



**MOTORIZED TEST STANDS**

## FMM FRAME OVERVIEW

FMM digital force testers are compact and ideal for high volume, lean manufacturing production. FMM Digital Force Testers may be used manually, with a DFG or DFC digital force gage, or any of the Lx software versions, L1, S1, L2, S2, L2Plus and L3.

FMM testers are available in three capacities: 110lbf (500N), 330lbf (1500N) and 550lbf (2500N). Two travel lengths are available for all capacities: standard travel at 20" (508mm) and extended travel at 30" (762mm). Crosshead speeds are controlled locally and can be set from 0.002 to 40 inch/min (0.05 to 1016mm/min). Quiet even when operating at full speed. Easily upgrade from force gage control to computer based operating using Lx software.



## L1 SOFTWARE

Starrett L1 Systems represent our most-basic, computer-based force testing solution. Optimized for production and quality control testing, they are designed to be easy to setup, operate and maintain.

L1 Systems can be used to perform a wide variety of testing methods including:

- Load Limit Testing
- Distance Limit Testing
- Break Limit Testing
- Cyclic Count Testing
- Cyclic Duration Testing
- Constant Load Testing
- Constant Distance Testing

### BASIC ARCHITECTURE

Your Starrett L1 System is comprised of the following:

- FMM Digital Force Tester
- Base clevis adapter kit
- USB 2.0 communication cable
- BLC Load Cell Sensor
- Load cell mounting block
- 2-in1 Windows® 10 Tablet Computer
- Table computer to column mounting fixture
- L1 Application Software

Communication between the hardware is USB 2.0.

The 2-in-1 L1 tablet features a 10", high-resolution, touchscreen, color display with three USB 2.0 ports.

The L1 application software lets you create your test methods quickly using test templates that guide you through the test setup process. Create common test methods in seconds.



L1-550 system with FMM-550 test frame and L1 tablet and software. Test fixture and BLC Load Cell Sensor are optional.

# TEST FRAMES

## FMM SERIES ECONOMY DIGITAL FORCE TESTERS

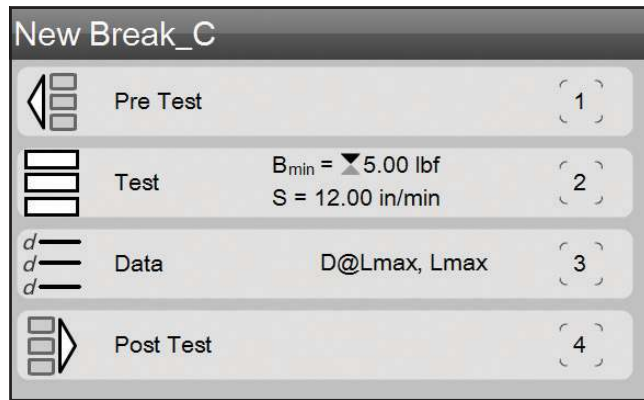
FMM Series Test Frames										
Model		Short Travel			Standard Travel			Extended Travel		
		FMM-110S	FMM-330S	FMM-550S	FMM-110	FMM-330	FMM-550	FMM-110X	FMM-330X	FMM-550X
Load Capacity	N	500	1500	2500	500	1500	2500	500	1500	2500
	kgf	50	150	250	50	150	250	50	150	250
	lbf	110	330	550	110	330	550	110	330	550
Minimum Speed	mm/min	0.05								
	in/min	0.00								
Maximum Speed	mm/min	1000								
	in/min	40								
Max Distance Resolution <sup>1</sup>	mm	0.02								
	in	0.00								
Vertical Test Space <sup>2</sup>	mm	400	400	400	559	559	559	813	813	813
	in	15.6	15.6	15.6	22	22	22	32	32	32
Total Crosshead Travel	mm	305	305	305	508	508	508	762	762	762
	in	12	12	12	20	20	20	30	30	30
Throat	mm	100								
	in	3.9								
Axial Frame Stiffness	kN/mm	2.5	2.6	2.7	2.5	3.1	3.1	2.2	2.5	2.5
	lbf/in	14,200	14,800	15,400	14,200	17,700	17,700	12,500	14,200	14,200
Accuracy Load Measurement		Load Cell Dependent								
Accuracy Position Measurement		±0.001in (20µm) or 0.1% of travel (whichever is greater)								
Accuracy Strain Measurement		N/A								
Accuracy Crosshead Speed		±0.1% of set speed								
Compatible Software		L1, S2, L2, S2, L2Plus, L3, and DFC Control								
Data Sampling	Hz									
Digital I/O		0 - 24Vdc (independent, configurable)								
Extensometer Connections		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Analog Inputs		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Electrical Phase		1								
Power Requirements		100, 120, 220, 230, 240VAC 10%; 47-63Hz Self-identifying								
Operating Temperature	°C	+5° to +43°C								
	°F	+40° to +110°F								
Storage Temperature	°C	+5° to +43°C								
	°F	+40° to +110°F								
Humidity		+10% to +90%, non-condensing								
Base Plate Threads	mm	#10-32, 5/16-18, 1/4-28, 1/2-20 (optional)								
	in	M4 x 0.7, M6 x 1, M10 x 1.5, M12 x 1.75 (standard)								
Total Height	mm	733			940			1194		
	in	28.9			37			47		
Total Width	mm	292								
	in	11.5								
Total Depth	mm	419								
	in	16.5								
Weight	kg	31.8			36.3			95		
	lb	70			80			43		

1. Total vertical space is the distance from the top surface of the base plate to the bottom surface of the crosshead, excludes load cell and fixtures  
 2. Resolution configurable in L3, L2Plus, and L1, fixed in L2, S2, and DFC control

## L1 TEST TEMPLATES

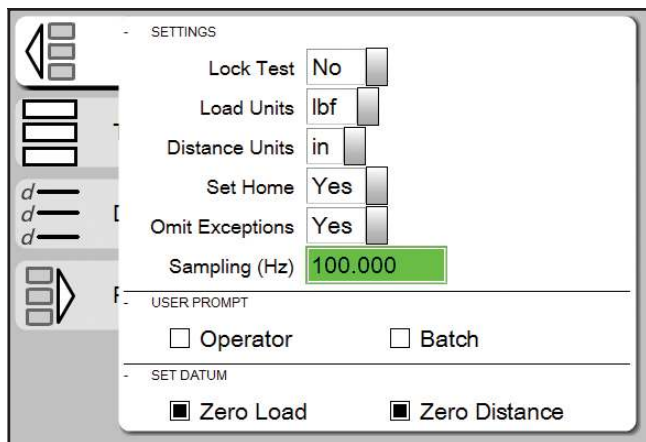
The L1 System includes a set of common force measurement test templates. The templates have a common format consisting of these four test setup stages.

- Pre Test
- Test
- Data
- Post Test



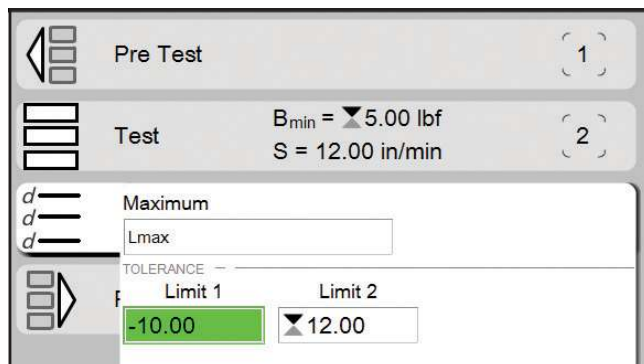
### TEST SETUP ARCHITECTURE

All test setups include four common, easy-to-understand, menu-guided stages: Pre Test, Test, Data and Post Test.



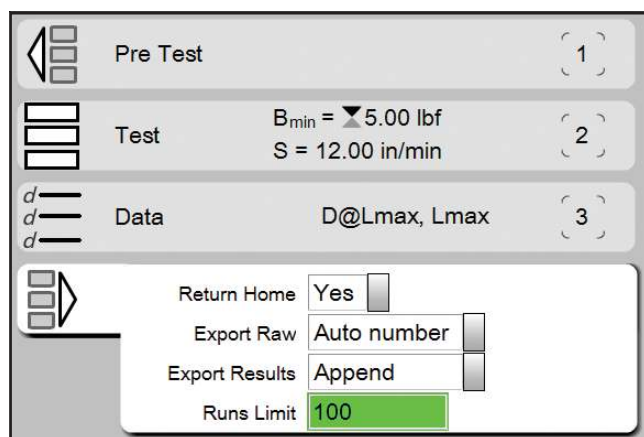
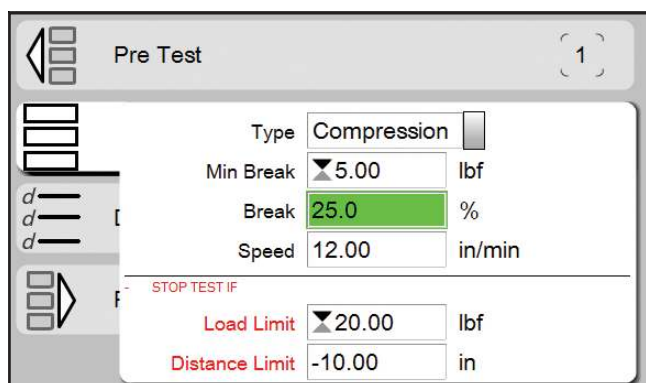
### PRE TEST STAGE

The Pre Test stage supplies options you would perform prior to testing, for example, specifying the units needed to measure load and distance.



### DATA STAGE

The Data stage is where you specify what results you want. For example, you can select Maximum Load, Distance @ Maximum Load, Distance @ Load Limit, Load @ Distance Limit and more. A list of values is displayed and you simply select the result you want. The Data stage is also where you can utilize tolerance limits for immediate "Pass/Fail" identification.



### TEST STAGE

The Test stage is where you specify your testing requirements- what load you are using, what distance your crosshead will move, how fast your test speed is. Plus, you can easily add "exceptions". Exceptions are events that can be used to automatically stop your test, if they occur.

### POST TEST STAGE

The Post Test stage lets you define what you want to do when the test concludes. You can export raw data or just the results and send to a network server. You can easily export directly to Microsoft® Excel® for custom report generation or analysis. Export information is saved as a .csv format for easy integration.

# L1 SOFTWARE

When your L1 test method concludes, you can see the results you specified in your setup. Your L1 System will display results in these formats:

- Results View
- Graph View
- Data View
- Tolerance View
- Statistics View

## RESULTS VIEW

Your results are displayed in a large, easy-to-read format organized for quick interpretation. The result and associated units of measure are displayed. During testing the active load and distance measurement is displayed. The crosshead speed and direction of travel is also displayed so the operator is aware of the current test status.

## GRAPH VIEW

Load, Distance and Time can be used to view the data points used for your test. You may sample at rates up to 1000Hz and display your graph profile for your test. You can select a point on the graph and see the associated load, distance and time. You can also overlay multiple graphs to make graphical comparisons.

Your Test Name is displayed as well as the type of test: compression or tension.

## DATA VIEW

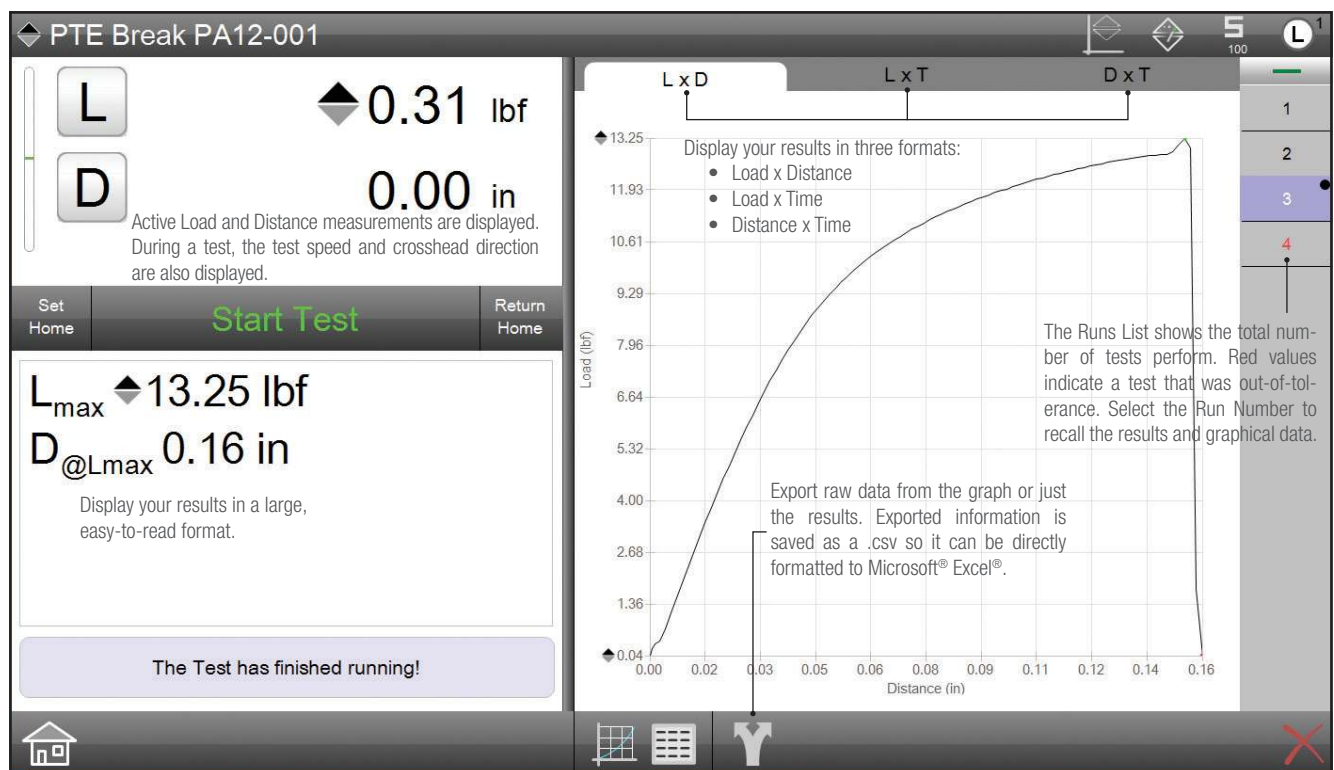
Results can be displayed in a tabular format. This is ideal for a quick comparison of each test in a batch of tests performed throughout the shift or day. You can export directly from the Data view to Microsoft® Excel®.

## TOLERANCE VIEW

When tolerance limits are used for "Pass/Fail" analysis, you can see your tolerance limits compared to actual results. You also see "Pass" or "Fail". Failed results are displayed in red text. And we supply a deviation bar graph that shows where your results measured compared to your tolerance limits.

## STATISTICS VIEW

Common statistics such as mean, maximum, minimum, standard deviation and six sigma may be displayed for all test results.



When the test concludes, your L1 software shows your results in numerical and graphical formats. Essential measurements are displayed in easy-to-interpret formats. You can Start and Stop a test using the touchscreen display; manually set the home position and return the crosshead to home position, and zero your load (L) and distance (D) measurements.



Compare the graphical results of multiple tests that you select. Individual graphs are color-coded and referenced to the test in the Runs List. You can also retrieve archived tests for making a graphical comparison. For example, you can compare a "benchmark" result from a year ago to a current result.

◆ PTE Break PA12-001

L 0.31 lbf  
D 0.00 in

Start Test

L<sub>max</sub> ◆ 15.65 lbf  
D<sub>@Lmax</sub> 4.35 in

The Test has finished running!

Run	Coef	Units	Actual	Limit 1	Limit 2	Deviation	P/F
1	Lmax	lbf	◆ 12.87	◆ 10.00	◆ 15.00	← →	Pass
1	D@Lmax	in	3.19				
2	Lmax	lbf	◆ 12.97	◆ 10.00	◆ 15.00	← →	Pass
2	D@Lmax	in	3.10				
3	Lmax	lbf	◆ 13.25	◆ 10.00	◆ 15.00	← →	Pass
3	D@Lmax	in	0.16				
4	Lmax	lbf	▲ 15.65	▲ 10.00	▲ 15.00	← →	Fail
4	D@Lmax	in	4.35				

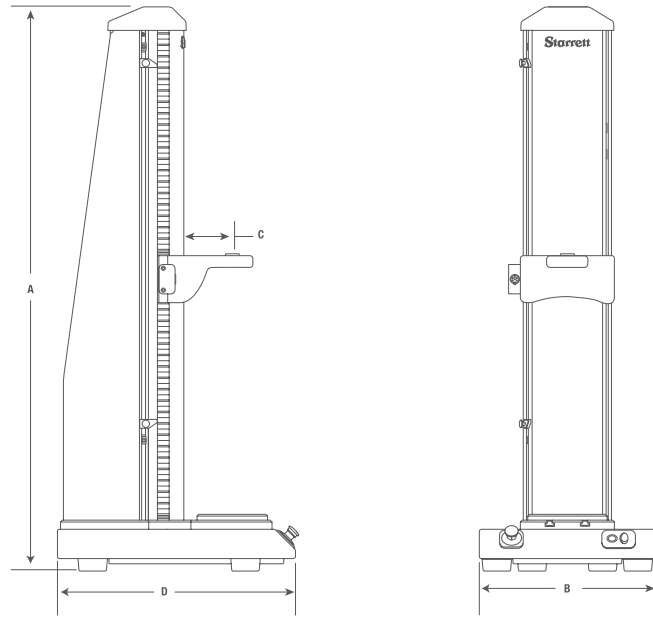
Select the Data view and view results in a tabular format. Easily switch to Graph view by selecting the Graph symbol.

"Pass" and "Fail" status is immediate when using tolerances. Out-of-tolerance results are displayed in red.

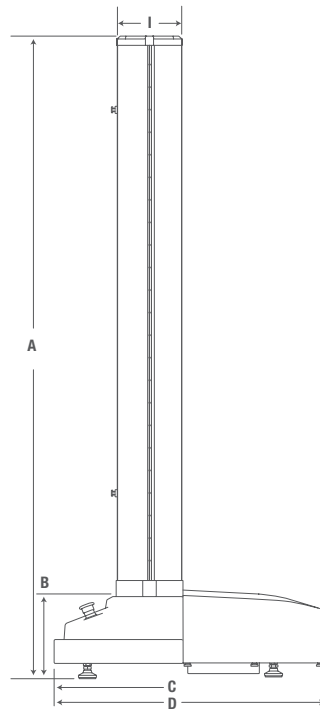
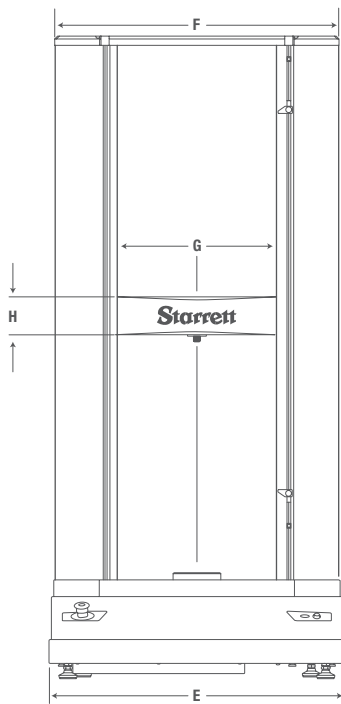
Display results in a tabular format complete with your tolerance limits. Test results that are out-of-tolerance are prominently displayed in red. Out-of-tolerance results are identified in the table, large results view and on the graph view in the Runs List. You can also display statistics on selected test runs. Calculate and display Minimum, Maximum, Mean and Standard Deviation with a single click.

# TEST FRAMES

## DIMENSIONS



Dimensions				
Single Column Test Frames	A	B	C	D
MMS/FMS-1000 Test Frame	47.9 in 1218mm	15.0 in 381mm	4.1 in 105mm	20.3 in 514mm
MMS/FMS-2500 Test Frame	61.9 in 1573mm	15.0 in 381mm	4.1 in 105mm	20.3 in 514mm
MMS/FMS-5000 Test Frame	61.9 in 1573mm	15.0 in 381mm	4.1 in 105mm	20.3 in 514mm

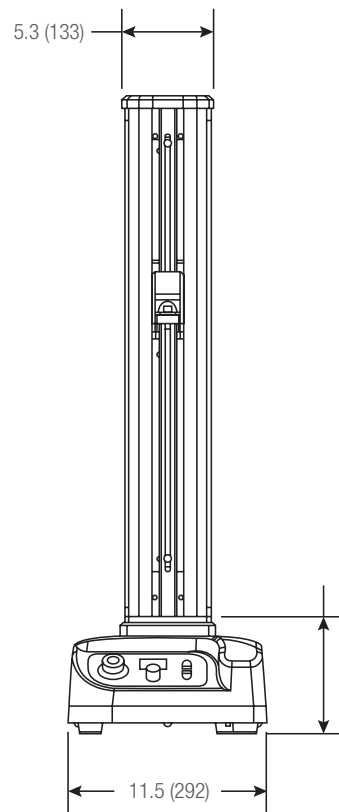
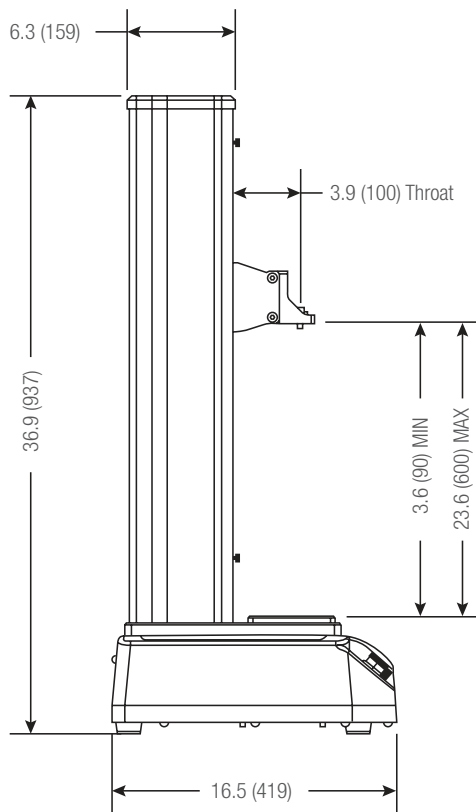


Dimensions									
Dual Column Test Frames	A	B	C	D	E	F	G	H	I
MMD/FMD-10K Test Frame	66.4 in 1685mm	9.4 in 238mm	10.0 in 254mm	28.5 in 724mm	31.0 in 787mm	29.7 in 754mm	16.7 in 424mm	3.0 in 76mm	6.7 in 170mm
MMD/FMD-30K Test Frame	67.4 in 1711mm	10.4 in 263mm	10.0 in 254mm	28.5 in 724mm	31.0 in 787mm	29.7 in 754mm	16.7 in 424mm	4.0 in 102mm	6.7 in 170mm
MMD/FMD-50K Test Frame	67.4 in 1711mm	10.4 in 263mm	10.0 in 254mm	28.5 in 724mm	31.0 in 787mm	29.7 in 754mm	16.7 in 424mm	5.0 in 127mm	6.7 in 170mm

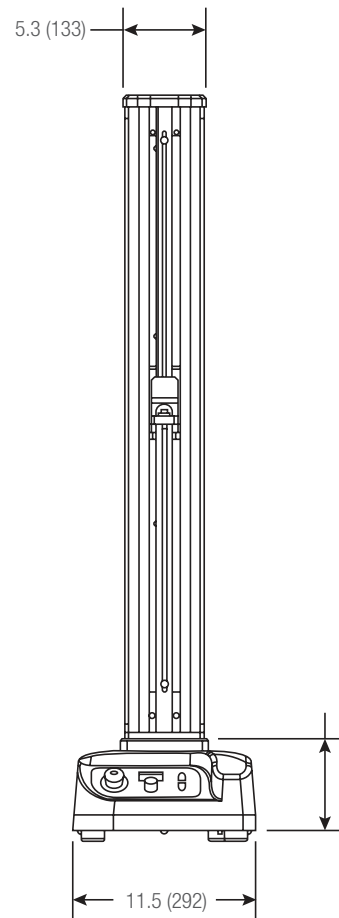
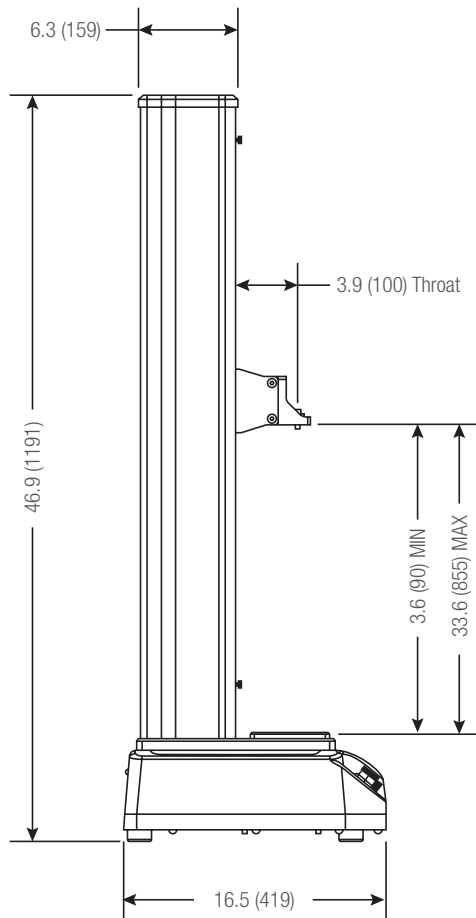


# DIMENSIONS

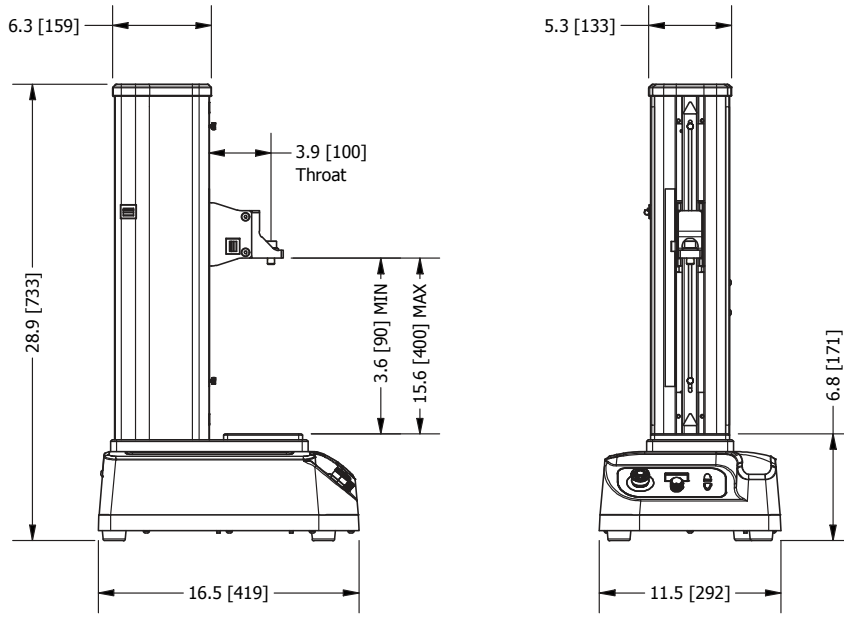
## STANDARD TRAVEL



## EXTENDED TRAVEL

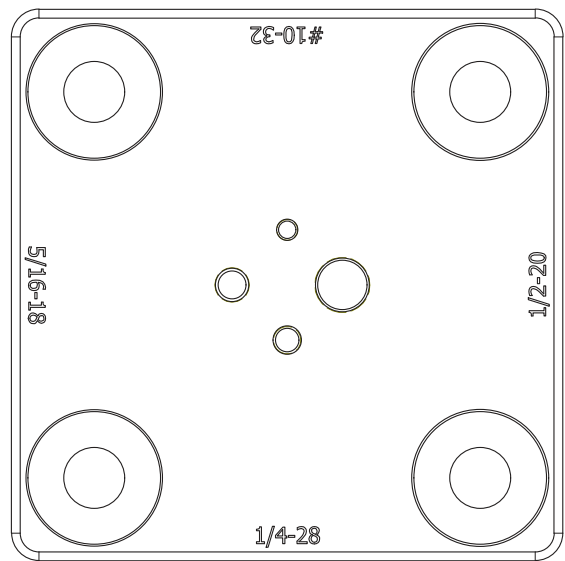
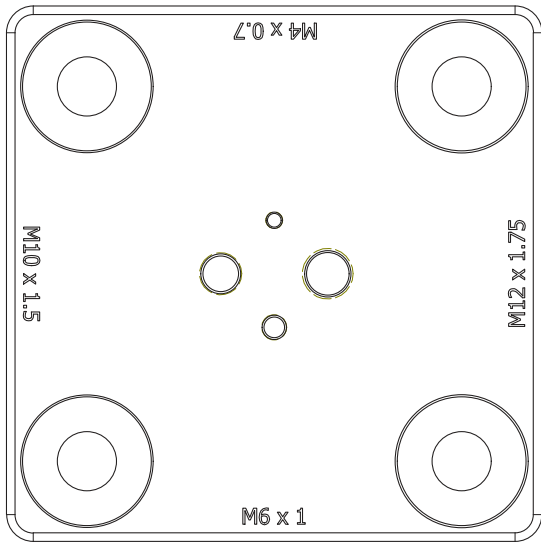


SHORT TRAVEL



The L1-Base-M is included standard on all FMM motorized test stands. Access the M4x0.7, M6x1, M10x1.5, or M12x1.75 threads by rotating the baseplate 90 degrees.

The L1-Base-US is an optional accessory. Access the #10-32, 1/4-28, 5/16-18, or 1/2-20 threads by rotating the baseplate 90 degrees.



# CREATE. TEST. ANALYZE. REPORT.

SOFTWARE



## L3 SOFTWARE

L3 Systems are optimized for users involved with material testing and characterization- the research engineer, the design engineer, the quality control technician, the test technician and others.



## L2 PLUS SOFTWARE

L2 Plus Systems provide engineering and quality personnel with an easy-to-use, yet comprehensive solution for complex force analysis and measurement.



## L2 SOFTWARE

L2 Systems are ideal for demanding force measurement testing. Create complex testing methods or use our standard test templates for all types of force measurement applications.



## L1 SOFTWARE

L1 Systems are great for quality control and incoming inspection. They are engineered to meet the requirements for fast, efficient, high-volume production testing. Combining functionality with affordability.



## S2 SOFTWARE

S2 Systems are application-specific solutions for testing compression and extension springs. Measure spring rate, spring constant, initial tension, free length and more.- fast and efficiently.



## S1 SOFTWARE

S1 Systems represent our most basic digital testing solution for compression and extension springs. S1 systems are ideal for high-volume production testing and individuals looking for more consistent testing results.



## DFC CONTROL

The DFC control option utilizes the DFC hand held force gages universal interface for basic load, distance and break testing. A great entry level economic solution.

Lx Software Product Comparisons and Capabilities							
Target Applications	L3	L2 Plus	L2	L1	S2	S1	DFC
Use for Stress, Strain and Material Testing applications	○						
Use for Advanced Load, Distance and Force Analysis applications	○	○					
Use for Basic Load, Distance and Force Measurement applications	○	○	○	○			
Use for Advanced Extension and Compression Spring applications	○	○					
Use for Basic Extension and Compression Spring applications					○	○	
<b>User Interface</b>							
All-In-On Computer Workstation, Windows® OS	○	○					
Tablet Computer, Windows® OS			○	○	○	○	
Force Gage							○
<b>Software Applications</b>							
Test Builder	○	○	○		○		
Force Quick Test Templates			○	○			
Spring Quick Test Templates					○	○	
Formula Builder	○	⊕	⊕		⊕		
Automation Builder	⊕	⊕	⊕		⊕		
<b>Measurement Methodology</b>							
Measure results using the graph	○	○					
Measure results using a List of Value menu	○	○	○		○		
Create Test Setups using Graphical Test Methods (No programming)	○	○	○		□		
Create Test Setups using Quick-Test Templates			○	○	○	○	
<b>Test Methods</b>							
Tensile Testing, Load, Distance, Break, Rate	○	○	○	○	□		○
Compression Testing, Load, Distance, Break, Rate	○	○	○	○	□		○
Hold Testing, Load, Distance for Duration or Event	○	○	○	○	□		
Cyclic Testing for Duration, Count, Loop or Event	○	○	○	○	□		
Shear Testing	○	○					
Flexural Testing	○	○					
Peel Testing	○	○					
Coefficient of Friction Testing	○	○					
Spring Testing	○	○			○	○	
<b>Measurement Capabilities</b>							
Measure Stress, Strain, Elongation, Strengths	○						
Measure Offset Yield	○						
Measure Modulus (Elastic, Chord, Tangent)	○						
Measure Strain and Elongation using Extensometer(s) (requires MMx test frames)	○						
Measure Energy, Work, Resilience	○	○					
Create Mathematical Expressions using Algebraic, Trigonometric and Logarithmic functions	○	▽					
Create Basic Expressions using Add, Subtract, Multiple and Divide	○	▽	▽		▽		
Use Digital I/O	▽	▽	▽		▽		
Use Analog I/O (requires MMx test frames)	▽	▽					
Use Command and Conditional Logic	▽	▽	▽		▽		
Measure Load, Distance, Time	○	○	○	○	○		○
Measure Minimum, Maximum and Averages	○	○	○	○	○		
Measure Slopes and Intersections	○	○					
Measure Peaks, Valleys, Counts, Averages	○	○					
Measure Break, Rupture	○	○	○	○	□		○
Measure Delta between results within a test	○	○	○				
Measure results within multiple test runs simultaneously (multiview)	○	○					
Measure Spring Rate, Spring Constant, Free Length	○	○			○	○	
<b>Reporting and Exporting Data</b>							
Print using standard reports, graph, batch, tolerance, statistics	○	○	○	○	○	○	
Export results/data in .csv for custom reporting	○	○	○	○	○	○	
Export results/data in .csv for integration with SPC software	○	○	○	○	○	○	
Include tolerances on any result	○	○	○	○	○	○	○

- = Standard
- ⊕ = Optional
- = Requires Test Builder application
- ▽ = Requires Automation Builder application