

Digital Controllers Series **DC**

MODEL DC4010 / ESMH-DC

MODEL DC4020 / ESM-DC

MODEL DC4030 / TSFM500-DC

MODEL DC4040 / TSTM-DC

User's Guide



Thank you!

Thank you for purchasing a Mark-10 Series DC digital test stand controller, designed for use with Mark-10 motorized test stands. Mark-10 test stands and controllers are ruggedly built for many years of service in laboratory and industrial environments.

This User's Guide provides setup, safety, and operation instructions for the digital controller. Dimensions and specifications are also provided. Instructions for the test stand may be found in a separate user's guide.

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 a Series DC digital controller and Mark-10 test stands should be fully trained in appropriate operation and safety procedures.

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1 LIST OF INCLUDED ITEMS

Qty.	Item
1	Series DC digital controller
1	Power cord
1	Cable, controller to test frame
1	09-1162 multi-function cable (optional)
1	09-1056 serial cable (optional)
1	RSU100 serial to USB converter (optional)

2 OVERVIEW

Several controller models are available to accommodate different test stands, as follows:

Model	For use with
DC4010	ESMH
DC4030	TSFM500 / TSFM500H
DC4040	TSTM / TSTMH

Series DC controllers have two functional modes:

1. OPERATING MODE

This is the operating mode in which testing sequences can be started and stopped.

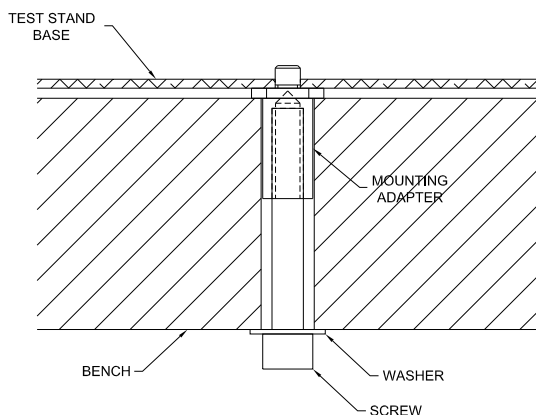
2. TEST PARAMETER SETUP

In this mode, test parameters are configured, such as rate of speed, number of cycles, password editing, and other parameters.

3 MECHANICAL SETUP & SAFETY

3.1 Mounting

The controller should be placed on a clean, flat and level work area free from vibration. If desired, the controller can be secured to the work area with 1/4-20 screws fastened into the underside of the housing. The controller 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 for proper assembly:



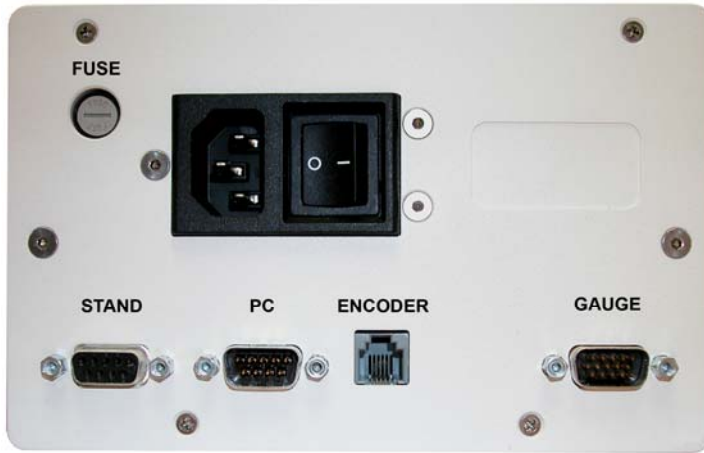
In general, the controller can be mounted at any angle, although extra care should be taken during installation and operation.

3.2 Setting Up The Controller



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



1. Fuse

2. STAND / Controller Cable Connector

Plug one end of the cable into this connector, and the other end into the connector adjacent to the motor on the test stand. If this cable is not connected, the error message **ENCODER ERROR** will be shown on the display and the test stand cannot be operated.

3. PC / PC Control Connector

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. ENCODER / Travel Indication Connector

Applicable for TSTM / TSTMH test stands only

Plug one end of the RJ11 cable into this connector, and the other end into the connector on the underside of the mechanism housing on the test stand.

6. GAUGE / Gauge Cable Connector

Plug one end of the 09-1162 cable into this connector, and the other end into the gauge or indicator.

3.3 Connecting Power

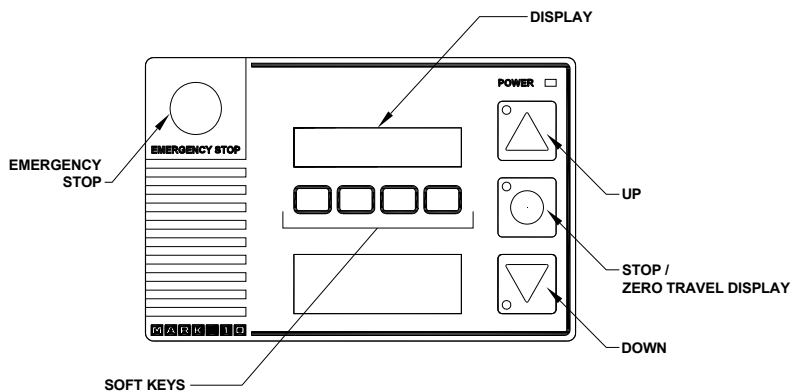
Plug one end of the power cord into its receptacle at the rear of the controller and the other end into a wall outlet with local earth ground (3-prong connector).

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

1. Never operate the controller if there is any visible damage to the power cord or the test stand. The controller is powered by 110V/220V. Any contact with this high voltage can cause serious injury or even death.
2. Ensure that the controller is kept away from water or any other electrically conductive liquids at all times.
3. Make sure the electrical outlet powering the controller has local earth ground (3-prong connector).
4. The controller 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 controller may be powered on and is ready for operation.

4 CONTROLS LAYOUT



SOFT KEYS	Functions are determined by the corresponding text on the display.
UP / RIGHT / CW*	Initiates movement in the up, right, or clockwise direction, depending on the test stand.
DOWN / LEFT / CCW*	Initiates movement in the down, left, or counterclockwise direction, depending on the test stand.
STOP	Stops movement.
EMERGENCY STOP	Stops movement and disables the test stand until reset.

* Although the direction of movement differs between test stands, this user's guide will refer to the buttons as **UP** and **DOWN**.

5 TEST PARAMETER SETUP

This section provides configuration instructions for each test parameter. The initial Test Parameter Setup screen appears as follows:

UNITS:	in/min
ESC	< - - > ENTR

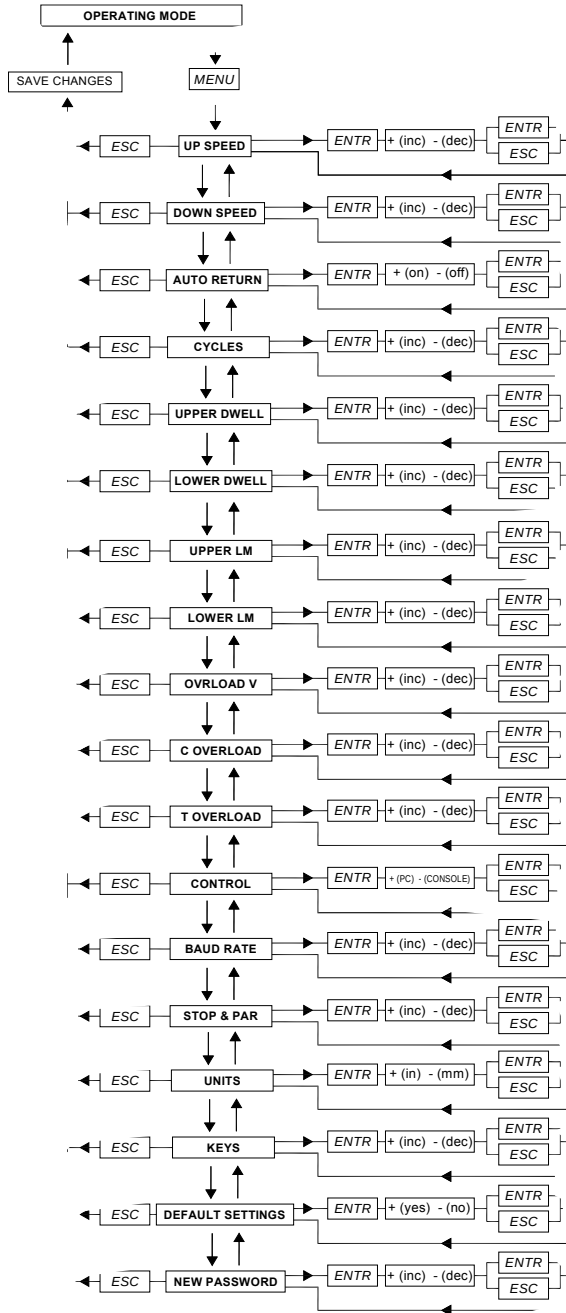


ESC	Exits Test Parameter Setup, reverts to Operating Mode
< -	Scrolls to the previous parameter
- >	Scrolls to the next parameter
ENTR	Selects the parameter, allowing it to be modified

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:



5.1 Speed

Independent speeds can be set for both directions of movement. The parameters are labeled as follows:

Test stand	Parameter labels
ESMH	L SPEED, R SPEED
TSFM500 / TSFM500H	UP SPEED, DN SPEED
TSTM / TSTMH	CW SPEED, CCW SPEED

Default speed settings and available speeds are as follows:

Test stand	Default speed	Available settings in/min [mm/min]
ESMH	10 in/min	0.2 - 50 [5 - 1270]
TSFM500 / TSFM500H	5 in/min	0.01 - 6 [0.2 - 150]
TSTM / TSTMH	6 RPM	0.01 - 15 RPM [0.05 - 90°/s]

UP SPEED:	10.73
ESC	- + ENTR



+	Increments the speed setting. Holding down + will increment at an increasingly faster rate.
-	Decrements the speed setting. Holding down - will decrement at an increasingly faster rate.
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

5.2 Auto Return (AUTO RETURN)

With this feature, the test stand moves to a limit switch, load set point, or travel limit (TSTM / TSTMH only), whichever occurs first, and stops. Then, the test stand returns to the other limit and stops. The test speed is dictated by the independent speed settings. The return speed is always maximum speed.

Default setting: off

Available settings: off, on

AUTO RETURN:	off
ESC – + ENTR	



+ 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.

5.3 Cycling (CYCLES)

This setting allows the user to configure the number of cycles through which the test stand will sequence. One cycle consists of the test stand moving to a limit switch, load set point, or travel limit (TSTM / TSTMH only), 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.

Default setting: 00000 (off)

Available settings: 00000 – 99999

CYCLES:	0 0 0 0 0
ESC – + ENTR	



+	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 two 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

5.4 Dwell Time

This setting corresponds to the amount of time, in seconds, for which the test stand stops at the limit during a cycle sequence. Independent dwell times can be set for both limits.

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

Default setting: 0 (no dwell time)

Available settings: 0 – 9999.9

DWELL U:	0	0	0	0	.	0
ESC	-	+		ENTR		



+	Increases dwell time in increments of .1 sec. 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 sec. 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

5.5 CW and CCW Travel Limits (CW L and CCW L)

Applies to TSTM / TSTMH only

This setting corresponds to the rotational travel distance the test stand moves before stopping or cycling. CW and CCW limits are programmed individually. The programmed distances are relative to the zero position of the test stand. The travel indicator can be zeroed by pressing and holding **STOP** for three seconds.

Default setting: 1 revolution

Available settings: $\pm 2,777.77$ revolutions

CW L:	0	0	0	4	0	.	7
ESC	-		+		ENTR		



+	Increases the travel limit setting. Holding down + will increment at an increasingly faster rate.
-	Decreases the travel limit setting. Holding down - will increment at an increasingly faster rate.
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

5.6 Overload Analog Output Voltage (OVRLOAD V)

This setting corresponds to the full scale analog voltage output of the force or torque gauge. Series DC controllers protect gauges from overload by measuring incoming analog voltage and stopping test stand motion when the programmed percentage of full scale has been reached (see Section 5.7). The value for Mark-10 gauges is $\pm 1V$. Adjustable voltage allows for compatibility with other brands as well.

Default setting: OFF

Available settings: $\pm 1V$, $\pm 2V$, $\pm 4V$, OFF

OVRLOAD V:	+ / - 1		
ESC	-	+	ENTR



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

5.7 Overload Settings (C OVERLOAD and T OVERLOAD or CW OLOAD and CCW OLOAD)

The setting corresponds to the percentage of full scale of the force or torque gauge at which test stand travel stops. For example, a setting of 80% for a 50 lb capacity force gauge would stop test stand motion when 40 lb is reached. Independent settings may be programmed for both load directions (tension and compression, or CW and CCW).

Note: For force test stands, 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. The same concept applies to the CW and CCW directions for torque test stands.

Default setting: 100%

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

C OVERLOAD:		20 %	
ESC	-	+	ENTR



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

5.8 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 controller. Any external commands received through the serial port are ignored.

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



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

5.9 Baud Rate (BAUD RATE)

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

Default setting: 19200

Available settings:

1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

BAUD RATE:	9	6	0	0
ESC	-	+	ENTR	

--	--	--	--

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

5.10 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:	8-1n		
ESC	-	+	ENTR

--	--	--	--

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

5.11 Units of Speed (UNITS)

Default setting: in/min or RPM

Available settings: in/min, mm/min or RPM, °/sec

UNITS:			mm/min
ESC	-	+	ENTR



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

5.12 Programmable Button Function (KEYS)

Three button function modes are available:

- 1. Maintained**
 The test stand will move continuously once the button has been pressed. Subsequently pressing the **UP**, **DOWN**, or **STOP** during a test will stop motion.
- 2. Momentary**
 The test stand 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 motion.

Default setting: maintained

Available settings: maintained, momentary, auto

KEYS:	m a i n t a i n e d		
ESC	-	+	ENTR



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

5.13 Default Settings (DEFAULT?)

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

UP SPEED:	Depends on test stand
DN SPEED:	Depends on test stand
AUTO RETURN:	off
CYCLING:	00000 (off)
CW L:	1 revolution
CCW L:	1 revolution
OVERLOAD V:	OFF
OVERLOAD:	100%
CONTROL:	CONSOLE
BAUD RATE:	19200
STOP & PAR:	8-1n
UNITS:	Depends on test stand
PASSWORD:	0000 (off)
KEYS:	maintained

Default setting: off

Available settings: off, on

DEFAULT?:	N O		
ESC	-	+	ENTR



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

5.14 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. Contact Mark-10 for instructions.

Default setting: 0000 (off)

Available settings: 0000 – 9999

NEW PWORD:	0000
ESC – + ENTR	



+	Increases the number in increments of 1. Holding down + will increment at an increasingly faster rate. If 9999 is reached the next number will be 0000 and continue incrementing.
–	Decreases the number in increments of 1. Holding down – will decrement at an increasingly faster rate. If 0000 is reached the next number will be 9999 and continue decrementing.
ENTR	Returns to the Test Parameter Setup menu
ESC	Exits the parameter without saving changes

6 OPERATING MODES

6.1 Mode Overview

Series DC controllers can be operated in three modes:

- 1. **Basic Mode**
Manual control of test stand movement.
- 2. **Auto Return Mode**
Test stand moves to a limit switch, load set point, or travel distance (TSTM / TSTMH only), whichever occurs first, then reverses and moves at maximum speed to the other limit, whichever occurs first.
- 3. **Cycling Mode**
Test stand cycles between limits at the selected speed, and pauses at each limit for a selected period of time.
- 4. **PC Mode**
Test stand is controlled through a serial connection with a computer.

The Operating Mode screen appears as follows:

Speed:	0 . 0 0
menu min max SET	



On the TSTM / TSTMH test stands, the screen appears as follows:
The item selected will be capitalized, as shown in the figure above. The **set** speed can be changed in Test Parameter Setup. Independent speeds may be programmed for each direction.

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



6.2 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:

Basic & Auto Return Modes:

Speed:	0 . 0 0
menu min max SET	



Cycling Mode:

CYCLES:	0 0 0 2 4
menu min max SET	



PC Mode:

Appears the same as in Basic and Auto Return modes.

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

P A S S W O R D :	0 0 0 0
E S C + - > E N T R	



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.

6.3 Basic Mode

The test stand moves in the direction indicated by the **UP** and **DOWN** buttons. When the test stand is in motion, an LED indicator on the button pushed will be illuminated. The **KEYS** setting controls how test stand movement responds to the push of the **UP** and **DOWN** buttons. The three settings are:

1. **Maintained (default)**

The test stand will move continuously once the button has been pressed. Subsequently pressing **STOP** during a test will stop motion.

2. **Momentary**

The test stand 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 motion. To resume the test, press **UP** or **DOWN** again.

Pressing **EMERGENCY STOP** will immediately stop 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**.

The test stand will move until a limit switch, load set point, or travel distance set point (TSTM / TSTMH only) has been reached. If the test stand has stopped at a load set point or travel distance set point, the limit condition may be overridden by pressing and holding **UP** or **DOWN** for two seconds.

6.3.1 Travel Indication (TSTM / TSTMH only)

Travel indication is displayed in the upper left corner of the display, as shown in Section 6.1. The displayed units are the same as configured in the **UNITS** parameter. Indicated travel is a relative value. To zero out travel distance, ensure that the test stand is not in motion, then press and hold **STOP** for three seconds. If the cable connecting the angle encoder to the rear of the controller is unplugged, the error message **ENCODER ERROR** will appear. To clear the message, insert the cable, then press **STOP**.

6.3.2 Limit Switch Operation

Note: limit switches are standard on the ESMH test stand but are optional on the TSFM500 / TSFM500H test stands. Not applicable for TSTM / TSTMH test stands.

Limit switches allow the operator to set a location along the column at which point the crosshead will stop moving. Adjust the switches' positions by

loosening, repositioning, and re-tightening the thumb screws.

Note: the distance between limit switches must be at least 0.2 in [5 mm].

6.3.3 Overload Protection

The 09-1162 cable is required for overload protection of a Mark-10 gauge. If overload protection is enabled, the test stand will stop when the programmed percentage of full scale of the 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, the error message **GAUGE ERROR** will appear. Plug in the cable and/or turn on the force gauge to clear the message.

Note: For force test stands, 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. The same concept applies to the CW and CCW directions for torque test stands.

6.4 Auto Return Mode

With this setting, the test stand moves to a limit switch, load set point, or travel distance (TSTM / TSTMH only), whichever occurs first, and stops. Then, the test stand returns at maximum speed to the other limit, whichever occurs first, and stops. The speed at which the test stand travels is dictated by the independent speed settings.

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

If the test stand has stopped at a load set point or travel distance set point, the limit condition may be overridden by pressing and holding **UP** or **DOWN** for two seconds.

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

6.4 Cycling Mode

This mode cycles the test stand between limit switches, load set points, or travel distance set points (TSTM / TSTMH only), whichever occurs first. One cycle consists of the following steps:

1. Test stand moves to a limit at the specified speed.
2. Test stand stops for the specified amount of dwell time.
3. Test stand reverses direction, returns to the other limit at the specified speed, and stops.

A cycling sequence can be initiated from any position and can start in either direction. If the test stand 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	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 has ended and the test stand has stopped at a load set point or travel distance set point, the limit condition may be overridden by pressing and holding **UP** or **DOWN** for two seconds.

6.4.1 Dwell time

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

DWELL:	0	0	1	.5
menu	min	max	SET	



If the **DWELL U** and/or **DWELL L** settings are set to 0, the test stand 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:

1. **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.
2. **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.

6.5 PC Mode

The test stand may be controlled by a computer through the Series DC controller via serial communication. A list of supported ASCII commands is provided below. All commands must be lowercase.

Note: Functions relating to distance measurement (indicated with *) are applicable only with the TSTM / TSTMH torque test stands.

a	Request speed
b	Set travel units to inches or revolutions
c	Enter cycle mode
d	Move down or CCW
e	Set speed (xx.xx, ex: e10.00 = 10.00 in/min or 10.00 deg/sec)
f	Set cycles (xxxx, ex: f0500 = 500 cycles)
g or h*	Set lower (g) or upper (h) travel limit <i>Degrees:</i> xxxxxx.x or -xxxxxx.x, ex: g-000090.0 = -90 deg <i>Revolutions:</i> xxxx.xx or -xxxx.xx, ex: h0180.00 = 180 rev
i	Set travel units to millimeters or degrees
j	Set speed to maximum speed
k	Set speed to minimum speed
l*	Enter travel limit mode
m	Enter manual mode
n*	Transmit travel and torque readings
o	Set speed to programmed speed
p**	Request stand status**
q	Request number of cycles completed
r	Request number of cycles set
s	Stop
t	Reset cycle counter to zero
u	Move up or CW
v*	Request upper or CW travel limit
w*	Request lower or CCW travel limit
x*	Request travel value
z*	Reset travel to zero

** The transmission of ASCII "p" will return the stand status, as defined below.

The following are the return codes and their definitions

Test stand status	U = Moving up or CW D = Moving down or CCW S = 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 and torque gauges are NOT the same as indicated in the 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/CCW Peak mode, and Compression/CW Peak mode
R	Zeroes the gauge (zeroes all modes)
S	Sends currently selected mode (Normal, Tension/CCW Peak, Compression/CW 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 currently selected mode

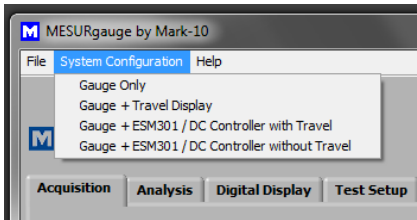
The 09-1162 cable is needed to communicate between a Mark-10 gauge or indicator and the controller.

The 09-1056 serial cable is needed to communicate between a computer and the controller. Baud rate, stop bits and parity must be programmed in the stand to correspond with the computer program's settings. Details on this are provided in Section 5.

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

7 COMMUNICATING WITH MESURGAUGE

Series DC controllers can communicate with MESURgauge data collection software. The test stand can output either load data only or load data combined with travel data. To communicate with MESURgauge, select the appropriate configuration from the **System Configuration** menu, as shown below:



For load vs. distance, select *Gauge + ESM301 / DC Controller with Travel*.

For load vs. time, select *Gauge + ESM301 / DC Controller without Travel*.

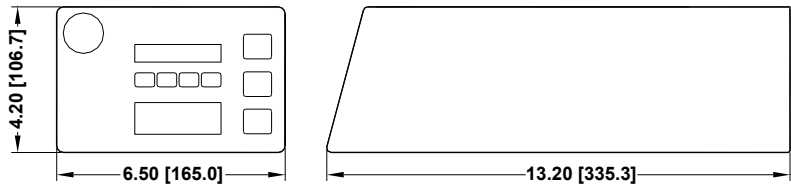
Refer to the MESURgauge user's guide for complete instructions.

8 SPECIFICATIONS

Load capacity	Depends on test stand
Standard speed range	Depends on test stand
Speed setting accuracy	±0.2%
Speed variation with load	±0% [Stepper motor driven]
Travel accuracy:*	±0.7°
Travel repeatability:*	0.01 rev / 0.1°
Travel resolution:*	0.01 rev / 0.1°
Power	Universal input 80-240 VAC, 50/60 Hz
Fuse type	1.2 A, 250V, 3AG, SLO BLO
Weight	11 lbs [5.0 kg]

* Applicable only to the TSTM / TSTMH stands.

9 DIMENSIONS in [mm]



WARRANTY

Mark-10 Corporation expressly warrants to its buyer for three (3) years from the date of delivery that the goods sold are free from defects in workmanship and materials. Mark-10 Corporation will, at its option, repair or replace or refund the purchase price of goods found to be defective. This remedy shall be the buyer's sole and exclusive remedy. Any modification, abuse, exposure to corrosive environment or use other than intended will void this warranty. This warranty is in lieu of all other warranties, including implied warranties of merchantability and fitness for an intended purpose. In no event shall Mark-10 Corporation be liable for any incidental and consequential damages in connection with goods sold or any part thereof.

NOTES



Mark-10 Corporation has been an innovator in the Force and Torque measurement fields since 1979. We strive to achieve 100% customer satisfaction through excellence in product design, manufacturing and customer support. In addition to our standard line of products we can provide modifications and custom designs for OEM applications. Our engineering team is eager to satisfy any special requirements. Please contact us for further information or suggestions for improvement.



We make a measurable difference in force and torque measurement

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REV 3 0113

Torque Test Stands Series **TS**
MODELS TST / TSTH & TSTM / TSTMH

User's Guide



Thank you...



Thank you for purchasing a Mark-10 Series TS Torque Measurement Test Stand. We are confident that you will get many years of great service from this product.

Mark-10 test stands are ruggedly built for many years of service in laboratory and industrial environments.

This User's Guide provides unpacking, setup, and operator instructions for each model in the TS Torque Measurement Test Stand Series. Dimensions and specifications are also provided. For additional information or answers to your questions, our engineering and technical support teams are eager to help you.

Thank you again for your purchase and happy testing!

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1 GENERAL

1.1 Unpacking and Setting up

1. Carefully unpack the test stand from the box and inspect for any damage. Check the contents to ensure that you have received a test stand complete with all accessories – see the list of included items below.
2. Remove the foam from the middle portion of the test stand and remove the plywood caps by unscrewing the pair of screws at each end. For the TST and TSTM models, install the base with four 5/16-18 x 1" screws and the top cap with two 1/4-20 x 5/8" screws. For the TSTH and TSTMH models, install the two column caps with two 1/4-20 x 5/8" screws per cap. Save all packaging materials for any future shipping.
3. Place the stand on a firm, flat and level working surface free from vibration to ensure accurate readings. It is recommended that the test stand be secured to a work bench – see your model's "Operation" section for further details.

1.2 List of Included Items

Item	Quantity	
	TST / TSTM	TSTH /TSTMH
Torque measurement test stand	1	1
Control Unit (TSTM and TSTMH, only)	1	1
Power cord (TSTM and TSTMH, only)	1	1
Base	1	-
Column cap	1	2
5/16-18 x 1" screw for base installation	4	-
1/4-20 x 5/8" screw for column cap installation	2	4
Mounting hole drill template	1	-
Wrench set	1	1

TST / TSTH

2 SETUP AND OPERATION

1. Mount the test stand to a firm, flat, and level working surface for maximum safety and accuracy using four 5/16 screws (not included). Use the included mounting hole drill template to accurately drill the holes. Testing can take place without securing the test stand in such a manner, however, it is strongly recommended that the stand be secured, especially for high torque tests.
2. Install an appropriate sensor and/or indicator onto the slider bracket (an indicator bracket that mounts onto the test stand column is available separately).
3. Install any required attachments, grips, adapters, and other items necessary for your test sample. Ensure that these items are set up in a secure and safe manner.
4. Begin the test by turning the hand wheel in either direction. To maintain smooth operation of the hand wheel, avoid overloads.

The angle dial is adjustable relative to the torque plate. Position the ring by hand to the desired angle.

The slider's position is adjustable along the column in order to engage and disengage the test sample. Move the slider lever clockwise to lower the slider's position closer to the torque plate. The slider may be locked into position by tightening the friction brake knob located on the opposite side of the slider.

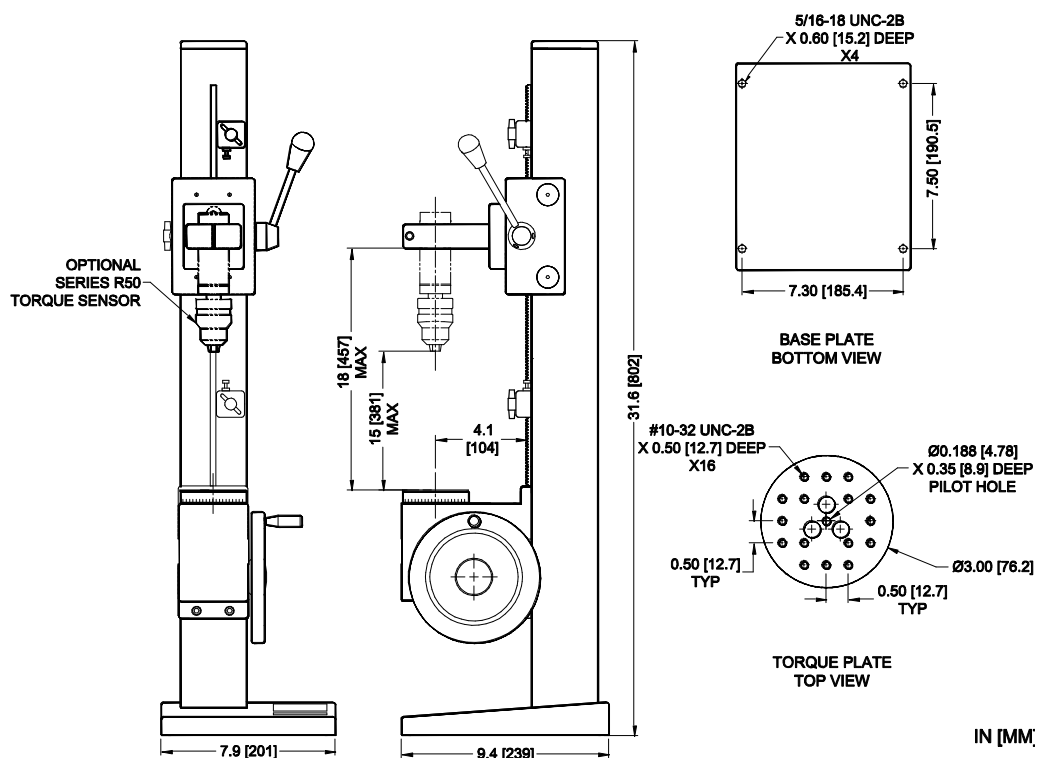
The travel stops' positions can also be adjusted. Loosen the knobs, adjust to the desired positions, and retighten.

3 SPECIFICATIONS

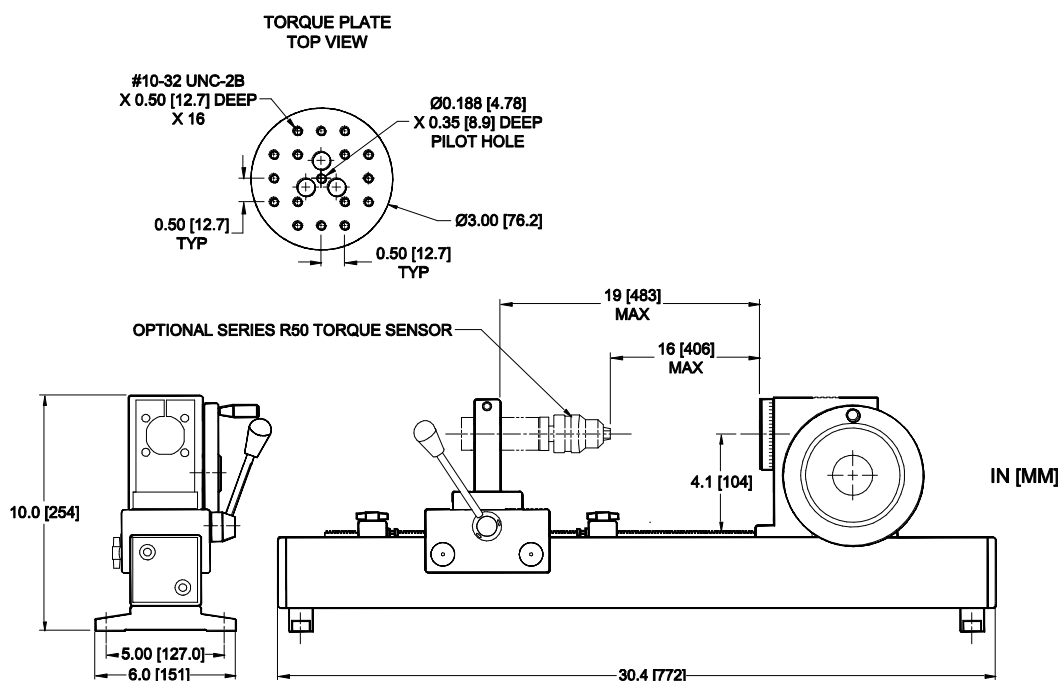
Load capacity:	100 lbFin [11.5 Nm]
Maximum angular travel:	No limit
Angular rate:	12°/wheel rev
Angle dial resolution:	2°
Maximum slider travel:	15.5" [394 mm]
Slider travel rate:	1.05" [26.6 mm]/lever rev
Weight (test stand only):	TST: 33 lb [15 kg], TSTH: 27 lb [12.3 kg]

3 DIMENSIONS

TST



TSTH



TSTM / TSTMH

4 SAFETY TIPS

- Wear eye and face protection when testing. Although the TSTM / TSTMH has relatively slow moving mechanisms, be aware of the dangers posed by potential energies that can accumulate in the sample during testing.
- Keep away from the moving parts of the test stand.
- Never operate the test stand if there is any visible damage to the power cord or the control unit. The TSTM / TSTMH is powered by 110/220 volts that are present in both the power cord and the Control Unit. Any contact with this high voltage can cause serious injury or even death.
- Ensure that the control unit be kept away from water or any other liquids at all times.
- Make sure the electrical outlet powering the test stand has local earth ground (3-hole outlet).
- If it is necessary to remove the cover of the Control Unit or motor drive, always disconnect power before doing so. Use Mark-10 replacement parts, only, if any repairs are needed.

5 SETUP

1. Mount the test stand to a firm, flat, and level working surface for maximum safety and accuracy using four 5/16 screws (not included). Use the included mounting hole drill template to accurately drill the holes. Testing can take place without securing the test stand in such a manner, however, it is strongly recommended that the stand be secured, especially for high torque tests.

With the base or legs of the TSTM / TSTMH removed, the test stand can be easily integrated into large systems such as production lines. In general, any mounting angle is feasible.

The angle dial is adjustable relative to the torque plate. Turn the dial by hand to the desired angle.

The travel stops' positions can also be adjusted. Loosen the wing nuts, adjust to the desired positions, and retighten.

2. Install an appropriate sensor onto the slider bracket. An indicator bracket that mounts onto the test stand column is available separately.
3. Install any required attachments, grips, adapters, and other items necessary for your test sample. Ensure that these items are set up in a secure and safe manner.
4. Plug the Control Unit cable into the 9-pin male connector located adjacent to the motor, then plug the power cord into the control unit and the other end into an electrical outlet with earth ground.
5. Turn on the power switch, located on the Control Unit beside the power cord in the rear of the unit. If applicable, connect the indicator to a computer or printer.
6. Recheck to ensure the sample is secured properly. The TSTM/TSTMH is now ready for use.

6 OPERATION

The slider's position is adjustable along the column in order to engage and disengage the test sample. Move the slider lever clockwise to lower the slider's position closer to the torque plate. The slider may be locked into position by tightening the friction brake knob located on the opposite side of the slider.

The test stand may be operated by motor or by hand. To begin a motorized test, use the Control Unit to operate the test stand (see instructions on the next page). For fine manual adjustment turn the knob on the motor drive in the desired direction.

Using the Standard Control Unit

CCW

Press and hold for counter-clockwise motion, release button to stop. Located on the face of the Control Unit.

CW

Press and hold for clockwise motion, release button to stop. Located on the face of the Control Unit.

SPEED CONTROL DIAL

Adjust speed by turning the dial 0.3 – 8.6 RPM (4 – 52°/s). Located on the face of the Control Unit.

POWER SWITCH

Use this switch, in the left rear of the Control Unit, to turn on and turn off power to the test stand. Power is indicated by an amber light on the face of the Control Unit.

POWER PLUG RECEPTACLE

Located in the left rear of the Control Unit. Plug the power cord in here.

CONTROL CABLE

Plug this cable into the lower male connector on the test stand, adjacent to the motor.

Using the DC4040 Control Unit

This advanced control unit is supplied with the TSTM-DC test stand. Refer to the DC Controllers user's guide for complete instructions.

7 SPECIFICATIONS

Load capacity:	TSTM: 100 lbFin [11.5 Nm] TSTM-DC: 100 lbFin [11.5 Nm] TSTM-DC with SP-2496 upgrade: 200 lbFin [22 Nm]
Speed range:	TSTM: 0.3 - 8.6 RPM [4 - 52°/s] TSTM-DC: 0.01 - 15 RPM [0.05 - 90°/s] TSTM-DC with SP-2624 upgrade: 0.04 - 60 RPM [0.2 - 360°/s] *
Speed variation with load:	±0% (Stepper motor driven)
Speed accuracy:	±5% of setting
Maximum angular travel:	No limit
Manual adjustment:	12°/knob rev
Angle indicator resolution:	2°
Maximum slider travel:	15.50" [394 mm]
Slider travel rate:	1.05" [26.6 mm] / lever rev
Line voltage:	Universal input 80-240 VAC, 50/60 Hz
Fuse type:	1.2 A, 250V, 3AG SLO BLO
Weight (without controller):	TSTM: 35.5 lb [16.1 kg], TSTMH: 29.5 lb [13.4 kg]
Standard Control Unit weight:	2.7 lb [1.2 kg]

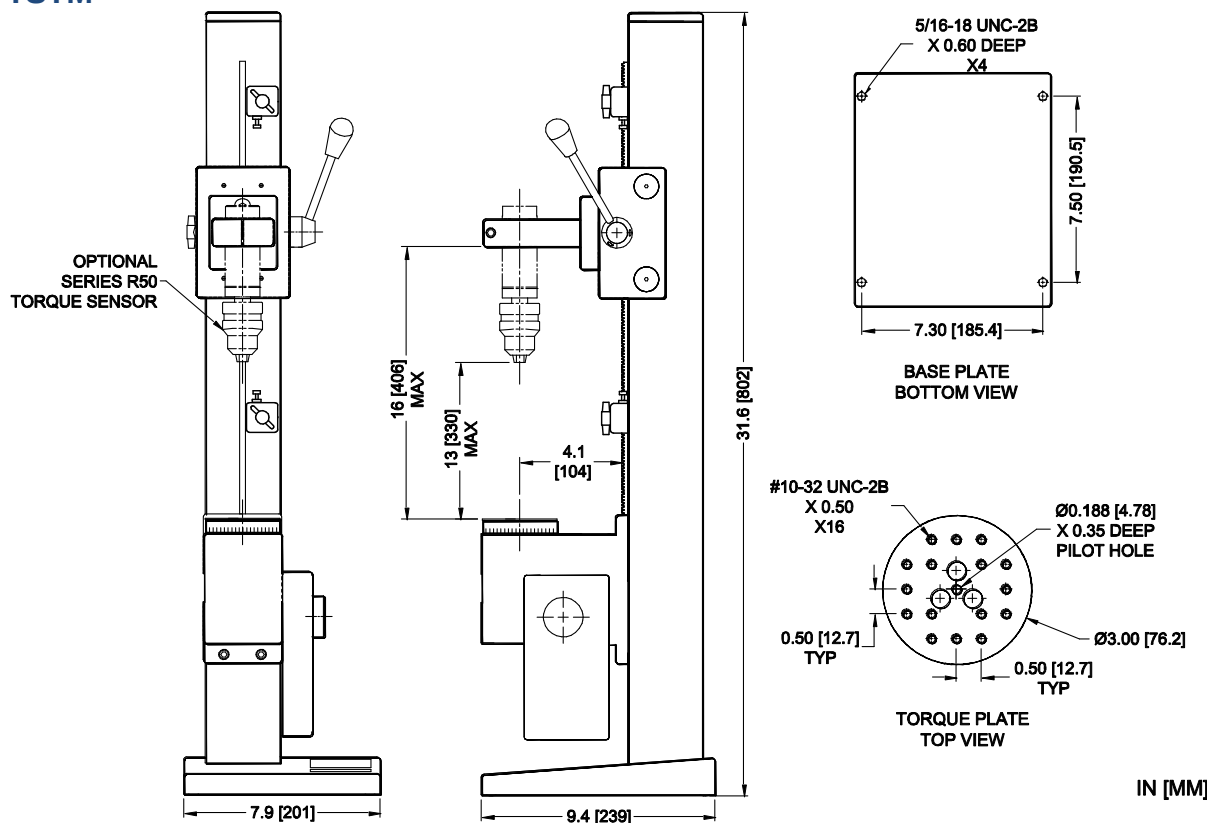
* Maximum torque decreases proportionately with speed. Examples:

- Maximum torque at 60 RPM = 25 lbFin [2.8 Nm]
- Maximum torque at 30 RPM = 50 lbFin [5.6 Nm]

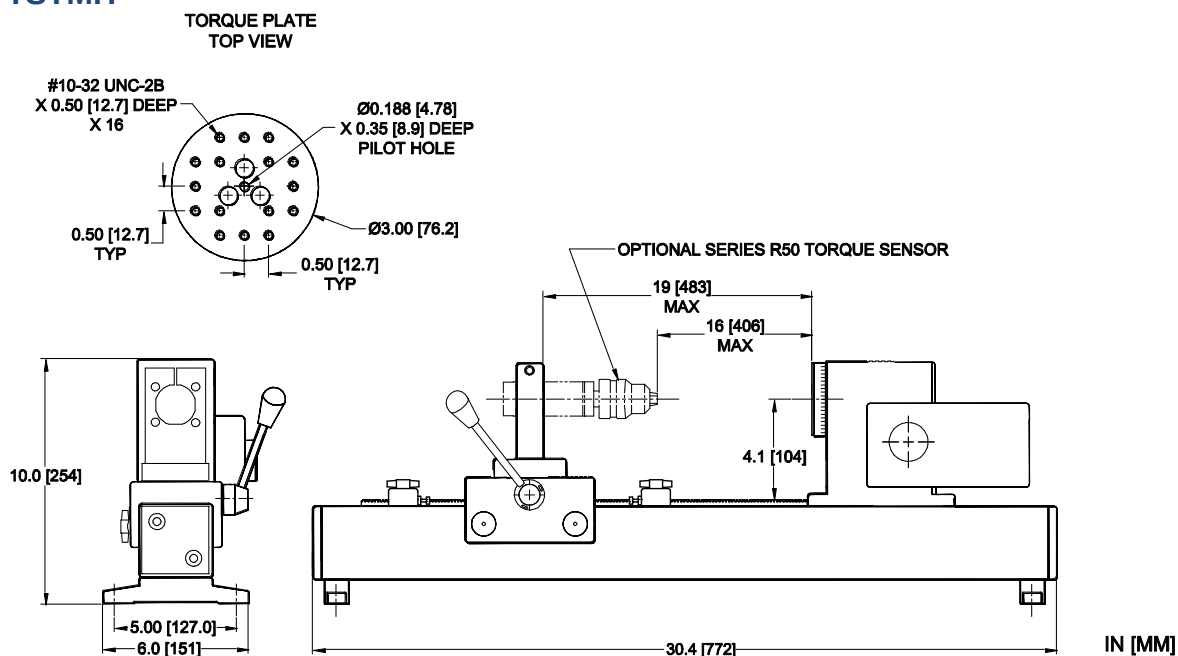
8 DIMENSIONS

in [mm]

TSTM



TSTMH





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