

User's Guide

Thank you...



Thank you for purchasing a Mark-10 ESM301 / ESM301L Version 2 Force Test Stand, designed for producing up to 300 lbf (1.5 kN) of tension or compression force. The ESM301 is an essential component of a force testing system, typically also comprising a force gauge and grips.

With proper usage, we are confident that you will get many years of great service with this product. Mark-10 test stands are ruggedly built for many years of service in laboratory and industrial environments.

This User's Guide provides setup, safety, and operation instructions. Dimensions and specifications are also provided. For additional information or answers to your questions, please do not hesitate to contact us. Our technical support and engineering teams are eager to assist you.

Before use, each person who is to use the test stand should be fully trained in appropriate operation and safety procedures.

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1 OVERVIEW

1.1 List of included items

Qty.	Description
1	ESM301 or ESM301L test stand
4	Force gauge mounting thumbscrews
2	Limit switch thumbscrews (same as above, supplied in a separate package)
1	Power cord
1	Cable, controller to test frame 12" (longer cables are optional)
1	Cable, USB to RJ11 (for optional integrated travel indication)
1	ESM301-002-X column extension (optional)
1	ESM301-003 bench mounting kit (optional)
1	09-1162 multi-function cable (optional)
1	09-1056 serial cable (optional)
1	Accessories kit (small hook, medium hook, 2" diameter compression plate, 2" extension rod, #10-32 coupler, tool kit)

1.2 Overview

Note: Unless otherwise indicated, all references to the model ESM301 also apply to the ESM301L.

The ESM301 has three functional modes:

- OPERATING MODE**
This is the operating mode in which testing sequences can be started and stopped.
- TEST PARAMETER SETUP**
In this mode, test parameters are configured, such as rate of speed, number of cycles, password editing, and other parameters.
- FEATURE ACTIVATION SETUP**
This facility allows the user to enable features not originally purchased through a code activation process.

DEMO MODE

The ESM301 is shipped in *Demo Mode*, during which time all available features are temporarily activated for 160 hours of operation. At power-up, a counter displays the number of hours remaining, as follows:



<p>REMAINING DEMO</p> <p>TIME : 160 HOURS</p>

Press the STOP button to continue.

At the end of this period, any features not originally purchased will be deactivated. *Demo Mode* can be suspended at any time by pressing and holding **STOP** while turning on power to the test stand. This mode can be re-enabled in the same manner, and will be active for the remaining time period.

Refer to the **Feature Activation Setup** section for instructions for field activation.

2 MECHANICAL SETUP AND SAFETY

2.1 Safety / Proper Usage

Typical materials able to be tested by the ESM301 include many manufactured items, such as springs, electronic components, fasteners, caps, films, mechanical assemblies, and many others. Items that should not be used with the ESM301 include potentially flammable substances or products, items that can shatter in an unsafe manner, and any other components that can present an exceedingly hazardous situation when acted upon by a force.

1. Using Grips & Fixtures with the ESM301

Ensure that the grip or fixture is positioned to ensure axial load with respect to the loading shaft of the force gauge. When using a grip, ensure that it secures the sample in such a way that it is prevented from slipping out during a test, preventing a potential safety risk to the operator and others in the vicinity. If using a grip or fixture from a supplier other than Mark-10, ensure that it is constructed of suitably rugged materials and components.

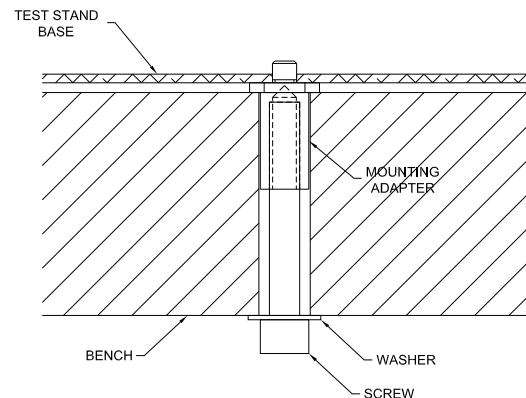
2. Mounting

Place the stand on a clean, flat and level work area free from vibration. If desired, the stand can be secured to the work area with 1/4-20 screws fastened into the underside of the base. Failure to properly mount the test stand may make it more vulnerable to tipping, causing a hazardous situation.



IMPORTANT: Do not fasten any screws more than 0.25 in [6 mm] into the base of the test stand, or damage to internal components can occur.

The test stand can also be mounted using the ESM301-003 mounting kit. Screws of various lengths are supplied with this kit to accommodate a range of bench thicknesses. Refer to the following illustration at right for proper assembly:



In general, the ESM301 can be mounted at any angle, although extra care should be taken during installation and operation.

Once the test stand is in a stable and secure position, install a force gauge with four thumb screws (provided). Mark-10 gauges mount directly without adapters. Grips can be mounted onto the force gauge and test stand base.

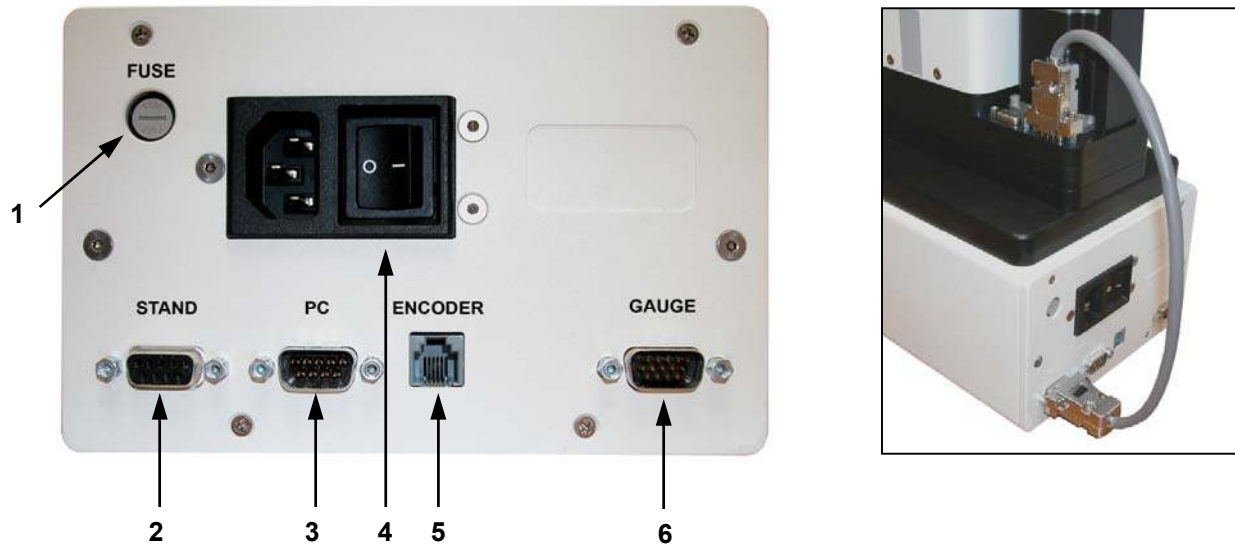
3. Installing the limit switches

Upper and lower limit switches are provided to stop crosshead travel at user-designated positions. Each limit switch consists of an internal block riding along a rail, and an external thumbscrew. The thumbscrews are shipped in a separate bag to avoid damage in transit. Refer to the illustration at right for proper installation:



2.2 Setting up the Controller

The power plug and controller cable must be connected to the rear of the controller, as shown in the illustration below:



1. Fuse

2. Controller Cable Connector

Plug one end of the cable into this connector, and the other end into the connector as shown in the illustration on the right.

3. PC Output Connector

Outputs force only or force and travel data via RS-232. Also allows for PC control, if appropriate features are enabled. Plug one end of the 09-1056 serial cable into this connector, and the other end into a serial connector on a computer.

4. Power Plug Receptacle

Plug the power cord in here.

5. Travel Indication Connector

Plug one end of the USB/RJ11 cable into this connector, and the other end into the mini USB connector in the rear of the crosshead.

6. Force Gauge Cable Connector

Interfaces with a Series 5 or 4 force gauge. Plug one end of the 09-1162 cable into this connector, and the other end into the gauge.

2.3 Connecting Power

Plug one end of the power cord into its receptacle at the rear of the controller and the other end into a wall outlet with local earth ground (3-prong connector).

Before turning on power, the following safety checks and procedures should be performed:

1. Never operate the test stand if there is any visible damage to the power cord or the test stand itself. The ESM301 is powered by 110V/220V. Any contact with this high voltage can cause serious injury or even death.
2. Ensure that the test stand is kept away from water or any other electrically conductive liquids

at all times.

3. Make sure the electrical outlet powering the test stand has local earth ground (3-prong connector).
4. The test stand should be serviced by a trained technician only. Power must be disconnected before the controller is opened.

After the above safety checks and procedures have been performed, the test stand may be powered on and is ready for operation.

3 OPERATION BASICS

3.1 Operational Safety

The following safety checks and procedures should be performed before and during operation:

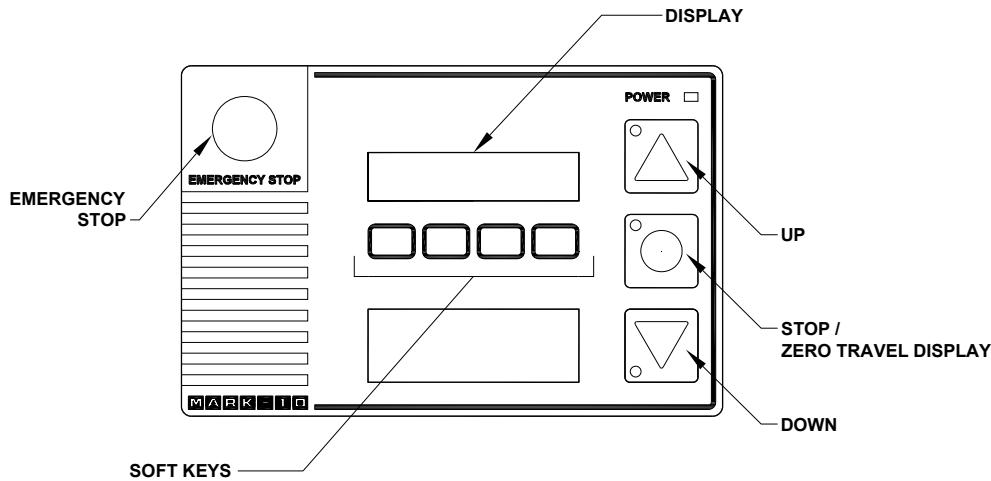
1. Always consider the characteristics of the sample being tested before initiating a test. A risk assessment should be carried out beforehand to ensure that all safety measures have been addressed and implemented.
2. Wear eye and face protection when testing, especially when testing brittle samples that have the potential to shatter under force. Although the ESM301 has relatively slow moving mechanisms, be aware of the dangers posed by potential energy that can accumulate in the sample during testing. Extra bodily protection should be worn if a destructive failure of a test sample is possible.
3. Keep away from moving parts of the test stand. Loose articles of clothing should not be worn, and long hair should be covered to avoid being caught in any moving parts. A Crush Hazard warning label is located on the base of the test stand. It appears as follows:



Definition: Keep any body parts and clothing clear of the area between the base of the test stand and the moving crosshead.

4. In certain applications, such as the testing of brittle samples that can shatter, or other applications that could lead to a hazardous situation, it is strongly recommended that a machine guarding system be employed to protect the operator and others in the vicinity from shards or debris.
5. When the test stand is not in use, ensure that the power is turned off to prevent accidental engagement of any of the controls.

3.2 Controls



Key	Primary Function
SOFT KEYS	Functions are determined by the corresponding text on the display.
UP	Commences movement in the up direction.
DOWN	Commences movement in the down direction.
STOP / ZERO TRAVEL DISPLAY	Stops crosshead movement / zeroes travel display (if travel indication is enabled).
EMERGENCY STOP	Stops crosshead movement and disables the test stand until reset.

4 TEST PARAMETER SETUP

This section provides configuration instructions for each test parameter. Parameters include:

Parameter	Standard / Optional
Speed (same for both directions)	Standard
Independent up and down speeds	Optional
Auto return	Optional
Cycling with dwell time	Optional
Programmable travel limits	Optional
Overload protection	Optional
Preload	Optional
Load Holding	Optional
Break Detection	Optional
PC control	Optional
Communication parameters	Standard
Units of speed	Standard
Programmable button configuration	Standard
Password protection	Standard

All ESM301 test stands are shipped in *Demo Mode*, as explained in Section 1.2. After *Demo Mode* expires, only installed features will be displayed in **Test Parameter Setup**. The initial Test Parameter Setup screen appears as follows:

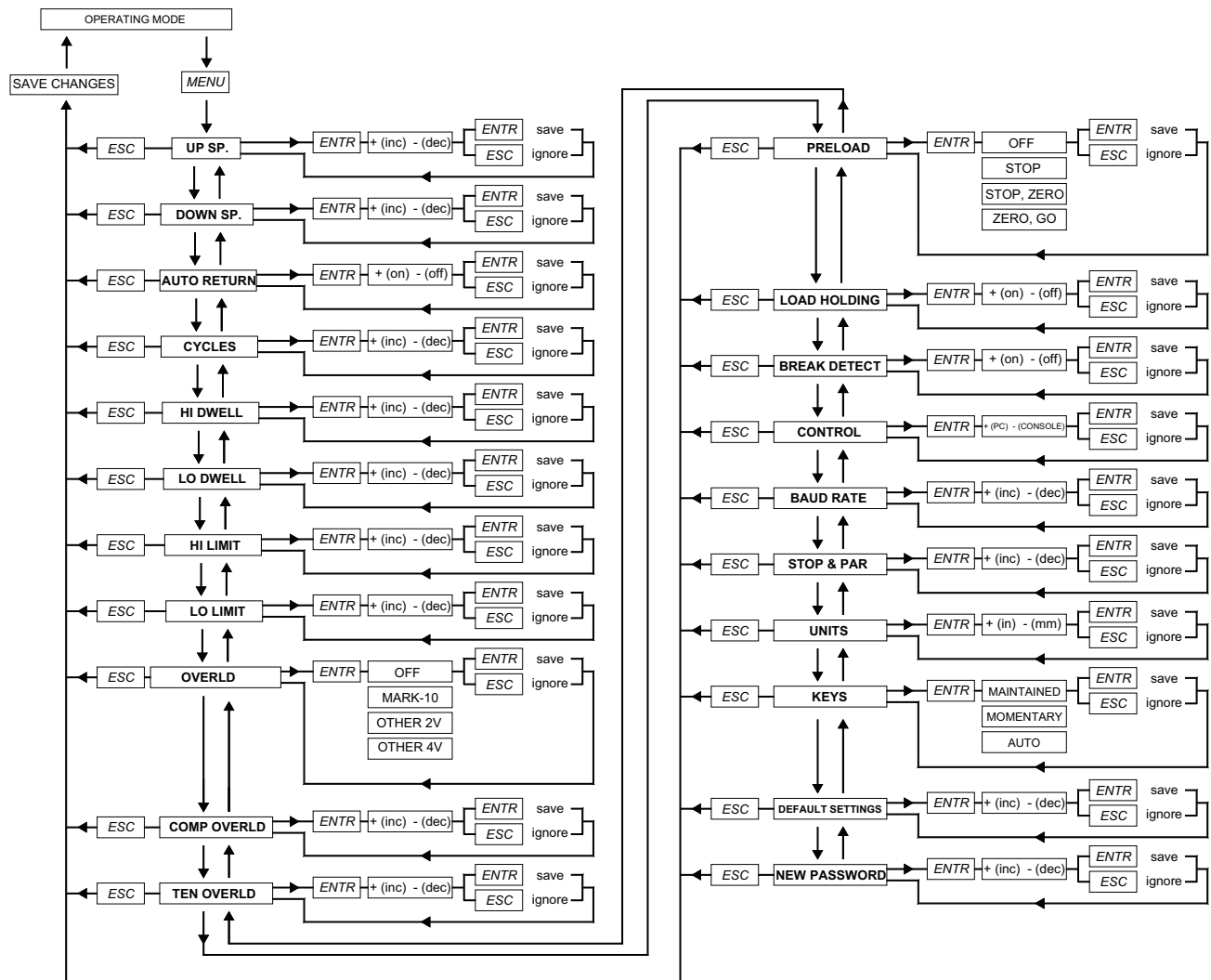
SPEED : 10.00
ESC < - - > ENTR

Label	Description
ESC	Exits Test Parameter Setup, reverts to Operating Mode
< -	Scrolls to the previous parameter
- >	Scrolls to the next parameter
ENTR	Selects the parameter, allowing it to be modified

When the parameters have been configured as desired and are ready to be saved, press **ESC** to exit Test Parameter Setup. The screen will show **SAVE CHANGES?** Pressing **YES** will save the changes and the display will revert to current status. Pressing **NO** will not save the changes and return to the Test Parameter Setup menu.

Note: Changes can be made to an unlimited number of settings before saving.

The following is a flow chart for the menu structure:



4.1 Speed, Up Speed, Down Speed (SPEED, UP SPEED, DOWN SP)

If the independent up and down speed option has not been enabled, the up and down speeds will be the same, and is programmed in the **SPEED** parameter. If independent up and down speeds are enabled, **UP SPEED** and **DN SPEED** parameters will be present, and may be set individually.

Default setting: 10 in/min

Available settings: 0.02 – 45 in/min

```
UP SPEED : 10.73
ESC - + ENTR
```

Label	Description
+	Increments the speed setting by .01 in or .5 mm. Holding down + will increment at an increasingly faster rate.
-	Decrements the speed setting by .01 in or .5 mm. Holding down - will decrement at an increasingly faster rate.
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.2 Auto Return (AUTO RETURN)

With this feature, the crosshead moves to a limit switch or *soft limit* (force set point, distance limit, preload, or break detection), whichever occurs first, and stops. Then, the crosshead returns to the other limit and stops. The test speed is dictated by the **SPEED** setting or the **UP SPEED** and **DOWN SP** settings. The return speed is always maximum speed. The maximum speed depends on whether or not the optional high speed range has been enabled.

Default setting: off

Available settings: off, on

```
AUTO RETURN off
ESC - + ENTR
```

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

Note: If **AUTO RETURN** is turned **on**, **CYCLING** is automatically turned **off** and the **KEYS** parameter is automatically set to **MAINTAINED** mode. See following pages for details on the **CYCLING** and **KEYS** parameters.

4.3 Cycling (CYCLES)

This setting allows the user to configure the number of up and down cycles through which the crosshead will sequence. One cycle consists of the crosshead moving to a limit switch or *soft limit*, whichever occurs first, at the specified speed, stopping for the specified amount of dwell time, and returning to the other limit at the specified speed. If the independent up and down speed feature is not enabled, the speed will be the same in both directions.

Default setting: 00000 (off)

Available settings: 00000 – 99999

```

CYCLES :      0 0 0 0 0
ESC      -    +    ENTR
  
```

Label	Description
+	Increases the number of cycles in increments of 1. Holding down + will increment at an increasingly faster rate. If 99999 is reached the next number will be 00000 and continue incrementing.
-	Decreases the number of cycles in increments of 1. Holding down - will decrement at an increasingly faster rate. If 00000 is reached the next number will be 99999 and continue decrementing.
Press and hold + and - simultaneously	If pressed and held for 2 seconds or longer the number of cycles will change to 0.
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.4 Upper Limit Dwell Time and Lower Limit Dwell Time (HI DWELL and LO DWELL)

This setting corresponds to the amount of time, in seconds, for which the crosshead stops at the limit during a cycle sequence.

Note: The dwell time setting is unavailable for an auto return sequence.

Default setting: 0 (no dwell time)

Available settings: 0 – 9999.9

```

HI DWELL : 0 0 0 0 . 0
ESC      -    +    ENTR
  
```

Label	Description
+	Increases dwell time in increments of .1. Holding down + will increment at an increasingly faster rate. If 9999.9 is reached the next number will be 0 and continue incrementing.
-	Decreases dwell time in increments of .1. Holding down - will decrement at an increasingly faster rate. If 0 is reached the next number will be 9999.9 and continue decrementing.
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.5 Upper and Lower Travel Limits (UPPER LM and LOWER LM)

This setting corresponds to the travel distance the crosshead moves before stopping or cycling. Upper and lower limits are programmed individually. The programmed distances are relative to the zero position of the crosshead. The travel indicator can be zeroed by pressing and holding **STOP** for 3 seconds.

Default settings: +12.000 in, -12.000 in

Available settings: From -19.000 to +19.000 in

```

HI LIMIT : 2.058
ESC - + ENTR
  
```

Label	Description
+	Increases the travel limit setting by .001 in or .02 mm. Holding down + will increment at an increasingly faster rate.
-	Decreases the travel limit setting by .001 in or .02 mm. Holding down - will increment at an increasingly faster rate.
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.6.1 Overload Protection (OVERLD)

The ESM301 protects a force gauge from overload by measuring incoming analog voltage and stopping crosshead travel when the programmed percentage of full scale has been reached (see Section 4.7). The default setting is for Mark-10 gauges ($\pm 1V$), however, the setting may be changed to $\pm 2V$ or $\pm 4V$ to accommodate other force gauges.

Default setting: OFF

Available settings: MARK-10, OTHER 2V, OTHER 4V, OFF

```

OVERLD : MARK - 10
ESC - + ENTR
  
```

4.6.2 Compression and Tension Overload Settings (COMP OVERLD and TEN OVERLD)

This setting corresponds to the percentage of force gauge full scale at which crosshead travel stops. For example, a setting of 80% for a 50 lbF capacity force gauge would stop crosshead travel when approximately 40 lbF is reached.

Note: When the crosshead is moving in the UP direction, only the tension overload setting applies. When the crosshead is moving in the DOWN direction, only the compression overload setting applies.

Default setting: 100%

Available settings: 20% - 100% (10% increments)

```

COMP OVERLD : 100%
ESC - + ENTR
  
```

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.7.1 Preload (PRELOAD)

This setting corresponds to the test stand's response to an initial load, referred to as a *preload*. The crosshead can stop and/or zero the travel display when the preload has been reached. This function is useful for applications such as spring testing, elongation testing, and tensile and compression testing of various materials. For details about setting the preload value, refer to Section 4.7.2.

Default setting: OFF

Available settings: STOP, STOP/ZERO, ZERO/GO, OFF

```
PRELOAD : ZERO , GO
ESC      -   +   ENTR
```

Label	Description
+ or –	Cycles through the available settings listed below:
STOP	Crosshead stops when preload has been reached
STOP, ZERO	Crosshead stops when preload has been reached, then zeroes the travel display
ZERO, GO	Travel display is zeroed when preload has been reached, crosshead does not stop
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.7.2 Preload Value (PRELD %FS)

This setting corresponds to preload value, defined as a percentage of the force gauge's full scale in lbf units. The test stand's response, as described in the previous section, occurs when this value has been reached.

Note: In low force applications, consider test stand vibration and crosshead acceleration, as they can be prominent enough to produce a force exceeding the preload value.

Default setting: 1%

Available settings: 0 – 100%

```
PRELD %FS : 01.0
ESC      -   +   ENTR
```

Label	Description
+ or –	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.8 Load Holding

This setting directs the test stand to dynamically adjust the crosshead position to maintain a programmed force. The force is programmed as a set point in a Series 5 force gauge (refer to the user's guide for details). If the **CYCLING** option has been enabled, load holding will be active for the period of time as defined in the Upper Dwell and Lower Dwell settings. If **CYCLING** has not been enabled, load holding will continue indefinitely.

Default setting: OFF

Available settings: ON, OFF

```
LOAD HOLDING : ON
ESC   -   +   ENTR
```

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.9.1 Break Detection

This setting directs the test stand to stop when a sample break has occurred. The test stand is triggered when the force has decreased to a specified percentage of peak. For details about programming the percentage of peak, refer to Section 4.9.2.

Default setting: OFF

Available settings: ON, OFF

```
BREAK DETECT : ON
ESC   -   +   ENTR
```

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.9.2 Break Detection Percentage Drop

This setting corresponds to the force trigger for break detection, defined as a percentage of peak force. For example: A sample is pulled until 50 lbF, then breaks. The break detection percentage drop setting is 50%. After the sample breaks, the force rapidly decreases to 25 lbF (50% of peak), then triggers the test stand to stop.

Default setting: 80%

Available settings: 10% - 90% (10% increments)

```
BREAK DETECT : ON
ESC   -   +   ENTR
```

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.10 Control Source (CONTROL)

This setting corresponds to the source of test stand control. The default value **CONSOLE** sets the test stand to accept commands only from the console (front panel). Any external commands received through the serial port are ignored, except for the following: Request Load, Request Travel, Zero Gauge, Zero Travel, Clear Peaks (refer to Section 5.8 for details).

PC refers to external control via serial communication. If any parameters are changed on the front panel, these settings will be ignored, except for **Auto Return** or **Cycling**. If either of these parameters are turned on, PC control will be turned off.

Default setting: CONSOLE
 Available settings: CONSOLE, PC

```
CONTROL : CONSOLE
ESC      -   +   ENTR
```

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.11 Baud Rate (BAUD RATE)

This setting corresponds to the baud rate setting of the computer program controlling the test stand.

Default setting: 115200
 Available settings: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

```
BAUD RATE : 115200
ESC      -   +   ENTR
```

4.12 Stop Bits and Parity (STOP & PAR)

This setting corresponds to the stop bits and parity settings of the computer program controlling the test stand.

Default setting: 8-1n
 Available settings:

8-1E 8 stop bits, 1 stop bit, even parity
 8-1o 8 stop bits, 1 stop bit, odd parity
 8-1n 8 data bits, 1 stop bit, no parity
 8-2n 8 data bits, 2 stop bits, no parity
 7-1E 7 data bits, 1 stop bit, even parity
 7-1o 7 data bits, 1 stop bit, odd parity
 7-2E 7 data bits, 2 stop bits, even parity
 7-2o 7 data bits, 2 stop bits, odd parity
 7-2n 7 data bits, 2 stop bits, no parity

```
STOP & PAR : 8 - 1 n
ESC      -   +   ENTR
```

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.13 Units of Speed (UNITS)

This setting corresponds to units of speed measurement.

Default setting: in/min
 Available settings: in/min, mm/min

UNITS :	in / min
ESC	- + ENTR

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.14 Programmable Button Function (KEYS)

Three button function modes are available:

- 1. Maintained**
 The crosshead will move continuously once the button has been pressed and held. Subsequently pressing the **UP**, **DOWN**, or **STOP** during a test will stop crosshead motion.
- 2. Momentary**
 The crosshead will move only if the button is held down. Releasing the button will stop movement immediately.
- 3. Auto**
 Holding down the button for more than 0.5 seconds will enter momentary mode, at which time an audible indicator will sound and the LED indicator on the button pushed will be illuminated. A short tap on the button will operate the test stand in maintained mode. Pressing **UP**, **DOWN**, or **STOP** during maintained mode will stop crosshead motion.

Default setting: maintained

Available settings: maintained, momentary, auto

KEYS :	MAINTAINED
ESC	- + ENTR

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.15 Return to Default Settings (DEFAULT SETTINGS)

This setting provides a quick return to factory settings, as follows:

SPEED:	10 in/min
UP SPEED:	10 in/min
DOWN SP:	10 in/min
AUTO RETURN:	off
CYCLING:	0000 (off)
HI LIMIT:	+12.000
LO LIMIT:	-12.000
OVERLD:	off
PRELOAD:	off
LOAD HOLDING:	off
BREAK DETECT:	off
CONTROL:	CONSOLE
BAUD RATE:	115200
STOP & PAR:	8-1n

UNITS: **in/min**
 KEYS: **maintained**
 PASSWORD: **0000 (off)**

Default setting: off

Available settings: off, on

DEFAULT ? :	NO
ESC - + ENTR	

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

4.16 Password (NEW PWORD)

If desired, a password can be set to prevent unwanted changes to test parameters. The password can be set to any number between 0000 and 9999. The default setting of 0000 indicates that the password is disabled, and that the user can freely enter the Test Parameter Setup menu. If misplaced or forgotten, the password may be reset through a code activation process. Details on this may be found in Section 9.

Default setting: 0000 (off)

Available settings: 0000 – 9999

NEW PWORD	0 0 0 0
ESC - + ENTR	

Label	Description
+ or -	Cycles through the available settings
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

5 OPERATING MODES

5.1 Mode Overview

The ESM301 can be operated in several modes, including combinations of these modes:

- 1. Basic Mode**
Manual control of crosshead motion.
- 2. Auto Return Mode**
Crosshead moves to a limit switch or force set point, travel distance, preload, or sample break (referred to as *soft limits*), whichever occurs first. Then, it reverses and moves at maximum speed to the other limit, whichever occurs first.
- 3. Cycling Mode**
Crosshead cycles between limits at the selected speed(s), and pauses at each limit or set point for a selected period of time.
- 4. Preload Mode**
Crosshead moves until the preload has been reached, and performs the action programmed in the setting. An auto-return, cycle/dwell time, or break detection sequence may follow.

5. Load Holding Mode

Crosshead moves to a force set point, stops, then dynamically adjusts position to maintain the programmed force. An auto-return or cycle/dwell time sequence may follow.

6. Break Detection

Crosshead stops when a sample break has been detected. An auto-return or cycle/dwell time sequence may follow.

7. PC Mode

Test stand is controlled through a serial connection with a PC.

The Operating Mode home screen appears as follows:

```
SPEED :      0 . 0 0
menu min max SET
```

If the travel indication option is enabled, the screen appears as follows:

```
TRAVEL      SPEED
  ↓          ↓
1 . 2 7 5   0 . 0 0
menu min max SET
```

The item selected will be capitalized, as shown in the figure above. The **set** speed can be changed in Test Parameter Setup. If enabled, the up and down speeds can be configured independently of each other (**UP SPEED** and **DN SPEED**). Otherwise, the **SPEED** setting corresponds to crosshead speed in both directions.

5.2 Menu Navigation

At power-up, the display will show the operation screen for whichever mode was used last. The display will appear as one of the following:

1. Basic & Auto Return Modes (*travel indication not enabled*):

```
SPEED :      0 . 0 0
menu min max SET
```

2. Basic & Auto Return Modes (*travel indication enabled*):

```
TRAVEL      SPEED
  ↓          ↓
1 . 2 7 5   0 . 0 0
menu min max SET
```

3. Cycling Mode (travel indication not enabled):

TRAVEL CYCLES REMAINING

↓ ↓

```
CYCLES :      0 0 0 2 4
menu min max SET
```

Note: The **min** and **max** keys will not appear when a password has been set.

4. PC Mode

Appears the same as in Basic and Auto Return modes.

Label	Description
menu	Enters Test Parameter Setup
min	Sets speed to minimum speed. Will not appear when a password has been set.
max	Sets speed to maximum speed. Will not appear when a password has been set.
set	Sets speed to the programmed SPEED, UP SPEED, or DN SPEED setting

Pressing **menu** will enter Test Parameter Setup. If a password has been programmed, the display will prompt the following:

```
PASSWORD      0 0 0 0
ESC - + ENTR
```

The password is a four digit number. The first digit in the password will be flashing, signifying that it is active and can be incremented by pressing **+**. To advance to the next digit, press **->**. Change subsequent digits in the same fashion. Once the complete password has been entered, press **ENTR**. If correct, the display will enter Test Parameter Setup Mode. If the password is incorrect, the words **INCORRECT PASSWORD** will flash, and the display will revert to Operating Mode.

5.3 Basic Mode

The crosshead moves upward when **UP** is pressed, and downward when **DOWN** is pressed. When the crosshead is in motion, an LED indicator on the button pushed will be illuminated. The **KEYS** setting controls how crosshead movement responds to the push of the **UP** and **DOWN** buttons. The three settings are:

- 1. Maintained (default)**
The crosshead will move continuously once the button has been pressed. Subsequently pressing **STOP** during a test will stop crosshead motion.
- 2. Momentary**
The crosshead will move only if the button is pressed and held. Releasing the button will stop movement immediately.
- 3. Auto**
Holding down the button for more than 0.5 seconds will enter **Momentary** mode, at which time an audible indicator will sound and the LED indicator on the button pushed will be illuminated. A short tap on the button will operate the test stand in **Maintained** mode. Pressing **STOP** during **Maintained** mode will stop crosshead motion. To resume the test, press **UP** or **DOWN** again.

Pressing **EMERGENCY STOP** will immediately stop crosshead motion in any mode. To release, twist the

button counter-clockwise until it assumes its original position. To resume the test, press **UP** or **DOWN**.

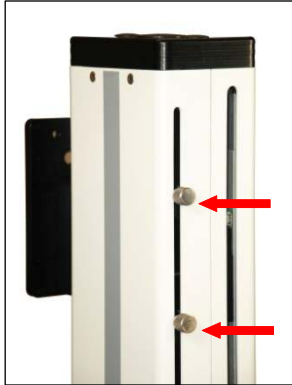
Crosshead movement will take place until a limit has been reached. If the crosshead has stopped at a soft limit, the limit condition may be overridden by pressing and holding **UP** or **DOWN**.

5.3.1 Travel Indication

If enabled, travel indication is displayed in the upper left corner of the display. The displayed units are the same as programmed in the **UNITS** parameter. Indicated travel is a relative value. To zero out travel distance, ensure that the crosshead is not moving, then press and hold **STOP**.

If the cable connecting the crosshead to the rear of the controller is unplugged, the position value will not change when the crosshead moves.

5.3.2 Limit Switch Operation



Limit switches allow the operator to set a location along the column at which point the crosshead will stop moving. Limit switches are located at the rear of the test stand column, as shown in the image to the left. Adjust the switches' positions by loosening, repositioning, and re-tightening the thumb screws. The thumb screws must be installed after unpacking. They are shipped separately to avoid damage in transit.

5.3.3 Overload Protection

The 09-1162 cable is required for overload protection of a Mark-10 force gauge. If overload protection is enabled, the crosshead will stop when the programmed percentage of full scale of the force gauge has been reached.

When overload protection is enabled, if the 09-1162 cable is disconnected, and/or if the force gauge is turned off, an error message will appear. Plug in the cable and/or turn on the force gauge to clear the message.

Note: When the crosshead is moving in the UP direction, only the tension overload setting is active. When the crosshead is moving in the DOWN direction, only the compression overload setting is active.

5.4 Auto Return Mode

In this mode the crosshead moves to whichever limit it encounters first and stops. Then, the crosshead returns at maximum speed to the other limit, whichever occurs first, and stops. The speed at which the crosshead travels is dictated by the **SPEED** setting or **UP SPEED** and **DN SPEED** settings (if independent speeds are enabled). Press **UP** or **DOWN** to initiate an Auto Return sequence.

The crosshead can be stopped at any time during an Auto Return sequence by pressing **STOP**. To resume the test, press **UP** or **DOWN**.

Note: If the crosshead has stopped at a soft limit, the limit condition may be overridden by pressing and holding **UP** or **DOWN** for two seconds.

5.5 Cycling Mode

This mode cycles the crosshead between limits, whichever occurs first. One cycle consists of the following steps:

1. Crosshead moves to a limit at the specified speed.
2. Crosshead stops for the specified amount of dwell time.

- Crosshead reverses direction, returns to the other limit at the specified speed, and stops for the specified amount of dwell time.

A cycling sequence can be initiated from any position and can start in either direction. If the crosshead is at a limit, however, cycling can only be started in the direction of the other limit. To initiate a cycle sequence, press **UP** or **DOWN**. During a cycle sequence, a counter will be displayed, indicating the number of cycles remaining, as shown below:

```
CYCLES      0 0 0 2 4
menu min max SET
```

As in Basic Mode, the **min**, **max**, and **set** soft keys are active during crosshead movement.

When the cycling sequence and the crosshead has stopped at a *soft limit*, the limit condition may be overridden by pressing and holding **UP** or **DOWN**.

5.5.1 Dwell time

Dwell time is the amount of time, in seconds, for which the crosshead stops at a limit during a cycle sequence. When the crosshead has reached a limit, a counter will be displayed, shown as follows:

```
DWELL :      0 0 0 1 . 5
menu min max SET
```

If the **DWELL U** and/or **DWELL L** settings are set to 0, the crosshead will immediately reverse direction upon reaching the corresponding limit, and no counter will be displayed.

The cycle sequence may be interrupted before it has been completed by pressing **STOP**. A soft key labeled **RESET** will appear as follows:

```
CYCLES :      0 0 0 2 4
                RESET
```

At this point, there are two options:

- Canceling the cycle sequence:**
Press **RESET** to stop and reset the cycle sequence. The cycle counter will revert to the number of cycles originally programmed.
- Resuming the cycle sequence:**
Press **UP** or **DOWN** to resume.

Once the sequence has been completed, the screen will revert to the number of cycles programmed originally. To begin another cycle test, press **UP** or **DOWN**.

Travel indication and limit switch operation is the same as in Basic Mode.

5.5 Preload Mode

In this mode, the crosshead moves at an approach speed of 10 in/min (250 mm/min) until the programmed preload value has been reached. If moving in the up direction, a tension preload is required. If moving in the down direction, a compression preload is required. When the preload is reached, the sequence of events programmed in the **Preload** setting occurs (see Section 4.7.1). If the **ZERO,GO** setting is selected, the crosshead speed will revert to the set speed after travel indicator is zeroed.

Note 1: Before the start of a preload sequence, the crosshead must be positioned at either the upper or

lower limit switch.

Note 2: Preload and **Load Holding** cannot be enabled simultaneously.

5.6 Load Holding Mode

In this mode, the crosshead moves until the set point value programmed in the force gauge is reached. The crosshead then dynamically adjusts its position to maintain a programmed force. The force gauge's capacity should be as close as possible to the intended load, for best performance.

In the force gauge, **both** set points must be set. The upper set point refers to a force limit in the up (tension) direction. The lower set point refers to a force limit in the down (compression) direction. The opposite set point must be set to any value in the **opposite** measuring direction. For example, for a test requiring load holding at 10 lbF of compression force, set the upper set point to 30 lbF tension (as an example), and the lower set point to 10 lbF compression.

If the **CYCLING** option has been enabled, load holding will be active for the period of time as defined in the **Dwell Time** settings. If **CYCLING** has not been enabled, load holding will continue indefinitely.

Before the start of a load holding sequence, the crosshead must be positioned at either the upper limit switch to begin compression load holding or at the lower limit switch to begin tension load holding.

The test speed should be adjusted according to the sample under test. Fine tuning may be necessary to ensure optimal crosshead dynamic adjustment. Stiff samples require a lower test speed; softer samples can be tested at higher speeds. If the speed of approach is too high for a given sample stiffness, the crosshead may overshoot the set point value, requiring an adjustment sequence where the crosshead reverses, then moves again in the original direction multiple times before settling at the set point value. A high enough speed may cause this correction cycle to repeat indefinitely.

For softer samples the amplitude of oscillation will be smaller, but could still be present for the duration of the load holding period. This is typical for samples which may relax, such as rubber, foam, etc. Lowering the test speed will reduce the oscillation.

For non-relaxing materials such as metal springs, the oscillation should stop shortly after the holding force is reached.

Note: Preload and **Load Holding** cannot be enabled simultaneously.

5.7 Break Detection Mode

In this mode, the crosshead will stop when a sample break has occurred. The test stand is triggered when the force has decreased to a specified percentage of peak.

For example: A sample is pulled until 50 lbF, then breaks. The break detection percentage drop setting is programmed to 50%. After the sample breaks, the force rapidly decreases, reaches 25 lbF (50% of peak), then triggers the test stand to stop.

Break detection becomes active only after 5% of the force gauge's full scale has been reached. For example, if a force gauge with 50 lbF capacity is used, the break detection feature will not become active until 2.5 lbF has been reached.

If enabled, an auto-return sequence or single-cycle sequence may follow break detection.

5.8 PC Mode

The ESM301 can be controlled by a PC via serial communication. A list of supported ASCII commands is provided below. All commands must be lowercase.

- a Request speed
- b Set travel units to inches
- c Enter cycle mode

d	Move crosshead down
e	Set speed (ex. e10.00 = 10.00 in/min)
f	Set cycles (ex. f0500 = 500 cycles)
g	Set lower travel limit (ex. g05.375 = 5.375 in)
h	Set upper travel limit (ex. h10.250 = 10.250 in)
i	Set travel units to millimeters
j	Set crosshead speed to maximum speed
k	Set crosshead speed to minimum speed
l	Enter travel limit mode
m	Enter manual mode
n	Transmit travel and force readings
o	Set crosshead speed to programmed speed
p	Request stand status*
q	Request number of cycles completed
r	Request number of cycles set
s	Stop crosshead
t	Reset cycle counter to zero
u	Move crosshead up
v	Request upper travel limit
w	Request lower travel limit
x	Request travel value
z	Reset travel to zero

*The transmission of ASCII "p" will return the stand status. The following are the return codes and their definitions:

Crosshead status	U = crosshead moving up D = crosshead moving down S = crosshead stopped
Operating mode	C = cycle mode L = limit mode M = manual mode
Limit switch status	UL = crosshead at upper limit DL = crosshead at lower limit

Commands relating to Mark-10 force gauges are **not** the same as indicated in their respective user's guides. A list of supported ASCII commands is provided below. All commands must be uppercase:

A	Displays current unit
F	Toggles between Normal and Data Collect modes
P	Steps through Normal mode, Tension Peak mode, and Compression Peak mode
R	Zeroes the force gauge (zeroes all modes)
S	Sends current mode (Normal, Tension Peak, Compression Peak, or Data Collect)
U	Steps through units
X or ?	Sends currently displayed reading
Y	Enables RS-232 output and sends continuous data stream when in Data Collect mode
Z	Zeroes the peak values

The ESM301 is compatible with legacy Nexygen™ TCD software, which also utilizes the above commands. The 09-1162 cable is needed to communicate between a Mark-10 gauge and the test stand.

The 09-1056 serial cable is needed to communicate between a PC and the test stand. Baud rate, stop bits and parity must be programmed in the stand to correspond with the PC software's settings.

While in PC control, if any parameters are changed on the front panel, these settings will be ignored, except if Auto Return or Cycling are turned on. If so, PC control will be turned off automatically.

6 COMMUNICATING WITH MESUR™ GAUGE

The ESM301 can communicate with MESUR™ gauge data collection software. The test stand can output either force data only or force data combined with travel data (if the ESM301(L)-001 integrated travel indication option is installed). To communicate with MESUR™ gauge, certain settings in the test stand and force gauge are required, as follows:

1. Check physical connections (refer to Section 3.4)
2. Force gauge settings
 1. Set to RS-232 output.
 2. Set the baud rate 9,600.
3. Test stand settings
 1. Set the baud rate to 115,200.
4. MESUR™ gauge settings
 1. Select *System Configuration, Gauge + ESM301 / DC Controller with Travel or without Travel* for force vs. time or force vs. distance measurement, respectively.
 2. In the *Port Configuration* tab, set the COM Port number to match the number assigned by *Windows*, accessible in *Device Manager*.

7 FEATURE ACTIVATION

This menu displays the list of available features and indicates which ones are enabled and disabled. Those that are disabled can be activated in the field. Features that are enabled are indicated by **ON**, and those that are disabled are indicated by **OFF**.

7.1 Accessing Feature Activation Menu

While in Operating Mode, press and hold **STOP**, then press **menu** simultaneously, and release both buttons. The display will appear as follows:

KEYS :	OFF
ESC	<- -> ENTR

Label	Description
< -	Scrolls to the previous feature
- >	Scrolls to the next feature
ENTR	Selects the feature
ESC	Exits Feature Activation Menu

7.2 Enabling Features

Features not originally purchased can be activated with an *authorization code*. To activate the feature, scroll through the menu until the desired feature is displayed, then press **ENTR**. If the feature is already enabled (indicated by **on**), pressing **ENTR** has no effect. If the feature is off, pressing **ENTR** will generate a *request code* on the display.

An example is shown below:

KEYS :	0 1 3 9 0 2 7
ESC	+ - ENTR

The *request code* must be supplied to Mark-10 or a distributor, who will then provide a corresponding *authorization code* to activate the feature.

The process for entering the *authorization code* is as follows:

1. The first digit of the *request code* will be flashing. Press **+** to increment the digit. Pressing **+** when the number 9 is displayed will return to 0.
2. Press **→** to advance to subsequent digits, and change them in the same manner.
4. Press **ENTR** when complete. If an incorrect code is entered, the controller will return to the Feature Activation Setup menu, without enabling the feature. If this happens the above process must be repeated.

The Feature Activation Menu also includes a utility with which to disable the password. Scroll through the features until the following is displayed:

DISABLE PASSWORD
ESC < - - > ENTR

Press **ENTR** to generate the *request code*, then follow the *authorization code* procedure as indicated above.

7.3 Demo Mode

All ESM301 test stands are shipped in *Demo Mode*, which provides full functionality of all available features for an evaluation period of 160 operating hours. *Demo Mode* can be suspended by pressing **STOP** while turning on power to the test stand. This mode can be re-enabled in the same manner, and will be active for the remaining time period.

8 TROUBLESHOOTING

1. The ESM301 displays several error messages, as follows:

Error Message	Description
CHECK GAUGE	The force gauge is powered off, in a menu, or not connected to the stand controller. Message appears when overload protection is turned on.
GAUGE COMM ERROR	The stand is attempting to move the crosshead up or down, but it cannot establish communication with the force gauge. The communication settings in the force gauge are not correct or the gauge is in a menu.
GAUGE OVERLOAD	The programmed overload percentage of the force gauge's full scale has been reached. Immediately reduce the force or adjust the overload settings.
M5 1.7+ REQD	A Series 5 force gauge with firmware version 1.7 or later is required for proper operation of the selected functions in the stand.

To clear any of the above errors, press **STOP**. The amber light in the **STOP** button will be blinking when the error message is displayed.

2. The crosshead will move only in one direction, or not at all.

Possible causes:

1. Ensure all cables are plugged in properly, as described in Section 2.2.
2. Ensure that the force value has not exceeded the overload limits configured in the gauge.
3. Ensure that force gauge set points have been configured properly. Refer to Section 5.6 for details.

3. The travel display value does not change when the crosshead moves.

Check to make sure the encoder cable is plugged in properly.

4. Certain menu items are no longer displayed.

All test stand functions are temporarily enabled for 160 hours of operation in *Demo Mode*. When demo mode has expired, any functions (and their associated menu items) not originally purchased will no longer be available.

9 MAINTENANCE AND SERVICE

The ESM301 should be operated in a dry and clean area. Under these circumstances only a few periodic maintenance operations are required:

9.1 Acme screw lubrication – twice per year



1. Remove the right column cover by loosening the screws, as shown above.
2. Using a brush, apply a small amount of silicon-based grease to the lead screw.
3. Cycle the crosshead up and down several times until the newly applied grease has been spread evenly over the length of the screw. Re-install the column cover.

9.2 Check for loosened grips and attachments - daily

Check to ensure that the grips attached to the force gauge and base plate are firmly secured. Looseness could result in a potentially hazardous situation.

Check for loosened components – once per month

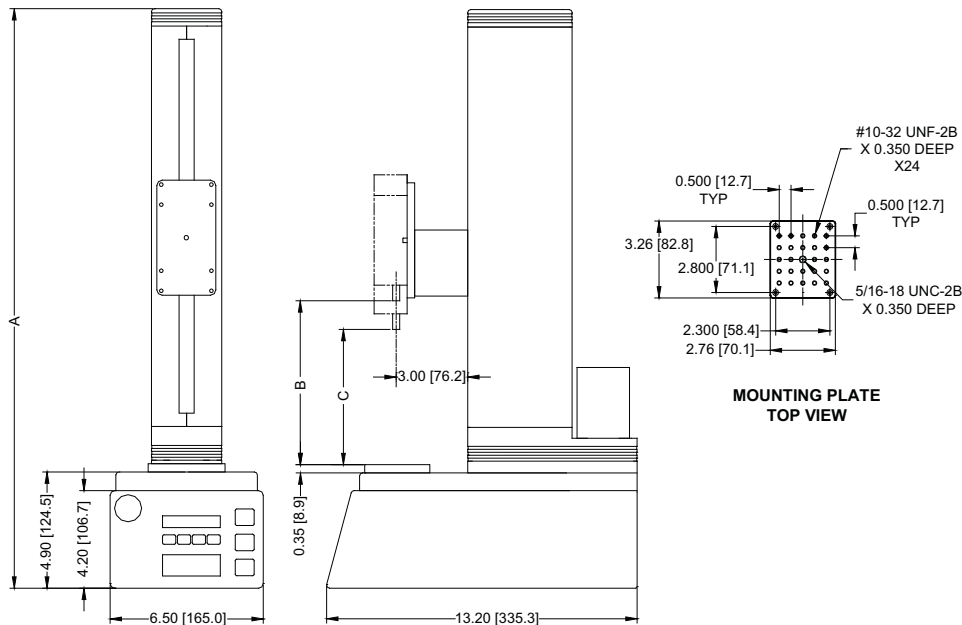
1. Remove the test sample from the test stand.
2. Turn off power to the test stand and disconnect the power cord. Attempt to loosen

subcomponents of the test stand (ex. fasteners, brackets, etc). All components should be firmly attached. If any looseness is detected, stop using the test stand and contact Mark-10 or a distributor for instructions.

10 SPECIFICATIONS

Load capacity:	300 lbF [1.5 kN] @ up to 24 in/min [610 mm/min] 200 lbF [1 kN] @ >24 in/min [>610 mm/min]
Standard speed range:	0.5-13 in/min [13-330 mm/min]
Maximum travel:	ESM301: 11.5 in [292 mm] ESM301L: 18.0 in [457 mm]
Speed setting accuracy:	±0.2%
Speed variation with load:	±0% [Stepper motor driven]
Limit switch repeatability:	0.001 in [0.03 mm]
Travel accuracy:	±0.002 in [0.05 mm]
Travel repeatability:	0.001 in [0.03 mm]
Travel resolution:	0.001 in / 0.02 mm
Power:	Universal input 80-240 VAC, 50/60 Hz
Fuse type:	1.2 A, 250V, 3AG, SLO BLO
Weight (without options):	ESM301: 34 lb [15.4 kg] ESM301L: 39.5 lb [23.7 kg]
Included accessories:	Extension rod, small hook, medium hook, #10-32 coupler, compression plate, force gauge mounting hardware, tool kit
Environmental Conditions:	40 - 100°F [5 - 40°C], max. 96% humidity, non-condensating

11 DIMENSIONS



Model	A	B (Series 3)	C (Series 5/4)
ESM301	24.5 [622]	3.5 - 15.0 [89 - 381]	2.3 - 13.8 [58 - 351]
ESM301L	31.5 [800]	3.5 - 21.5 [89 - 546]	2.3 - 20.3 [58 - 516]

NOTES: