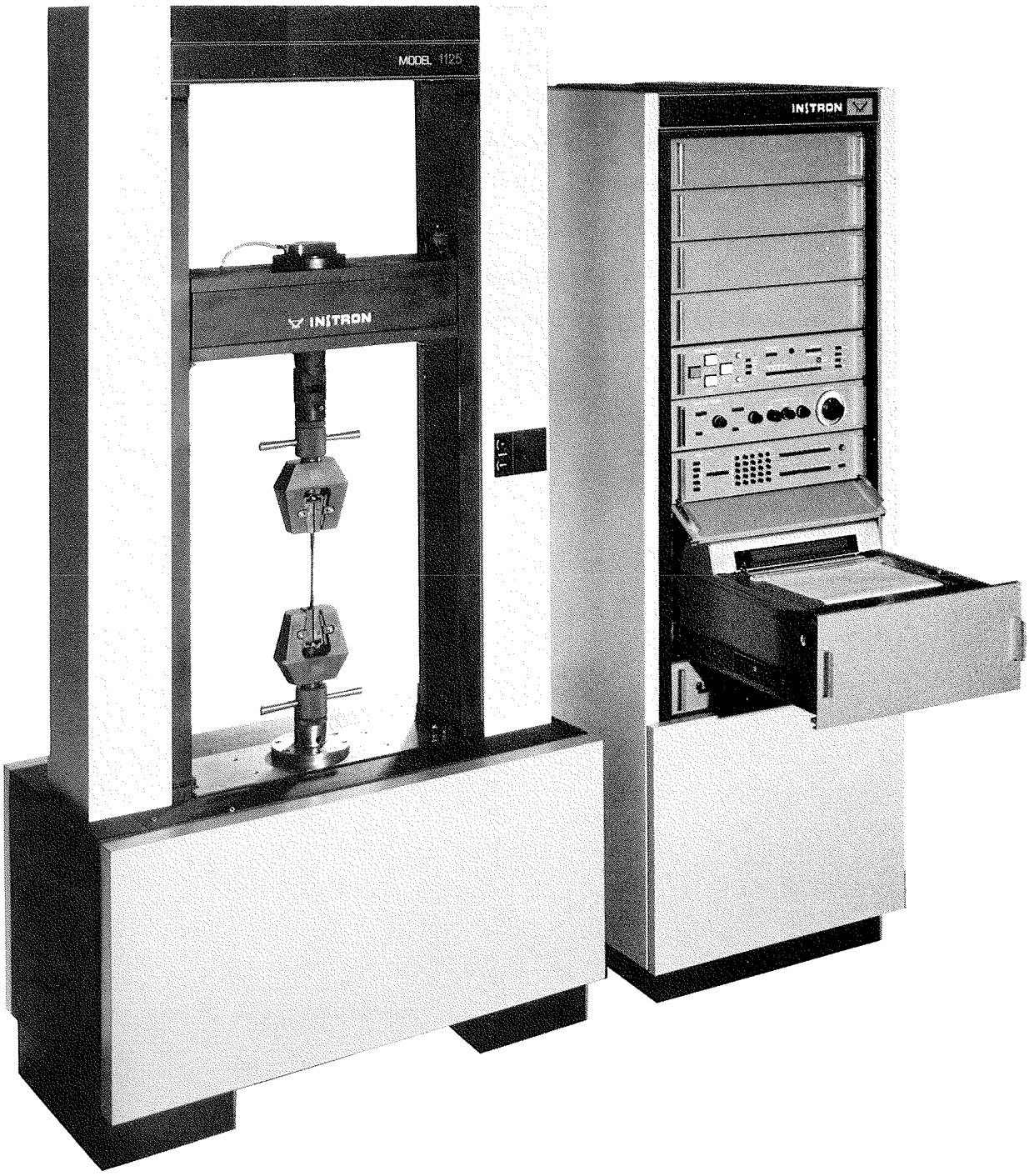


Figure 1-1. Instron Model 1125 Universal Testing Instrument

Universal Testing Instrument

Model 1125

INSTRON

1.0 INTRODUCTION

Instron universal testing instruments are highly reliable precision systems for evaluating the mechanical properties of materials. The advantages of these systems, as accurate and versatile tools, make them equally adaptable to research and development requirements as to the repetitive testing applications of production quality control.

Each instrument includes a loading frame and control console as separate basic assemblies. This configuration, along with portability, allows the instrument to be adapted to differing space allocations. The modular design of the control electronics enables an instrument to be matched to particular test requirements through the addition of modular accessories. These electronic control and readout accessories are readily available and may be specified initially with the instrument or added later to extend its capabilities. A complete range of environmental chambers, rheometers, and other auxiliary equipment can also be added to the system to meet testing program requirements.

This manual contains the basic instrument operating instructions, detailed component and control descriptions, and a summary of operating principles. Section 7 includes information on the accessories that are available for use with the instrument.

Other manuals provide full maintenance instructions for the system and basic components, and complete details on accessories.

For detailed information about Instron's complete line of testing equipment, for consultation on test programs, or for the answers to questions on the operation or maintenance of the equipment, contact your local Instron Regional Sales and Service center which is listed on the back cover of this manual.

2.0 SPECIFICATIONS

TESTING MODES

Tension, compression and reverse stress testing above or below moving crosshead. Torsion testing between base and crosshead with optional fixture.

TENSION LOAD RANGES

10 gm (0.1N) to 20,000 lb (10,000 kg, 100 kN) through the use of interchangeable load cells (and from 1.0 gm on high sensitivity).

COMPRESSION LOAD RANGES

100 gm (1.0N) to 20,000 lb (10,000 kg, 100 kN) through the use of interchangeable load cells, (and from 10 gm on high sensitivity).

TORSION LOAD RANGES

$\pm$2,000 lb-in. ($\pm$2,000 kg-cm, $\pm$20 kN-cm) capacity with clockwise/counterclockwise capability.

LOAD WEIGHING ACCURACY

$\pm$0.5% of indicated load or $\pm$0.25% of load range in use whichever is greater, on standard load ranges. When using Instron series 2511 load cells, this accuracy specification applies for ranges from full cell capacity to 1/50th of cell capacity.

CROSSHEAD SPEED RANGE

0.002 to 20 in/min (0.05 to 500 mm/min). Range extended to 40 in/min (1000 mm/min) with high speed option.

CROSSHEAD SPEED SELECTION

13 standard speeds pushbutton selectable. 14th speed selectable at any speed in overall range.

CROSSHEAD RETURN SPEED

20 in/min (500 mm/min) or at testing speed. 40 in/min (1000 mm/min) with high speed option.

CROSSHEAD TRAVEL

36 in. (914 mm) - 47 in. (1,194 mm) and 56 in. (1,422 mm) available optionally.

CROSSHEAD GUIDANCE

Independent crosshead guidance restricts horizontal crosshead motion to 0.001 inches in any 1.0 inch of crosshead travel and 0.010 inches throughout the full travel.

RATED LOAD/SPEED CAPABILITY

20,000 lb (10,000 kg, 100 kN) at speeds up to 2.0 in/min (50 mm/min).

5,000 lb (2,500 kg, 25 kN) at speeds up to 20 in/min (500 mm/min).

2,000 lb (1,000 kg, 10 kN) with high speed option.

SPEED ACCURACY

$\pm$0.1% of set speed at all loads and speeds. [averaged over 4 in. (100 mm) of travel].

HORIZONTAL CLEARANCE BETWEEN FRAME COLUMNS

22 in. (559 mm) - 30 in. (762 mm) available optionally.

FRAME STIFFNESS

1 x 10^6 lb/in (with crosshead 12 in. above base).

RECORDER SYSTEMS

10 in. (250 mm) strip chart recorder.

PEN RESPONSE

0.5 sec from 5-95% of full range.

CHART SPEEDS

Standard - 1, 2, 5, 10, 20, 50 in/min (20, 50, 100, 200, 500, 1000 mm/min).

Optional - 0.1 - 100 in/min (1-1,000 mm/min) 10 speeds pushbutton selectable and 10 speeds proportional to crosshead motion.

CHART SERVO RESPONSE

0.5 sec from 5-95% full range. (Chart servo is optional).

POWER REQUIREMENTS

2.2 kw maximum

VOLTAGE

Standard - 120 VAC (110-130) single phase. Optional (requires external transformer as an accessory) - 100, 230, or 440 VAC, single phase.

POWER FREQUENCY

50 or 60 Hz

DIMENSIONS

Console -

Width	24-3/4 in. (629 mm)
Depth	26-1/4 in. (667 mm)
Height	71-1/4 in. (1,810 mm)

Loading Frame -

Width	40-1/4 in. (1,022 mm)
Depth	21-1/2 in. (546 mm)
Height	78-1/4 in. (1,988 mm)

WEIGHT

Console - 405 lbs (184 kg)
Loading Frame - 1,600 lbs (726 kg)

3.0 DESCRIPTION OF SYSTEM OPERATION

3.1 GENERAL CHARACTERISTICS

The Instron universal testing instrument incorporates a highly sensitive electronic load weighing system with load cells that use strain gages for detecting tensile or compressive loads. Figure 3-1 is a functional block diagram of the instrument.

A specimen is physically attached to the load cell by grips for tension testing and reverse stress testing, or it is table-mounted for compression testing. Tensile or compressive forces are applied by a moving crosshead operated by two vertical lead screws.

Digitally commanded crosshead speeds, derived from frequency dividing a master oscillator signal, are pushbutton-selectable. Positional control of the crosshead is provided by an analog error signal developed from resolver feedback in a closed loop system. Direction and sequence of crosshead movement may be manually or automatically controlled.

The load weighing system includes a solid-state load cell signal conditioning amplifier, providing a wide selection of full scale load ranges with each load cell. The amplifier controls provide for adjustment and calibration of the load weighing system to give accurate and reliable test data. The output of the load cell amplifier is in a signal form suitable for controlling the pen servo system of the recorder.

Test results are presented on a strip chart recorder. The recorder pen provides a trace describing specimen loading, while the chart movement is indicative of lapsed time at a pushbutton-selectable speed. Automatic chart speed control, in conjunction with crosshead motion, is available as an option.

A number of optional accessories (reference section 7) may be added on a modular basis to increase the versatility of the instrument.

3.2 LOAD WEIGHING SYSTEM

A number of load cells are available to use in the load weighing system of this instrument. These load cells, easily interchangeable, provide a range of full scale sensitivities from 0-10 grams (0.1N) in tension (0-100 grams in compression) up to 0-20,000 pounds (10,000 kg, 100 kN). Tension and reversible tension-compression load cells may be mounted on the fixed or the moving crosshead. Specimen grips are attached to the load cell spindle by a bayonet-type universal coupling. Exceptions to this are the lowest range cell with which a simple hook-on grip is used, and the highest range tension-compression cells (20,000 lb, 10,000 kg, and 100 kN) that use a universal coupling threaded to the spindle.

When compression cells or combination tension-compression cells (in compression mode) are used, they are normally located on the base of the testing frame beneath the moving crosshead. Specimens to be tested in compression are placed between a compression anvil mounted under the moving crosshead and a compression table on the load cell spindle. The compression table may be either rigidly fixed or self-aligning on a spherical seat.

As an alternative testing method, the load cell may be mounted beneath or in the moving crosshead with the anvil fastened to the base of the loading frame.

Figure 3-2 shows the load weighing system in block diagram form. Strain gages, arranged in a bridge circuit in the load cell, are excited

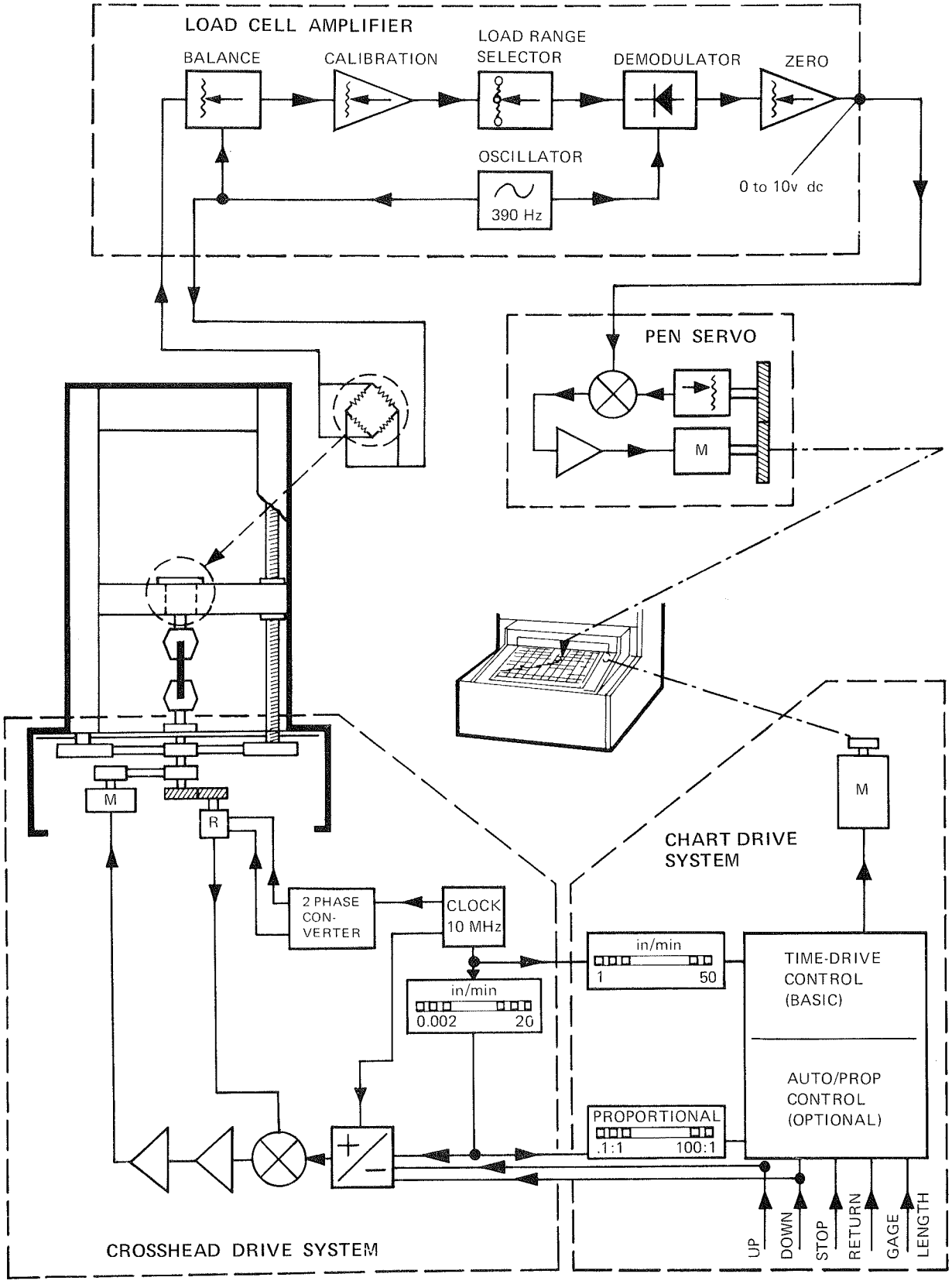


Figure 3-1. Block Diagram of Model 1125 Testing System

by a stabilized oscillator. An applied load in the cell causes a proportional change in the resistance of the strain gages and an unbalance in the bridge. The resulting signal is fed to a load cell amplifier where it is amplified, and demodulated. The dc output voltage is then applied as an error signal to the pen servo system of the strip chart recorder. The load cell amplifier also includes controls for balancing the load cell strain gages to compensate for differing weights of grips, fixtures and specimens.

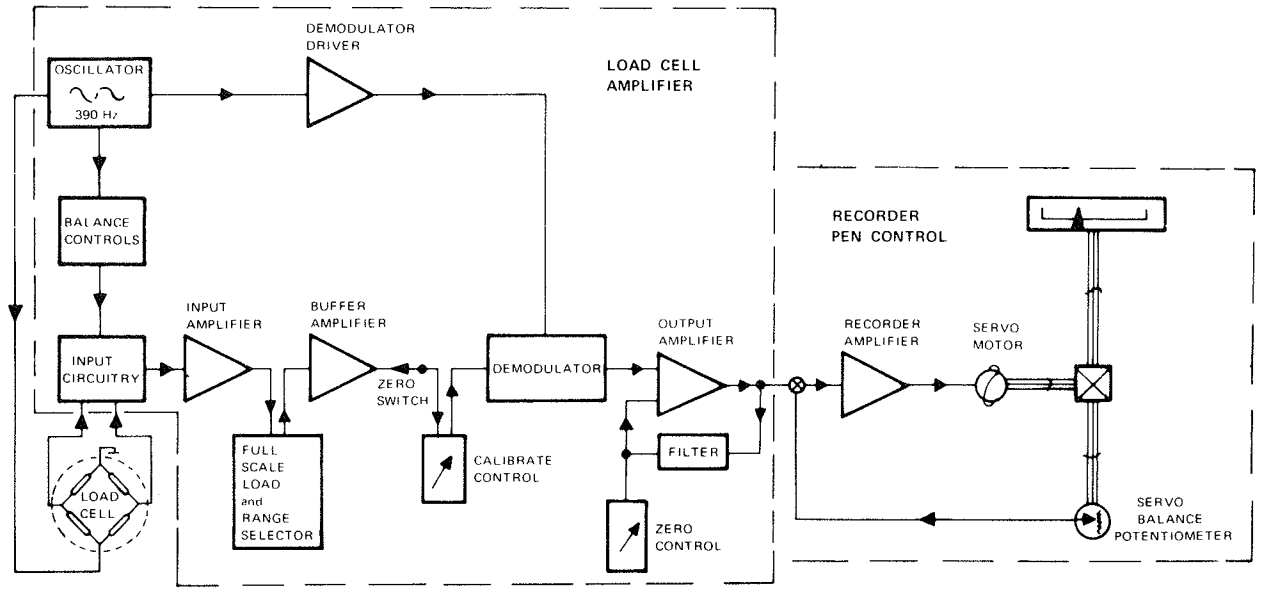


Figure 3-2. Block Diagram of Load Weighing System

The load weighing system is quickly and accurately calibrated with a signal obtained by one of two methods, depending on the load cell type used:

a. By hanging precision weights directly from a mechanically calibrated load cell.

b. By a precise calibration signal from the load cell amplifier when using an electrically calibrated load cell.

The calibration is not affected by any change in the sensitivity control (FULL SCALE LOAD) on the load cell amplifier panel. Normally the procedure is performed only once for any one load cell. Recalibration is necessary only if the instrument is shut down or the load cell is changed. As a minimum, the calibration should be checked once a day.

The load weighing system, aside from the recorder, exhibits no mechanical inertia, thus it does not influence the properties of the specimen to be measured. The accuracy of the overall load weighing system is independent of the range in use and is better than 0.5% of indicated load or 0.25% of recorder scale, whichever is the greater. Even higher readout accuracies can be achieved with the use of a digital voltmeter. The speed of response is limited mainly by the pen speed of the recorder, since the load cells have a very high frequency response.

Load cells exhibit very little deflection under an applied load, therefore the motion

of the crosshead alone may be used in most cases to determine specimen extension except for stiff metallic specimens.

3.3 CROSSHEAD DRIVE SYSTEM

The moving crosshead is operated by two vertical leadscrews that are driven by a d.c. motor through a clutch-controlled gearbox. A two-phase reference resolver is geared directly from the motor shaft. The angular position of the resolver shaft is compared electronically with a command signal, and any resulting error signal is amplified to drive the d.c. motor. The motor turns the resolver shaft in a direction that will reduce the positional error, and drives the leadscrews to move the crosshead at a preset speed.

A simplified block diagram of the crosshead drive control system is shown in figure 3-3. All the crosshead control electronics, except the power amplifier for the drive motor, is contained in the crosshead control unit located in the control console. Mounted on the panel of this unit are the pushbutton switches for preset speed, automatic cycling. and manual control of the crosshead.

Crosshead travel limits are manually set. Upper and lower adjustable limit stops are mounted on a vertical limit switch rod in back of the left-hand column of the loading frame. Two microswitches, when actuated by a bracket on the limit switch rod, energize the upper and lower limit functions in the crosshead control logic circuitry. Two additional microswitches, actuated by the same bracket, remove the crosshead drive motor power if either of the other limit switches fail or the control logic is inoperative.

3.4 RECORDING SYSTEM

The 10-inch (250 mm) strip chart recorder was specifically designed for use in material testing systems. The chart drive of the basic unit is a time-drive system with a 6-speed reversible stepper motor. Chart direction and speed are pushbutton selectable.

An optional chart drive unit is available that allows the chart to be automatically controlled in relation to crosshead commands. Manual or automatic control of the chart speed and direction is selectable at any of 10 ratios proportional to crosshead speed, or at any of 10 time-drive speeds.

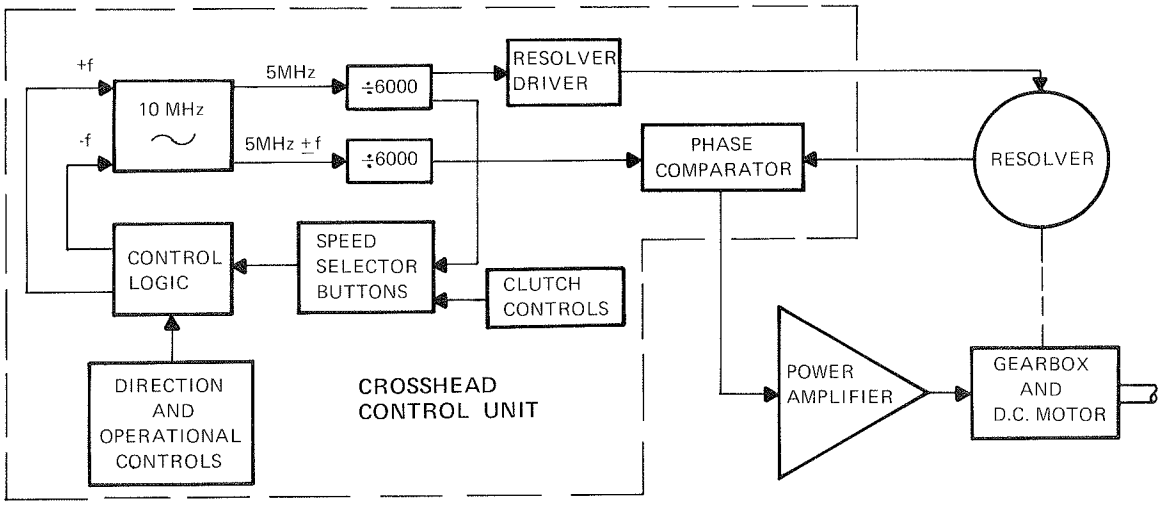


Figure 3-3. Block Diagram of Crosshead Drive Control System

The recorder is of modular construction. The basic single pen unit can be expanded at any time to a two or three pen configuration allowing simultaneous multifunction recording. The pen is an easily replaceable ball-point cartridge type mounted on ball bearings in a slotted carriageway. The pen drive system consists of a high performance servo with a null-balancing slide wire potentiometer feedback control.

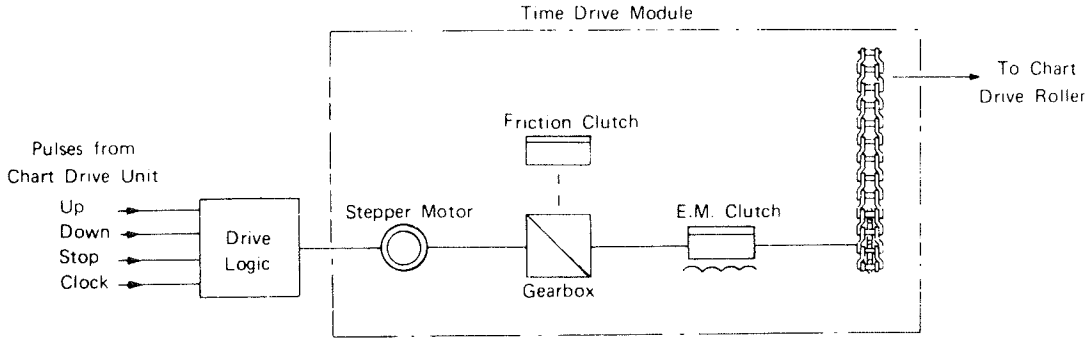


Figure 3-4. Block Diagram of Chart Time Drive System

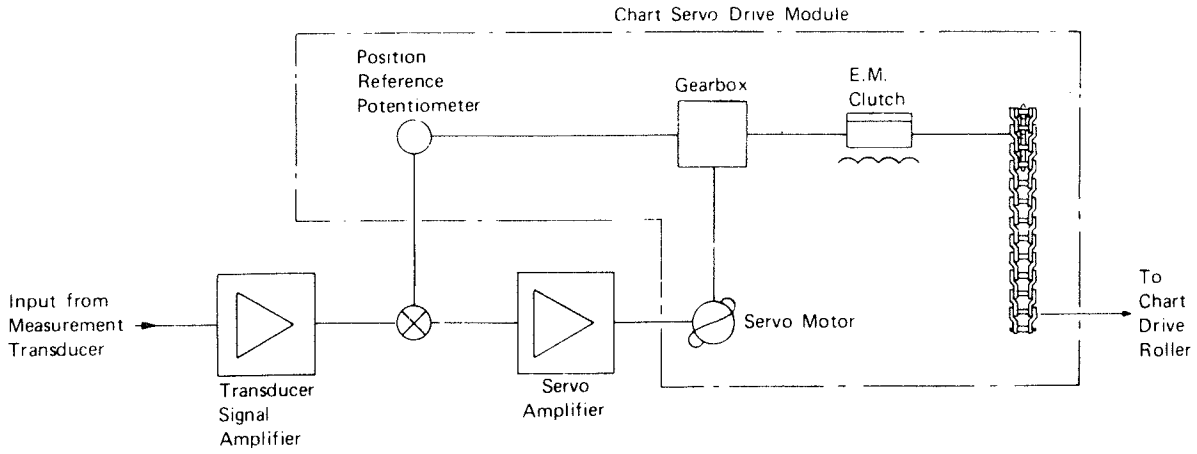


Figure 3-5. Block Diagram of Chart Servo Drive System

4.0 DESCRIPTION OF COMPONENTS AND CONTROLS

4.1 GENERAL

This section describes the function and shows the location of all components and operational controls on the 1125 instrument. Figure 4-1 is an instructional view for reference in locating various components and controls on and within the instrument.

All electrical interconnections from loading frame to control console, except d.c. motor power cable and load cell cable, are accomplished by a single 10-foot multiconductor cable. This cable terminates in 90-pin connectors that bolt securely to the outlet panel of the console and the connector box of the loading frame.

4.2 MAIN POWER

Main electrical power for the 1125 instrument is connected to the outlet panel at the rear of the console. The receptacle is a 20-ampere rated type connector for 110-130 volts, single phase, 50/60 Hz. A 10-foot power cord for this voltage is supplied with the instrument. Other main power voltage options (220/240 volts or 440 volts, single phase) require an external transformer, available as an accessory.

The main power switch is a 20-ampere rated circuit breaker mounted on the front of the console below the recorder. Actuation of this switch controls electrical power to both units of the instrument. An auxiliary receptacle, for 120 volts, 50/60 Hz, is mounted on the console outlet panel. This convenience outlet is not controlled by the main power circuit breaker.

4.3 POWER SUPPLIES

4.3.1 Console Power Supply

The main power supply for the 1125 instrument is located in the console. This unit furnishes all the fixed voltage levels, regulated and unregulated, for the system, except the 28 VDC required for the drive motor relay and gearbox clutches in the loading frame.

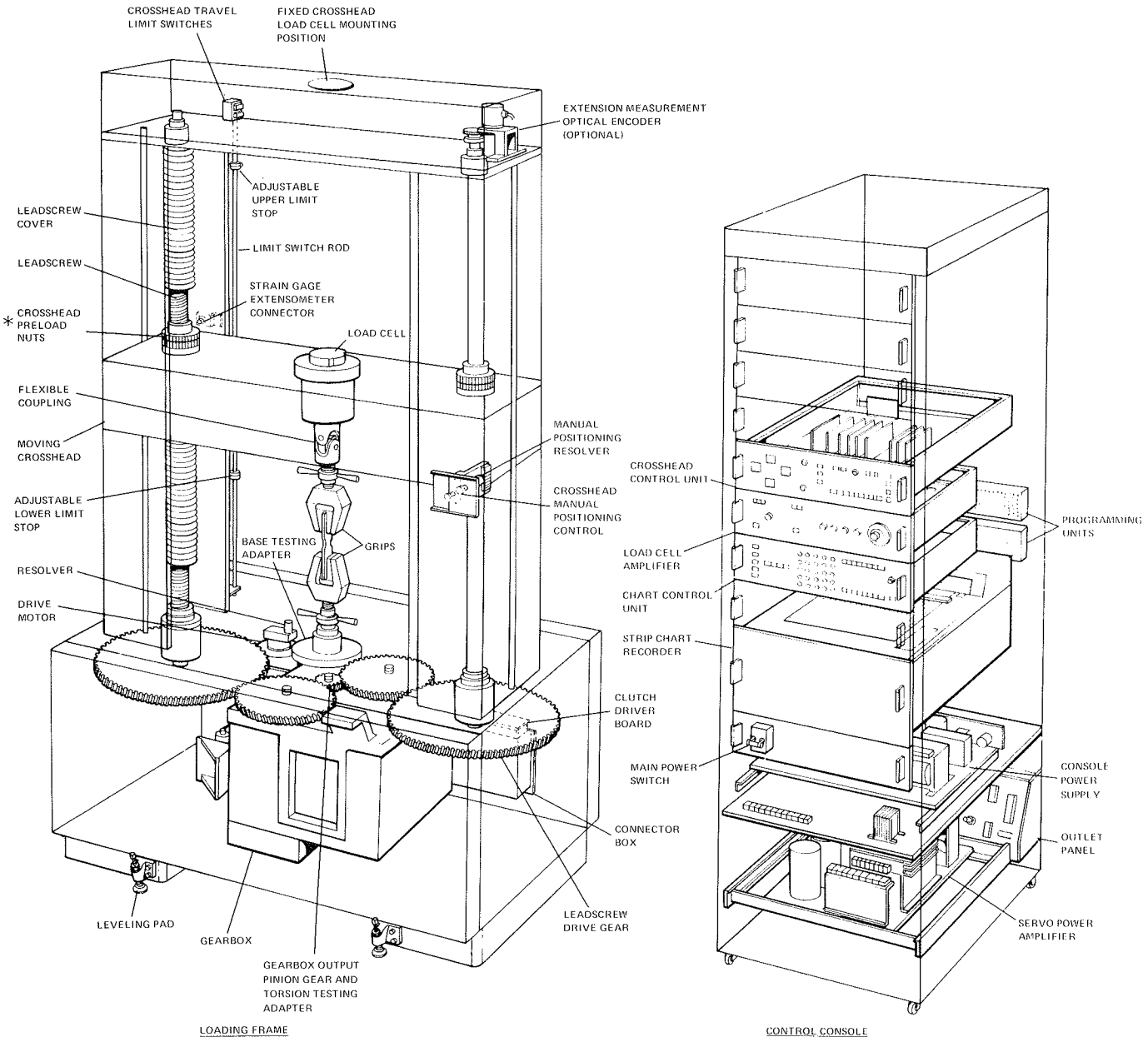
Access to this supply is gained by opening the rear door of the console; it is shelf-mounted above the outlet panel. Fuses for the unit are located on its rear panel, and are marked in accordance with their respective current ratings and associated voltage levels. The a.c. input to this supply is controlled by the main power circuit breaker.

4.3.2 Motor Relay/Clutch Power Supply

The crosshead drive motor relay and the gearbox clutches are controlled by a clutch and relay driver unit mounted in the loading frame. The input to this driver unit is 28 VDC obtained from a transformer and rectifier mounted in the console. These components, mounted on the shelf containing the console power supply, are protected by the 5 amp fuse, F1, on the console outlet panel.

4.3.3 Crosshead Drive Motor Power Amplifier

A pulse-width modulated servo power amplifier mounted in the console, supplies the d.c. power for the crosshead drive motor. The control signal input to this amplifier is



* Used on units below Serial No. 6590 only.

Figure 4-1. Model 1125 Testing Instrument Components and Controls

derived from a d.c. tachometer and two-phase resolver geared to the motor. The feedback from these components is summed with a command signal to develop a d.c. error signal.

The d.c. output of the amplifier is routed through the MOTOR circuit breaker mounted on the console outlet panel, and the motor relay mounted in the loading frame. The a.c. power input is controlled by the main power circuit breaker.

There are no replaceable fuses in the power amplifier as the unit has built-in safety features, including circuits providing low voltage and over current shutdown capability. Consult maintenance manual 10-1120-2 for complete details.

Access to the power amplifier, mounted in the bottom of the console, is gained as follows:

WARNING

Dangerous voltages are present within the console. Shut off main power circuit breaker and remove a.c. power cable from console outlet panel receptacle before attempting the following procedure.

a. Open console rear door. Reach over console power supply and turn two metal strips, securing lower panel to console frame, a quarter-turn from vertical to horizontal.

b. At front of console, lift lower panel out and up.

c. Loosen retaining clip on right-hand bracket and pull amplifier forward on its slides.

4.4 LOADING FRAME

4.4.1 Crosshead Manual Positioning Knob

A manual positioning knob is located behind an access cover in the middle of the right-hand column of the loading frame. This control enables the moving crosshead to be adjusted manually when mounting a specimen or precisely setting test limits. Clockwise rotation of the knob causes an upward movement of the crosshead.

The 1125 instrument must be powered when this control is used, as the knob turns a resolver-transmitter that is electrically connected to the crosshead drive motor follower resolver. Any phase difference between resolvers generates an error signal that operates the crosshead drive motor.

4.4.2 Limit Stops

Adjustable upper and lower crosshead limit stops are mounted on a rod behind the left-hand frame column. These stops, when positioned by an operator, define the limits of crosshead travel desired during a test. The stops engage a bracket on the moving crosshead, causing the rod to be lifted or depressed to actuate an upper or lower limit switch.

A limit stop is positioned by loosening the small knurled thumbscrew on the stop and sliding the assembly up or down as required. Retighten the thumbscrew firmly by hand. Further precise positioning is obtained by adjusting the large knurled nut on the assembly.

4.4.3 Crosshead Preload Nuts

(Applies to units below Serial No. 6590 only)

Preload nuts are provided on the topside of the moving crosshead at both leadscrews. These are tightened against the crosshead,

with the crosshead preloaded, prior to certain types of tests (reference paragraph 6.6.1). In this manner, forces are translated evenly between leadscrew and crosshead at all times during these specific tests.

NOTE: Preload nuts are usually tightened when tension testing above the moving crosshead, compression testing below the moving crosshead, or reverse stress testing. Otherwise, they must be loosened to avoid excessive wearing of the leadscrews.

4.4.4 Load Cell Connection

A load cell connecting cable is provided with the instrument. This cable extends from the 15-pin receptacle located on the rear of the console, about midway on the left-hand edge, to a clip mounted on the column of the loading frame. The free plug of this cable then connects to the load cell plug at whatever position the load cell is mounted.

4.4.5 Accessory Connections

Optional accessories connect directly to the connector box on the rear base of the loading frame, or to the middle rear of the left-hand column. These include a remote handset for crosshead control; an air kit for pneumatic specimen grips; and a strain gage extensometer connection. The function of these accessories is covered fully in separate descriptive literature available from Instron.

4.4.6 Crosshead Drive Motor Circuit Breaker

A circuit breaker for the crosshead drive motor is located on the rear outlet panel of the console. This breaker, rated at 20 amps, protects the motor from excessive current that may occur during a stall condition caused by crosshead overloading.

4.4.7 Crosshead Limit Override Controls

A LIMIT OVERRIDE pushbutton switch and a paddle-type switch, marked UP/DOWN, are located on the rear outlet panel of the console. These controls are used to operate the crosshead when the normal signal input to the crosshead drive motor has been disabled due to an actuation of a second-level limit switch (reference paragraph 4.7.4). This would result from a failure of a first-level limit switch or the crosshead control unit. To operate these controls, depress and hold the LIMIT OVERRIDE pushbutton while pushing the paddle switch to the UP or DOWN position to drive the crosshead accordingly.

CAUTION

The limit override controls cause the crosshead to move at a maximum rate (UP or DOWN). Operate the controls cautiously, as the load cell and fixtures could be damaged if a rigid test specimen is installed.

4.5 LOAD CELLS

Load cells available for use with this instrument are listed in the chart below. The following paragraphs describe each type of cell and its use.

4.5.1 Tension Load Cells

The 500-gram tension cell (figure 4-2) is intended primarily for fiber and light yarn and wire measurements. It consists of a very sensitive bending beam. A mechanism in the cell connects the beam to a wire that is extended through the hole in the bottom of the cell. The specimen is attached to this wire cell hook by means of either small clamps or rings to which the sample has been cemented,

Load Cell Chart for the Model 1125 Testing Instrument

Instron Load Cell Designation	MAXIMUM CAPACITY		
	ENGLISH	METRIC	SI
TENSION LOAD CELLS			
2511-101		500 grams	
2511-102		2000 grams	
2511-103	50 pounds		
2511-104		50 kilograms	
2511-105	200 pounds		
2511-106		100 kilograms	
2511-109			5 newtons
2511-110			20 newtons
2511-111			500 newtons
2511-112			1 kilonewton
COMPRESSION LOAD CELLS			
2511-201		2000 grams	
2511-202	50 pounds		
2511-203		50 kilograms	
2511-204	200 pounds		
2511-205		100 kilograms	
2511-208			20 newtons
2511-209			500 newtons
2511-210			1 kilonewton
TENSION-COMPRESSION CELLS			
2511-301	1000 pounds		
2511-302		500 kilograms	
2511-317			5 kilonewtons
2511-325	5000 pounds		
2511-326		2500 kilograms	
2511-327			25 kilonewtons
2511-303	10,000 pounds		
2511-304		5000 kilograms	
2511-318			50 kilonewtons
2511-305	20,000 pounds		
2511-306		10,000 kilograms	
2511-319			100 kilonewtons

or other techniques that will be determined by the type of the material. Spring overload and mechanical stops have been provided to limit the deflection of the beam so that the cell will withstand up to 300 grams of overloading, including the tare weight of the grips.

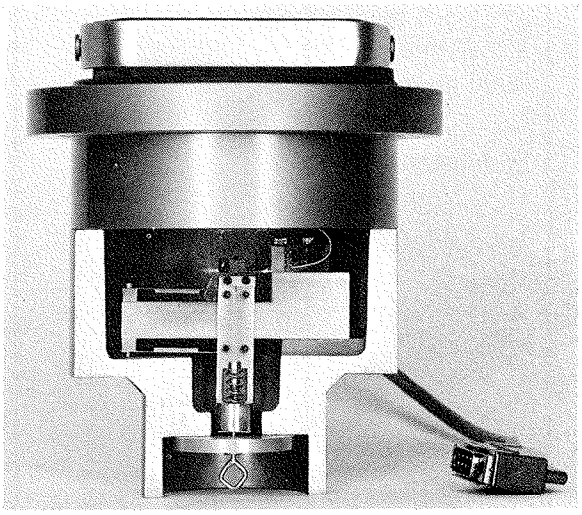


Figure 4-2. Tension Load Cell, 500 Gram (Cutaway View)

The other tension load cells, listed in the preceding chart, also utilize a bending beam construction, but the load is transmitted by means of a diaphragm-supported spindle (figure 4-3). This spindle is spring-loaded upward against the end of the beam by a force which is somewhat greater than the rated capacity of the cell. The externally-applied tension load unloads the beam so that, should the capacity of the cell be accidentally exceeded, the spindle merely leaves the beam and contacts a stop in the case of the cell. A very accurately positioned stop is provided to protect against overloading in the opposite direction.

These features give the cells a desired rigidity and ruggedness. Nevertheless, the proper care should be used to avoid unnecessarily rough handling. If a cell has been overloaded to the extent that the spindle has been pulled away from the beam, a shift in the balance point is likely to occur each time due to changes in the seating conditions. This does no damage but requires a readjustment of the balance controls. The 2000-gram cell is particularly susceptible to this effect since the spindle preload is only about 2-1/2-kilogram, so operators should use caution against pulling down too hard when tightening the grips.

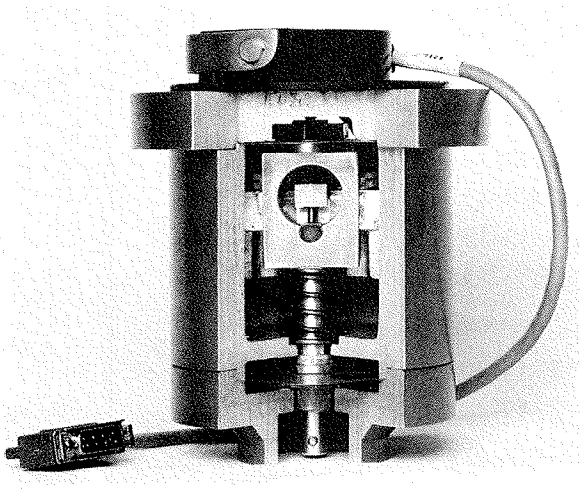


Figure 4-3. Tension Load Cell, High Capacity (Cutaway View)

4.5.2 Compression Load Cells

Compression cells are similar in design to tension cells, except that the end of the connecting spindle is designed to accommodate a compression table instead of the bayonet grip connection (figure 4-4).

If the table is rigidly mounted on the cell, a bushing should be screwed into the bottom side which allows the table in turn to be threaded onto the spindle of the cell. A special spanner wrench is supplied to tighten or remove this bushing.

If it is desired that the table be self-aligning, the bushing should be removed. The table

will rest on the spherical surface at the end of the spindle and is free to tilt over a small angle.

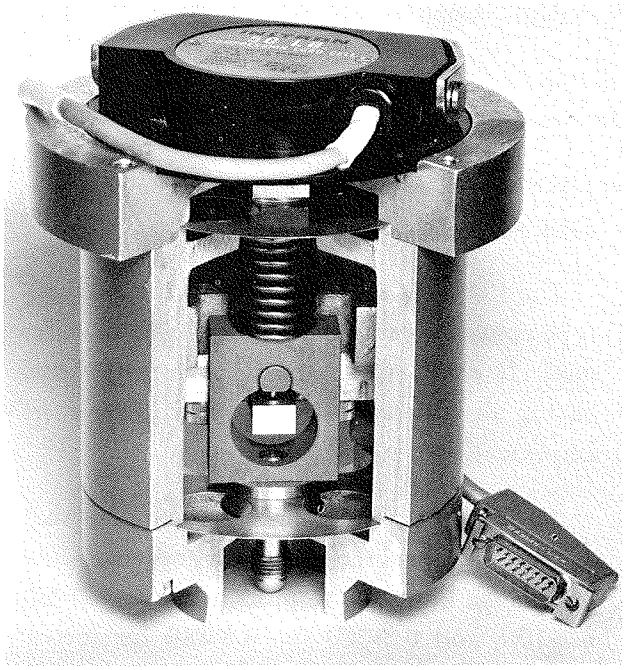


Figure 4-4. Typical Compression Cell (Cutaway View)

4.5.3 Tension-Compression Load Cells

The reversible tension-compression cells (figure 4-5) use a spindle to transmit the load to a shear element. Strain gages on this element indicate the applied tension or compression load. The load cells are rugged and will withstand overloads of up to 150% of the cell capacity.

These cells may be used for tension, compression, and reverse stress testing above or below the moving crosshead. The load signal output of these cells changes polarity between tension and compression loading.

4.6 LOAD CELL AMPLIFIER

The load cell amplifier, one of the basic units of the instrument, is located in the control console. Its function is to signal condition the load cell output to provide an accurately calibrated positional input signal to the recorder No. 1 pen drive servo. All operational controls are front panel-mounted (figure 4-6), and function as described below.

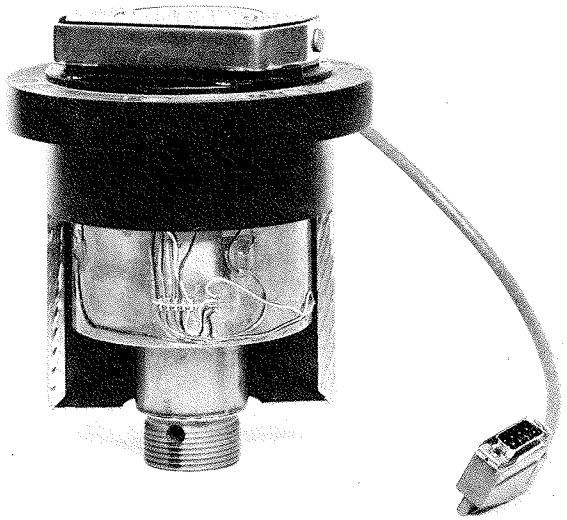


Figure 4-5. Typical Tension-Compression Load Cell (Cutaway View)

4.6.1 Zero Control

The ZERO control is used to adjust the recorder pen (No. 1) to a desired zero position on the chart. Depressing the associated ZERO pushbutton grounds the input to the final stage of the amplifier. This enables a recorder pen zero to be established independently of any signal from the load cell. One turn of the 10-turn ZERO control will move the recorder pen approximately 15% of full scale.

4.6.2 Balance Controls

The BALANCE controls determine the magnitude of a voltage that is summed in opposition to the load cell signal output. The purpose of this voltage is to compensate for the initial weight imposed on a load cell by grips and fixtures, and for variations in electrical characteristics of different load cells.

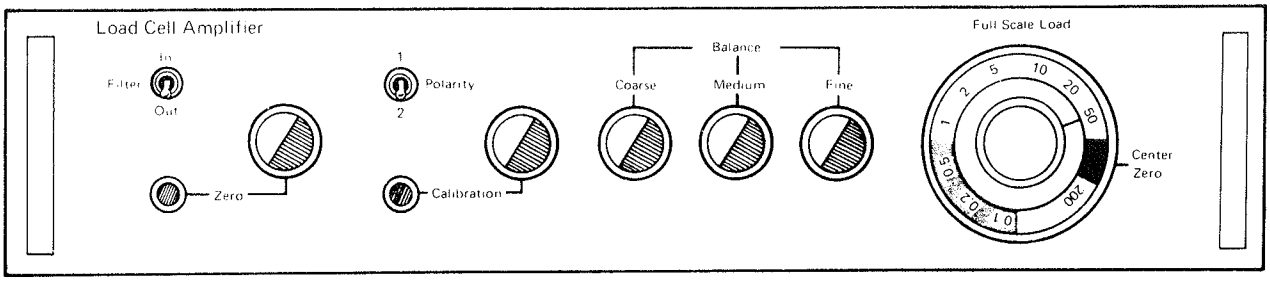


Figure 4-6. Load Cell Amplifier Operational Controls

The sensitivity of these controls will vary with the setting of the CALIBRATE control and the setting of the FULL SCALE LOAD range selector switch.

The COARSE control switches between taps of a 10-tap transformer secondary. The sensitivity of each step is approximately 22% of maximum load cell capacity. The FINE and MEDIUM controls are 10-turn potentiometers. The range of maximum load cell capacity covered by each control is ±10% for the MEDIUM control and ±2.5% for the FINE control.

4.6.3 Calibration Control

The CALIBRATION control is used to adjust the sensitivity of the load cell amplifier in order to establish an accurate relationship between the load cell output signal and the deflection of the recorder pen. This 10-turn potentiometer can vary the gain of the amplifier continuously by a factor of approximately 3:1.

The CALIBRATION pushbutton switch, when depressed, completes the calibration circuit that is used with electrically-calibrated type load cells. Completing this circuit introduces an accurate signal as an input to the load cell amplifier. This provides a calibration load signal that is similar to placing an accurate calibration weight on the load cell.

4.6.4 Full Scale Load Selector

The FULL SCALE LOAD selector is a dual-type control operated by a knob and an outer dial. It consists of two stepped attenuators, having an accuracy of 0.1%, that change the amplification of the load cell signal.

The outer dial is a 3-position control that sets and indicates the minimum and maximum load range limits. The positions are: 0.1-50, 0.2-100, and 0.5-200 (or 0.5-250 for metric units). The inner knob is a 10-position control that sets the load range value of the load cell capacity which will give a full scale pen deflection on the recorder. The positions, depending upon the outer dial setting, are: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, and 200 (or 250 for metric units).

The fully clockwise position of the inner dial, marked CENTER ZERO, is used in conjunction with tension-compression cells for reverse stress testing. At this position the amplifier gain is halved. Setting the recorder pen for zero load at mid-scale, allows + or − full scale recordings to be made.

As the outer dial is rotated to change the load range limits, the six standard load ranges appear in the white section of the color-coded dial; the three ultra-high sensitive ranges appear in the orange section. These ultra-high ranges increase the amplifier sensitivity by a factor of 10X, allowing a wider span of load ranges with any given load cell. When using these ultra-high ranges, the FILTER switch

should be set to the IN position. It should be noted that there is an increased noise level and some sacrifice in linearity, stability, and accuracy at these more sensitive load ranges.

4.6.5 Filter Switch

This switch introduces additional filtering to reduce pen disturbances when the high sensitivity positions of the full scale load selector are used.

When set to the IN position, a low pass filter is added to the output stage of the load cell amplifier. Although increased damping of the recorder pen servo driving signal occurs, the steady-state accuracy is not affected.

4.6.6 Polarity Switch

The POLARITY switch enables the load cell amplifier output signal to be reversed by reversing the polarity of excitation voltage to the load cell. This allows the recorder pen zero condition to be set on either the left or right side of the chart.

4.6.7 Quadrature Adjustment

A quadrature adjustment is required to compensate for a reactive component on the load signal due to distributed stray capacitance in the load cell, load cell cable and load cell amplifier input circuitry. This signal component, if not properly compensated, will cause a nonlinear operation of the load weighing system. The adjustment, a variable resistor (R3) mounted internally on the load cell amplifier assembly, is initially factory set but should be checked and readjusted periodically. Small changes in quadrature will result when load cells are interchanged, and when the polarity of the load signal is reversed. If the load cell cable is altered or replaced, the quadrature must be readjusted. Refer to paragraph 6.4.2 for this procedure.

4.7 CROSSHEAD CONTROL UNIT

The crosshead control unit contains the master oscillator and logic circuitry for controlling the speed and directional functions of the moving crosshead. This unit is the main element in the closed-loop positional control system. It supplies the excitation for the reference resolver that is geared to the main drive motor, and generates the error signal that is amplified to drive the motor.

The operational controls are shown in figure 4-7, and function as described below.

4.7.1 Manual Crosshead Control Switches

The UP, DOWN, STOP, and RETURN pushbutton switches provide manual control of the moving crosshead. These switches are lit when actuated and function as follows:

UP - causes crosshead to move up at a speed preset on CROSSHEAD SPEED selector switches.

DOWN - causes crosshead to move down at a speed preset on CROSSHEAD SPEED selector switches.

RETURN - causes crosshead to move in opposite direction from testing direction. Speed of crosshead is determined by RETURN SPEED switches. This switch overrides any preset cycling function.

RETURN SPEED switches - determines speed at which crosshead will return to gage length as follows:

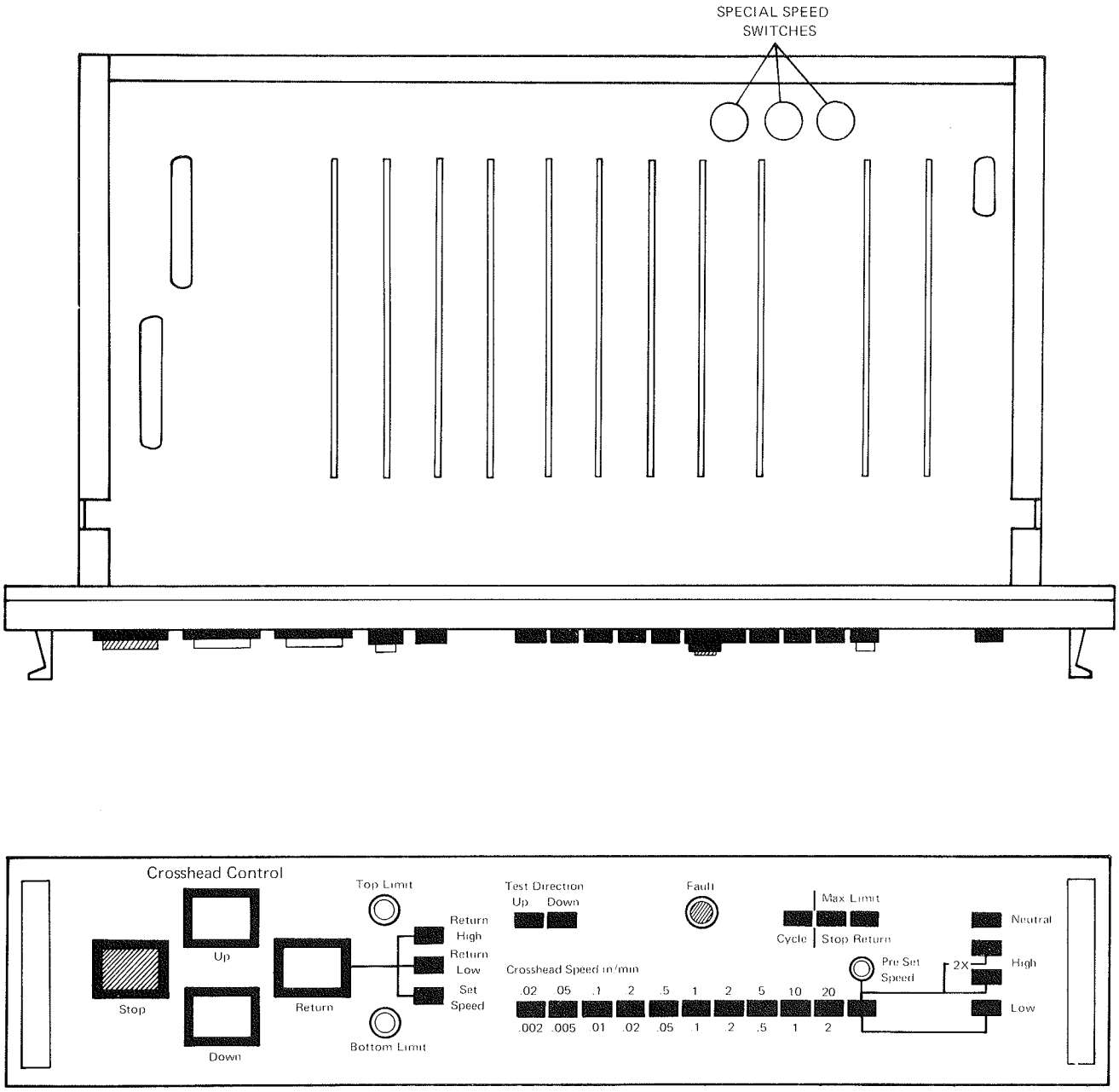


Figure 4-7. Crosshead Control Unit Operational Controls

RETURN HIGH - causes crosshead to return at a maximum high speed of 20 in/min (500 mm/min). If the optional 2X clutch is selected for testing use, return speed will be 20 in/min (500 mm/min) as the 2X clutch is disabled in the RETURN mode.

RETURN LOW - causes crosshead to return at maximum LOW speed of 2 in/min (50 mm/min).

SET SPEED - causes crosshead to return at a speed preset on CROSSHEAD SPEED selector switches (testing speed). This includes 2X testing speed if optional 2X clutch is selected.

4.7.2 Limit Indicator Lamps

The TOP LIMIT lamp lights when the crosshead reaches the upper first or second level limit switch. The BOTTOM LIMIT lamp lights when the crosshead reaches the lower first or second level limit switch. These lamps will be lit only when the crosshead is at the limit.

4.7.3 Test Direction Switches

The selection of one of these switches prior to starting a test determines the return direction of the moving crosshead. If the initial test direction from the specimen gage length position is up, the UP pushbutton must be depressed; if the initial test direction is down, the DOWN pushbutton must be depressed.

4.7.4 Fault Indicator Lamp

When the FAULT lamp is lit the 1125 instrument is inoperative, and one of the following conditions exist:

a. When the main power is initially turned on, the lamp will light for approximately 3 seconds duration during an equipment reset mode.

b. If the crosshead actuates an upper or lower second level limit switch, the crosshead drive motor input will be disabled and the system will go into a stop mode. When this condition exists, the OVERLOAD lamp on the console rear outlet panel will also be lit. To recover from this mode, proceed as follows:

1. Use LIMIT OVERRIDE controls, on console outlet panel (reference paragraph 4.4.7) to drive crosshead away from actuated limit.

2. Depress NEUTRAL clutch pushbutton on crosshead control unit panel.

3. Shut off instrument's main power for several seconds. When power is again applied, control logic functions will be restored and FAULT lamp will extinguish.

c. If a large error signal results from an excessive loading of the crosshead, an overload condition will result. The crosshead drive motor input will be disabled, and the system will go into a stop mode. When this condition exists, the OVERLOAD lamp on the console rear outlet panel will also be lit. To recover from this mode, proceed as follows:

1. Depress NEUTRAL clutch pushbutton on crosshead control unit panel.

2. Shut off instrument's main power for several seconds. When power is again applied,

control logic functions will be restored and FAULT lamp will extinguish.

3. Move crosshead, to relieve test overload condition, by using crosshead manual positioning control, or by crosshead control unit at a low speed setting.

d. If the crosshead drive motor power amplifier is overheating, the drive motor input will be disabled and the system will go into a stop mode. When this condition exists, the OVERTEMP lamp on the console rear outlet panel will also be lit. To recover from this mode, shut off the instrument's main power to allow system to cool. Check for possible causes of overheating, such as high ambient temperatures or excessive loading.

4.7.5 Max Limit - Cycle/Stop/Return Switches

These switches determine the crosshead action that will result when a first level upper or lower limit switch is actuated. The switches are interlocking, and depressing any one pushbutton will release any other previously selected.

A pushbutton is depressed prior to starting a test, and the following actions result during the test:

CYCLE - causes the crosshead to be driven continuously between the upper and lower limits at the selected speed.

STOP - causes the crosshead to stop when either limit is reached.

RETURN - causes the crosshead to be reversed when the limit is reached in the initial drive direction; to return, at desired return speed, and stop when the other limit or gage length is reached.

4.7.6 Crosshead Speed Selector Switches

The CROSSHEAD SPEED selector switches set the basic testing speed of the crosshead. High gear speeds are indicated above the pushbuttons and low gear speeds below the pushbuttons. High, low and optional 2X clutches are selected by the column of switches (paragraph 4.7.8) to the right of the speed switches.

The speed of the crosshead, when the PRESET SPEED pushbutton is selected, is determined by the setting of three special preset speed switches (paragraph 4.7.7). The lamp above the PRESET SPEED selector will light when the pushbutton is depressed.

All 11 CROSSHEAD SPEED switches are interlocking, and depressing any one pushbutton will release any other previously selected.

4.7.7 Special Preset Speed Switches

Three rotary switches for setting special speeds are mounted on the rear right-hand side of the crosshead control unit's motherboard (figure 4-7). Access to the switches is gained by pulling the unit forward out of the console until the knobs are visible. The function of the switches is for setting any special crosshead speed required within the normal speed range of the unit (.002 to 20 in/min or .05 to 500 mm/min). This speed may then be selected by the PRESET SPEED switch.

Each switch has 10 positions, 0-9, but only positions 1-4 are usable on the right-hand switch. The left-hand and center switches make up the first and second digits, respectively, of a two digit number. This number is multiplied by a scaling factor determined by the right-hand switch setting as follows:

RH Switch Position	Multiplier (with HIGH clutch selected)	
	English	Metric
0	off (not used)	off (not used)
1	1.0	10
2	0.1	1.0
3	0.01	0.1
4	0.001	0.01

NOTE: When a preset speed of 3-digits is desired, the third digit can only be a "0".

Several examples of preset speeds are shown below:

Preset Speed Required	LH Switch Setting	CTR Switch Setting	RH Switch Setting	Clutch Selector
English Units				
0.003 in/min	0	3	3	LOW
15 in/min	1	5	1	HIGH
Metric Units				
0.06 mm/min	0	6	3	LOW
400 mm/min	4	0	1	HIGH

4.7.8 Clutch Selector Switches

The clutch selector switches control the gearing between the drive motor and crosshead. These switches, marked NEUTRAL, 2X, HIGH, and LOW, are interlocking and depressing one will release any other previously selected.

The function of these switches is as follows:

NEUTRAL - releases all clutches. Crosshead will not move (but drive motor will run) when this pushbutton is depressed.

HIGH - allows testing speeds of 0.02 to 20 in/min (0.5 to 500 mm/min) at loads up to 5000 pounds.

2X - this is an optional clutch. If installed, testing speeds are available from 0.04 to 40 in/min (1.0 to 1000 mm/min) at reduced crosshead loading. Speeds above the CROSSHEAD SPEED selector switches are multiplied by a factor of 2 when this clutch is selected.

NOTE: Do not press the 2X clutch selector switch if this option is not installed, because the crosshead drive will be placed in neutral.

LOW - allows testing speeds of 0.002 to 2.0 in/min (0.05 to 50 mm/min) at loads up to 20,000 pounds.

4.8 CHART DRIVE CONTROL - GENERAL

The chart drive control unit is located in the instrument console directly above the strip chart recorder assembly. Its function is to control the speed and direction of the recorder chart movement. There are two chart drive assemblies available: a basic 6-speed unit with a time-drive mode only; and an optional 10-speed unit, with automatic chart control and time or proportional drive modes.

In both units, the front panel switches interface with control circuitry to provide the input signal for the chart drive stepper motor. In the time-drive mode, the clock pulses are obtained from the master oscillator in the crosshead control unit. For the proportional mode in the optional unit, the clock pulses are derived from the crosshead drive signal.

The chart drive units contain the recorder pen servo amplifier, and a provision for mounting two additional servo amplifiers for optional multiple pen recording systems. Also,

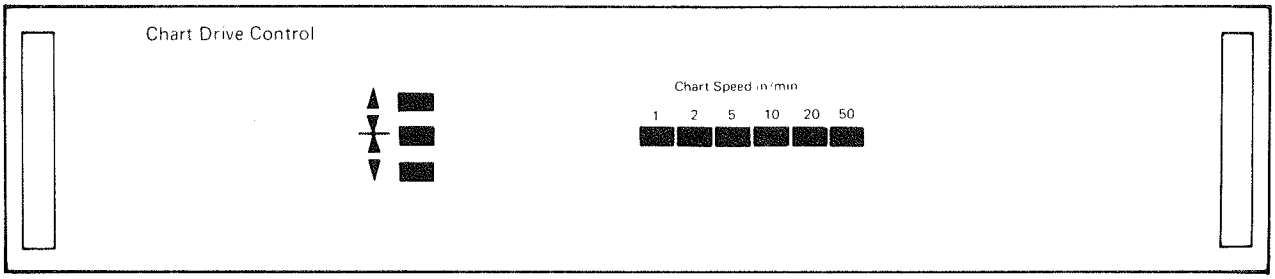


Figure 4-8. Basic Chart Drive Unit Operational Controls

provision is included for adding a servo amplifier for an optional servo chart drive control for x/y recording of load/strain data.

NOTE: For chart and pen movements to occur, additional controls on the recorder must be actuated (reference paragraph 4.11).

4.9 CHART DRIVE - BASIC UNIT

The basic unit provides chart speeds, in a time-drive mode only, within the range of 1 to 50 inches/minute (20-1000 mm/min, metric units). The operational controls are front panel-mounted speed and direction switches, that are shown in figure 4-8 and function as described below.

4.9.1 Chart Control Switches

The three pushbutton switches, on the left-hand side of the front panel, are used to manually control the movement of the recorder chart. The function of the switches, as indicated by the arrowhead legends, is as follows:

Top switch depressed - chart motion is toward the console (reverse) at a speed determined by a preselected CHART SPEED switch.

Center switch depressed - chart stops.

Bottom switch depressed - chart motion is out of the console (forward) at a speed determined by a preselected CHART SPEED switch.

4.9.2 Chart Speed Selector Switches

A CHART SPEED switch must be depressed to enable the chart forward and reverse switches to function. The figures above each of the 6 switches indicate the chart running speeds in inches/minute (mm/min, metric units). The switches are interlocking, and depressing one will release any other previously selected.

4.10 CHART DRIVE CONTROL - OPTIONAL UNIT

The optional unit has two identical sets of speed control switches, designated A and B speeds, and a PRESET SPEED selector switch. Chart speeds, within the range of 0.1 to 100 inches/minute (1-1000 mm/min, metric units), are available with each of 10 switches. Additional preset speeds within the maximum speed are also available.

An automatic mode, in conjunction with an array of 25 pushbuttons, allows a preprogramming of recorder chart motion to time-related events of crosshead movement.

A proportional mode allows the chart motion to be relative to the crosshead motion: in speed, with a ratio determined by an A speed switch; and automatically, in direction.

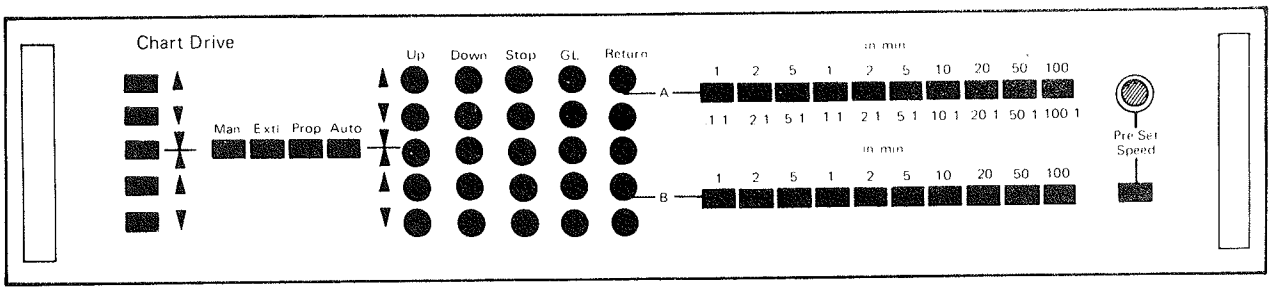


Figure 4-9. Optional Chart Drive Unit Operational Controls

The operational controls are shown in figure 4-9, and function as described below.

4.10.1 Manual Controls

The column of five pushbutton switches, on the left-hand side of the front panel, are used to manually control the movement of the recorder chart in a time-drive mode. For these switches to be operative, the MAN (manual) pushbutton in the row of four pushbuttons must be depressed. Also, an A CHART SPEED, B CHART SPEED, or the PRESET SPEED switch must be depressed. The five switches are interlocked, and function as follows:

Top switch selected - chart motion is toward the console (reverse) at a speed determined by a preselected A CHART SPEED switch.

Second switch selected - chart motion is out of the console (forward) at a speed determined by a preselected A CHART SPEED switch.

Middle switch selected - chart movement stops.

The bottom pair of switches function the same as the top pair, as indicated by the arrowhead legends, except in conjunction with the B CHART SPEED switches or the PRESET SPEED switch.

4.10.2 Operating Mode Switches

The row of four pushbuttons, marked MAN/EXTL/PROP/AUTO, determine the operating mode of the chart drive unit. These switches are interlocked and function as follows:

MAN - selecting this switch allows the recorder chart to be operated with the manual controls as described in paragraph 4.10.1.

EXTL - when this switch is selected, the chart control information can be from a computer or other external preprogrammed device.

PROP - selecting this switch enables the recorder chart to be driven at a speed proportional to the speed of the moving crosshead. When this mode is selected, all chart functions - start, reversal, and stop - are controlled by crosshead command signals. The ratios between the chart and crosshead speeds are the same as those shown beneath the A CHART SPEED switches only when the HIGH speed clutch selector switch, on the crosshead control unit, is depressed. If the LOW clutch or 2X clutch (optional) is energized, the ratios differ from those indicated by factors of 10 and 1/2, respectively. The chart speed/crosshead speed ratios available for each clutch selection are shown in the table below.

NOTE: In the PROP mode, the chart does not return (remains stationary) during the crosshead return phase.

Crosshead Clutch	Ratio – Chart Speed/Crosshead Speed									
High	.1:1	.2:1	.5:1	1:1	2:1	5:1	10:1	20:1	50:1	100:1
Low	1:1	2:1	5:1	10:1	20:1	50:1	100:1	200:1	500:1	1000:1
2X	.05:1	.1:1	.25:1	.5:1	1:1	2.5:1	5:1	10:1	25:1	50:1

AUTO - this switch allows the recorder chart to be controlled automatically in relation to events of crosshead movement, as described in paragraph 4.10.3.

4.10.3 Automatic Controls

The array of 25 pushbutton switches on the front panel, in conjunction with the AUTO mode switch, enable the recorder chart movements to be programmed to moving crosshead events. A crosshead event is named above each column. The resultant chart action is indicated by the arrowhead legend to the left of each row. These legends specify the same chart movement (forward, reverse, and stop) as those associated with the manual controls.

The five switches in each column are interlocked, and depressing one will release any other previously selected. The top two rows of switches relate to the A CHART SPEED switches, and the bottom two rows to the B CHART SPEED switches and the PRESET SPEED switch. A center row switch, if selected, will stop the chart movement when the crosshead event marked above the related column occurs. Crosshead events which determine a programmed chart action are:

UP - crosshead moving up the frame.

DOWN - crosshead moving down the frame.

STOP - crosshead stopped.

GL - crosshead at gage length.

RETURN - crosshead returning to gage length.

4.10.4 Chart Speed Switches

Each of the two rows of CHART SPEED controls, marked A and B, Consist of 10 interlocked pushbutton switches. The same speeds are selectable in each row, as indicated by the figures above the row. Also, each row is associated with identical sets of manual and automatic chart directional controls. With this type of arrangement, differing chart speeds can be preselected for chart forward and reverse motions as desired. The A row of chart speed switches is additionally related to the proportional mode of operation as previously described.

4.10.5 Pre Set Speed Switch

The PRESET SPEED switch and indicator light are located on the right-hand side of the panel. This is a push-on, push-off type of switch and when it is depressed, the indicator lamp is lit and the B chart speeds are not selectable. This PRESET SPEED switch is associated with the same manual and automatic chart directional controls as the B CHART SPEED switches.

A preset speed is initially set by the manual placement of three single-wire, push-on connectors on tabs. These are located directly

behind the unit front panel on the right-hand side of the base printed circuit board. The tabs are arranged in three groups: two of the groups are each marked with numbers 1 through 9; a third group is marked ÷1, ÷10, ÷100, and ÷1000 (figure 4-10). Located between the two groups of 1-9 numbers is a single tab marked 0.

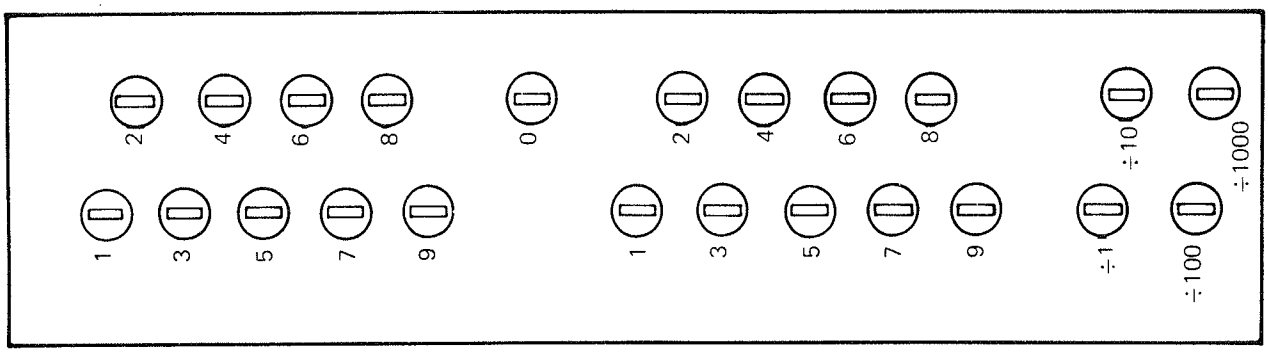


Figure 4-10. Preset Speed Selection Tabs on Chart Drive Unit Base Printed Circuit Board

Preset speeds are available between .001 and 99 inches/minute (.01-990 mm/min, metric units). The first and second digits of the desired speed number are set in the center and left-hand groups, respectively. This number is divided by a scaling factor, which is selected by connecting the right-hand single-wire connector to the proper tab in the right-hand group. If either the first or second digit of the desired speed is a "0", then connect the corresponding single-wire connector to the "0" tab located between the left-hand and center groups.

The preset speed as set on the tabs, has the units of inches/minute (centimeters/minute for metric instruments). Several examples of preset speeds are shown below:

Connector Positions			Preset Speed		
CTR	LH	RH	English	Metric	
			in/min	cm/min	mm/min
0	1	÷1000	0.001	0.001	0.01
5	5	÷100	0.55	0.55	5.5
9	0	÷10	9.0	9.0	90
3	2	÷1	32	32	320

4.11 CHART RECORDER

The chart recorder consists of the platen assembly, and the chart drive and pen drive mechanisms. The basic unit has a single pen, but may be optionally expanded to include two or three pens with individual pen servo drive modules. These modules mount on the rear base of the recorder, below the pen carriage.

The platen assembly includes the paper drive, supply, and take-up rollers, and a reciprocating roller (figure 4-11).

A pair of small d.c. motors are geared directly to the supply and take-up rollers. These motors, with balanced voltages applied, rotate in opposition to automatically maintain proper tensioning of the chart. Each motor is used separately for fast forward and fast reverse chart operation.

The chart drive roller is belt-driven by a stepper motor (DIGITAL CHART DRIVE module) mounted on the recorder base beneath the platen. An optional SERVO

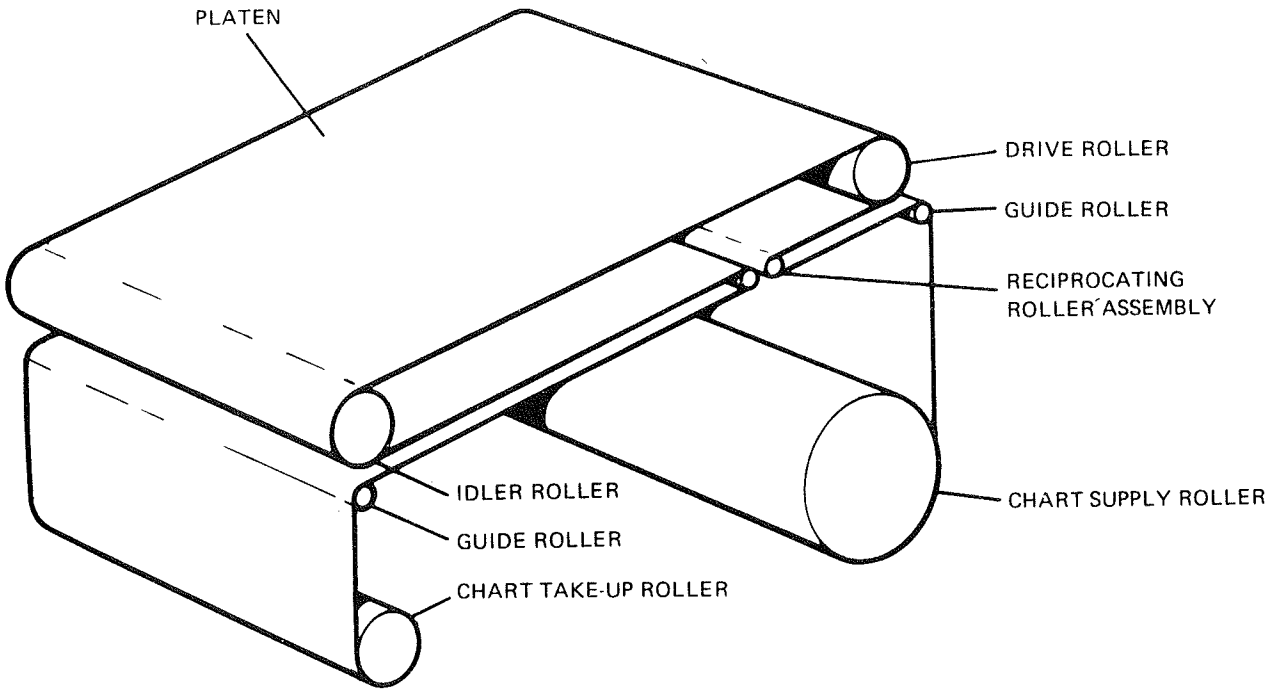


Figure 4-11. Recorder Paper Control System

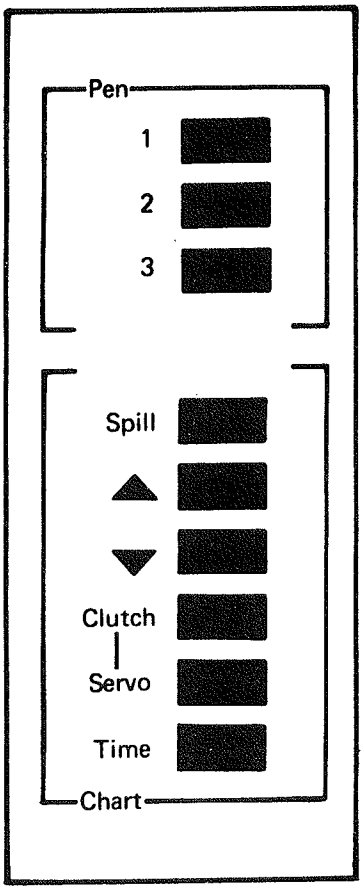


Figure 4-12. Chart Recorder Operational Controls (Basic and Optional)

CHART DRIVE module, if included, is similarly located and drives the same belt.

The chart and pen servo control signals are provided by the chart drive unit (paragraph 4.10). For the chart and pen to function with these signals, certain recorder controls must be actuated. These controls are located on the right-hand side of the recorder platen (figure 4-12), and function as described below:

NOTE: Controls for two optional pens and an optional servo drive (CLUTCH/SERVO) are shown in figure 4-12.

4.11.1 Pen Controls

The three pushbuttons, marked PEN 1, 2, and 3, are latching switches that enable up to three pen drive mechanisms to be actuated. Depressing one of these switches closes the control signal circuit to the related pen drive motor.

4.11.2 Chart Controls

The CHART pushbutton switches function as follows:

SPILL - this latching switch allows the chart to free-run over the front of the platen, although the chart may still be operated in either direction by the chart control unit. Depressing this switch de-energizes the tensioning motor on the chart take-up roller. A small weight should be attached to the free end of the paper to offset the torque of the supply roller tensioning motor.

NOTE: When the SPILL switch is latched, the fast forward and fast reverse switches are inoperable.

Fast Forward/Fast Reverse - these are non-latching switches that enable the chart to be moved independently of any other control, except SPILL, in the directions indicated by the arrowhead legends. Each switch applies full voltage to a related tensioning motor, de-energizes the opposing tensioning motor, and disables the chart stepper motor clutch.

CLUTCH/SERVO - these latching switches are associated with the optional chart servo drive control. The CLUTCH switch energizes the servo control clutch which connects the servomotor to the chart drive. The SERVO switch connects the servo amplifier to the servomotor.

TIME - this latching switch energizes the chart stepper motor clutch. Depressing this switch allows chart control by the chart drive unit in any of the operating modes.