

Twin Column Testing Frames

***User Guide for
MMD Series Material Testers
FMD Series Force Testers***



Starrett®
The Better Solution



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Product Warranty

Starrett force measurement products carry a one-year (from date of purchase) warranty against defects in material and workmanship (parts and labor), subject to factory inspection.

The L.S. Starrett Company will repair or replace, at its option, any part or parts found to be defective in workmanship or material. Starrett warrants repaired or replaced parts for the balance of the original warranty period or 90 days, whichever is longer. Parts returned to the factory under warranty will be repaired at no charge. Freight charges to the factory will be paid by the customer. Return freight charges to the customer will be paid by Starrett.

This warranty does not cover damages from such causes as abuse, accident, neglect, fire or freight damage. It does not apply to defects resulting from modifications made by the customer or improper use of the system or its components.

Disclaimer of Liabilities

The L.S. Starrett Company shall have no liability or responsibility to the customer or any other person or entity with respect to any liability, loss or damage caused or alleged to be caused directly or indirectly by this documentation, or the hardware described in it. This includes but is not limited to any interruption of service, loss of business or anticipatory profits, or consequential damages resulting from the use or operation of hardware or equipment.

General Safety Precautions

Force measurement systems are potentially hazardous. Prior to operating your testing system, Starrett recommends that you read and understand the instruction manuals for your system and components and that you receive training on the proper use of this equipment from your authorized Starrett representative.

Observe all warnings and cautions identified in this manual for your equipment. A warning identifies a function that may lead to injury or death. A caution identifies a hazard that may lead to damage to equipment or loss of data.

Starrett products, to the best of our knowledge, comply with various national and international safety standards as they apply to material and force measurement testing. This Starrett product has been tested and found to comply with the following recognized standards:

- EN61010-1 Safety Requirements for Electrical Equipment
- EN61000-6-3 EMC Generic Emissions Standard
- EN61000-6-1 EMC Generic Immunity Standard

Starrett also certifies that this product complies with all relevant EU directives and carries the CE mark.

Warning Labels

Listed below are the warning labels used in this manual including their definitions. Please pay particular attention to these labels and sections within this manual denoted with a warning label.



HAZARD: This label identifies a potentially dangerous hazard that may lead to serious injury to personnel.



WARNING: This label alerts the user of a potentially serious hazard that may result in injury to personnel and damage to equipment.



CAUTION: This label advises the user to proceed using caution while performing this action. Failure to do so may harm equipment.



NOTE: This label is used to call-out important information including helpful operating instructions.

Electromagnetic Compatibility

Your MMD Series material test system is designed to comply with International Electromagnetic Compliance (IEC) standards.

To ensure reproduction of this EMC performance, connect this equipment to a low impedance ground connection. Typical suitable connections are a ground spike or the steel frame of a building.

Warnings

Emergency Stop

Press the emergency stop button whenever you feel there is an unsafe condition during a test. The emergency stop button removes power to the motor drive system causing the crosshead to stop.

Flying Debris

Eye protection, protective clothing and splinter/safety shields should be used whenever any possibility exists of a hazard from the failure of a sample, assembly or structure under test. Due to the wide range of materials that may be tested and that may result in a failure which may cause bodily injury, the precautions and preventative methods taken prior to testing is entirely the responsibility of the owner and the user of the equipment.

Crush Hazard

Always use caution when installing or removing apparatus and your sample material between the frame's crosshead and the base. A potential pinch/crush hazard exists. Keep clear of the testing fixture, and particularly the jaw faces at all times. Keep clear of the crosshead during movement. If available, always make sure the Pinch Load feature is enabled. This will stop inadvertent crosshead operation if in manual mode. Always ensure that other personnel cannot operate the system while you are working within the test fixture area.

Electrical Hazard

Disconnect equipment from the electrical power supply before removing any electrical safety covers. Disconnect power when replacing fuses. Never reconnect power while the covers are removed. Never operate the system with protective covers removed.

Rotating Machinery Hazard

Always disconnect power before removing covers that protect the user from the internal rotating mechanisms. If maintenance to the drive mechanism is required, and power is needed to perform maintenance to the drive system, maintenance should be performed by an authorized Starrett representative who has received factory training on performing such procedures.

1.0 Introduction

Thank you and congratulations for selecting the Starrett FMD or MMD Series twin column testing frame.

Your MMD and FMD Series testing frame may be used for tension and compression testing including specific test methods such as peak, break, constant hold, flexural, shear, peel, coefficient of friction and more.

Your MMD and FMD testing frame should be used with Starrett equipment and accessories only.

For optimum performance, your MMD and FMD testing frame should be maintained and serviced annually by an authorized Starrett representative.



HAZARD

MMD and FMD test frames are used in applications with inherent hazards from high forces, rapid motions and stored energy.

Users should be aware at all times of moving components that are potentially hazardous, particularly moving crossheads.

Failure to read and follow all operating instructions can result in serious injury to personnel and damage to equipment and facilities.

Operation and service of MMD and FMD test frames should be by authorized personnel trained in their safe operation.



Starrett Twin Column Test Frames

1.1 System Description

Your Starrett MMD and FMD Series test frames are twin column testing frame that make up any of the following testing systems:

- L3 Series System used for material testing
- L2 Plus Series System used for advanced force measurement and analysis
- L2 Series System use for force measurement

L3 Series System

An L3 Series System uses our L3 Series software operating on an all-in-one touchscreen workstation (L3 Workstation), combined with an MMD Series testing frame. L3 Series Systems are used to measure stress, strain, load, distance, height and time. L3 Series Systems are optimized for research & development, engineering and advanced quality control applications involving material characterization.

L2 Plus Series System

The L2 Plus Series System uses our L2 Plus Series software operating on an all-in-one touchscreen workstation (L2 Plus Workstation), combined with an FMD Series testing frame. The L2 Plus Series Systems are used to measure load, distance, height and time. They cannot be used with extensometers and cannot be used to measure and analyze stress or strain. L2 Plus Series Systems are used for advanced force measurement and analysis.

L2 and S2 Series System

L2 Series Systems are designed for high-volume testing in a production environment. The L2 Series System uses our L2 Series software operating on a table personal computer, combined with an FMD Series testing frame. L2 Series Systems are used to measure load, distance, height and time. The cannot be used with extensometers and cannot be used to measure stress or strain. L2 Series Systems are optimized for the production floor- they are easy-to-use, and provide basic force measurement results.

The S2 Series System is an application-specific system used exclusively for testing compression and extension springs.

MMD Series Test Frames

MMD Series test frames are designed for more complex material testing and therefore, these testing frames have higher performance specifications compared to the FMD Series. MMD Series further distinguish themselves from an FMD Series by having two (2) extensometer inputs, plus optional analog inputs, analog outputs and digital I/O that may be used with ancillary equipment.

FMD Series Test Frames

FMD Series are for high load capacity force testing. FMD Series have lower performance specifications compared to the MMD Series. FMD Series cannot be used with extensometers. FMD Series cannot use analog input or analog outputs. FMD Series can be supplied with optional digital I/O.

1.2 System Safety and Labeling

ISO and ANSI safety labels are affixed to Starrett equipment to alert users and operators of the equipment to warnings and cautions. System users should obey all warnings and cautions and should be trained on the safe operation of this equipment by an authorized Starrett representative.



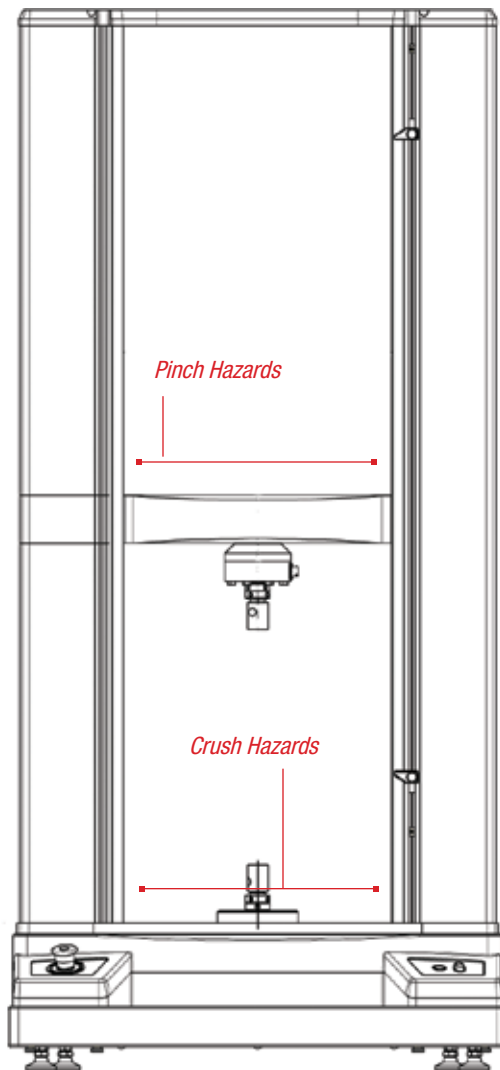
HAZARD

Never operate the MMD or FMD test frame without the protective cover over the mechanical and electronic components.

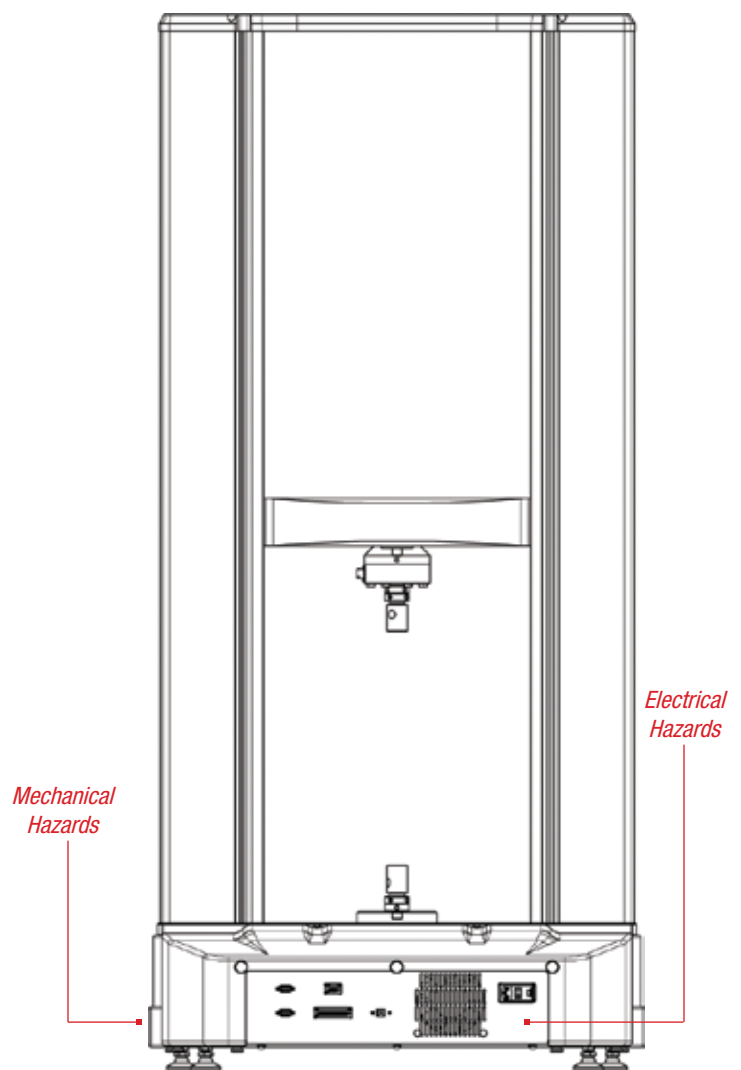


HAZARD

Servicing the MMD or FMD test frame should be performed by authorized Starrett personnel only.



Front view



Rear view

Starrett Twin Column Safety Labels

1.3 Product Support

If you ever require product support for your Starrett system, contact your authorized Starrett representative. Authorized Starrett representatives are listed on our website at www.starrett.com. In the event that your Starrett representative may not be able to assist you, contact Starrett at one of our many international sales offices. Our sales offices are listed on our website at www.starrett.com.

1.4 Calibration and Verification

Your Starrett MMD and FMD Series test frames are calibrated and tested at our factory prior to shipment to you. Our factory calibrations are traceable to national standards. Prior to shipment, Starrett performs the following at our manufacturing facility:

- Force Calibration per ASTM E4
- Displacement Calibration per ASTM E2309/E2309M
- Speed Verification ASTM E2658

If you require an on-site calibration, Starrett or a Starrett authorized representative can perform a calibration at your location to comply with these international calibration standards.



NOTE

MMD Series used for material testing require calibration at the time of installation.

Starrett recommends that you calibrate your system at least annually. More frequently calibrations may be required depending on the frequency of which the system is used. If your system is calibrated to ASTM E4, ASTM E2309/E2309M or equivalent international standards, the system must be calibrated whenever the system is relocated, e.g. moved from its location where the previous calibration occurred.

1.5 Software Options

Your Starrett MMD and FMD Series test frame is designed to be used for material testing and force measurement applications. Starrett offers three different software products, each one optimized for its intended application. The user interface differs depending on the software selected. Force measurement applications utilize a tablet computer operating our L2 Series software or an all-in-one desktop touchscreen computer with our L2 Plus Series advanced force measurement and analysis software. Material testing applications utilize an all-in-one desktop touchscreen computer with our L3 Series material test software. Contact your Starrett representative for assistance in selecting the correct software application for your needs.



FMD Series with L2 Plus Workstation



FMD Series with L2 Tablet Controller

1.5.1 Using L3 Material Test Software

Starrett L3 Series material test software is designed for general purpose material testing application and for use on a variety of materials including metals, composites, rubber, plastic, elastomers, films, foils, adhesives, etc. The software is optimized for use for material characterization, material research & development and material quality and specification verification. L3 Series software supports a variety of testing methods for load, distance, stress, and strain based on industry standards from ASTM, DIN, ISO, TAPPI and others.

1.5.2 Using L2 Plus Force Measurement Software

Starrett L2 Plus Series force measurement software is designed for detailed force analysis in the laboratory. The software is optimized for research & design, engineering and quality control testing where load and distance are measured and where detailed analysis, including force characterization is necessary.

1.5.3 Using L2 Force Measurement Software

Starrett L2 Series force measurement software is designed for high volume production environments. The software is optimized for in-situ production or quality control testing where load and distance are measured on a variety of products including adhesives, medical devices, foam/film, springs, etc.

2.0 System Descriptions

2.1 MMD Series Test Frames

The Starrett MMD Series are twin column, electromechanical test frames designed for material testing applications. The MMD Series are bench top systems ideal for tensile, compression, shear, flexural, cyclic and other forms of testing applications.

Three model test frames are available:

- MMD-10K Series
- MMD-30K Series
- MMD-50K Series

The MMD Series has been designed to be used with Starrett L3 software for material testing operating on an all-in-one, touchscreen computer.

The MMD Series features include:

- Precision motion controls including powerful motors with excellent acceleration and position resolution
- High Axial Stiffness with granite base and adjustable deflection compensation and linear error correction
- Pre-loaded ball screws and bearings and low-stretch belts for outstanding responsiveness and repeatability
- Extra heavy-duty crosshead for testing loads up to 50kN
- Data sampling from 1 to 2000Hz
- USB communications
- Interfaces for up to two (2) extensometers capable of exceeding strain measurement accuracies per ASTM E83, ISO 9513 and EN 10002-4.
- Load measurement using IEEE 1451.4 TEDs-compliant load cell sensors with accuracies up to 0.5% of reading down to 1/1000 of load cell capacity.
- Digital and analog I/O channels for interfacing with ancillary testing equipment or for incorporating programmable logic control
- Easy to use fixture mounting for the many hundreds of different test fixtures and grips that may be used
- Worldwide sales and service support

Test Frame

Your MMD Series test frame consists of a granite base, cast-aluminum base plate, two (2) extruded aluminum columns and a cast-aluminum top plate. The precision aluminum crosshead is engineered for

minimal deflection under full loads at full velocity. Within each column are precision ballscrews. The ballscrews are preloaded. The ballscrews rotated synchronously driven by a precision motion control system. Overall, the system components provide an industry-leading system with extraordinary axial stiffness.

Drive System

The drive system for your MMD Series test frame resides within the back housing protected by a lightweight fiberglass housing. The drive system connects to the lower end of the ballscrews using a belt and pulley system. Motor rotation rotates the ballscrews synchronously which moves the crosshead up or down with excellent position control resolution.

Load String

The load string consists of the load cell sensor, clevis adapter and test fixture. The load cell is mounted to the crosshead using a set screw that secures the load cell to the crosshead surface.

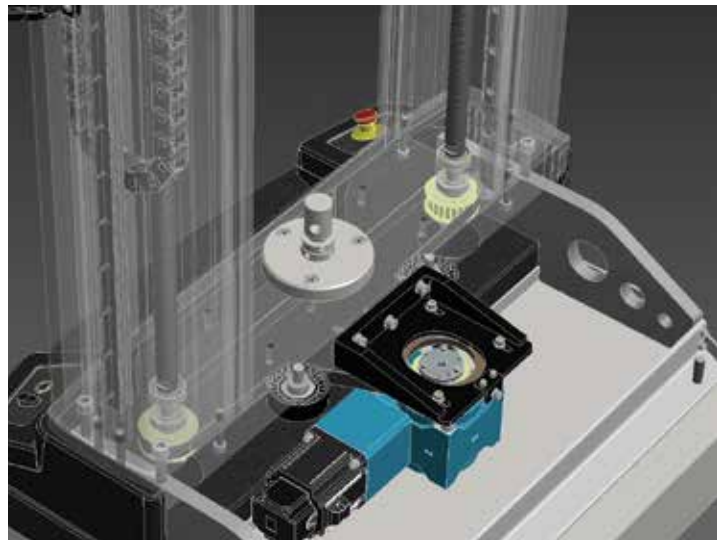
Starrett recommends using low-profile load cell sensors for material testing because of their excellent axial stiffness.

Starrett recommends that your load cell sensor is attached to a base adapter. The base adapter is standard with ULC Series load cells and optional for MLC Series load cells. The base adapter helps ensure a proper surface mounting.

The test fixture is mounted using the clevis adapter. The clevis adapter has an M16 thread and comes in either a 15.9mm or 31.8mm diameter. The clevis adapter threads into the load cell sensors. The test fixture slides onto the clevis adapter and is secured using locking rings and a grip pin.

Communications

Communications between the L3 Series workstation and your MMD Series test frame is via USB 2.0.



MMD /FMD Series System Drive System

2.2 FMD Series Test Frames

The Starrett FMD Series are twin column, electromechanical test frames designed for force testing applications. The FMD Series are bench top systems ideal for tensile, compression, shear, flexural, cyclic and other forms of testing applications.

Three model test frames are available:

- FMD-10K Series
- FMD-30K Series
- FMD-50K Series

The FMD Series has been designed to be used with Starrett L2 Plus software for advanced force measurement testing operating on an all-in-one, touchscreen computer. Or, the FMS Series may be used with Starrett L2 software for basic force measurement testing operating on a tablet personal computer.

The FMD Series features include:

- Precision motion controls including powerful motors with excellent acceleration and position resolution
- High Axial Stiffness with granite base and adjustable deflection compensation and linear error correction
- Pre-loaded ball screws and bearings and low-stretch belts for outstanding responsiveness and repeatability
- Extra heavy-duty crosshead for testing loads up to 50kN
- Data sampling from 1 to 2000Hz
- USB communications
- Load measurement using IEEE 1451.4 TEDs-compliant load cell sensors with accuracies up to 0.5% of reading down to 1/1000 of load cell capacity.
- Digital I/O channels for interfacing with ancillary testing equipment or for incorporating programmable logic control
- Easy to use fixture mounting for the many hundreds of different test fixtures and grips that may be used
- Worldwide sales and service support



MMD/FMD Series System Design

MMD Series Product Specifications

Specification		MMD-10K Series		MMD-30K Series	MMD-50K Series
Load Capacity	kN	10		30	50
	kgf	1000		3000	5000
	lbf	2250		6750	11,250
Crosshead Speed - MINIMUM	mm/min	0.001		0.001	0.001
	in/min	0.00004		0.00004	0.00004
Crosshead Speed - MAXIMUM	mm/min	1500		1500	750
	in/min	60		60	30
Position Control Resolution	µm	0.05		0.025	0.025
	µin	1.9		0.9	0.9
Frame Axial Stiffness	kN/mm	72		150	161
	lbf/in	412,844		855,513	918,367
Vertical Test Space¹	mm	1270		1245	1220
	in	50		49	48
Total Crosshead Travel	mm	1162		1137	1111
	in	45.75		44.75	43.75
Column Spacing	mm	424		424	424
	in	16.7		16.7	16.7
Total Height	mm	1626		1626	1626
	in	64		64	64
Total Width	mm	787		787	787
	in	31		31	31
Total Depth	mm	736		736	736
	in	29		29	29
Test Frame Weight	kg	136		192	225
	lb	300		425	500
Load Measurement Accuracy	±0.5% of reading down to 1/1000 of load cell capacity. Starrett load cell sensors are supplied with a Certificate of Calibration traceable to NIST. Starrett recommends verification of load cell accuracy during installation per ASTM E4, ISO 7500-1 or EN 10002.				
Position Measurement Accuracy²	±0.0002 inch (±5 µm)				
Strain Measurement Accuracy	±0.5% of reading down to 1/50 of full scale with ASTM E83 class B or ISO 9513 class 0.5 extensometer				
Crosshead Velocity Accuracy	±0.1% of set speed at zero or constant load hold				
Data Sampling	1 to 2000Hz				
Digital I/O	12 total channels Channel 1 & 2 for Power (5-24V) Channels 3 thru 10 for either digital inputs or outputs Channels 11 & 12 for Ground				
Analog Inputs	1 channel @ ±10V				
Analog Outputs	2 channels @ 0-10V				
Extensometer Ports	2 channels for independent connection to an extensometer(s)				
USB Interface	1 USB 2.0 connector				
Single Phase Voltage (Vac) ±10%		100-120Vac	220-240Vac	220-240Vac	220-240Vac
Maximum Power (A)	Amps	4.0	1.5	3.7	3.7
Frequency	50/60Hz				
Operating Temperature	°C	+10 to +38 °C			
	°F	+50 to +100 °F			
Storage Temperature	°C	-40 to +66 °C			
	°F	-40 to +150 °F			
Humidity	10% to 90%, non-condensing				
CE Compliance	MMD Series Systems meet all relevant CE standards				

Notes:

- 1 Total vertical space is the distance from the top surface of the base plate to the bottom surface of the crosshead, excluding load cell sensor, test fixtures, and clevis adapter.
- 2 Assumes Linear Error Correction and Deflection Compensation have been performed on test frame.

FMD Series Product Specifications

Specification		FMD-10K Series		FMD-30K Series	FMD-50K Series
Load Capacity	kN	10		30	50
	kgf	1000		3000	5000
	lbf	2250		6750	11,250
Crosshead Speed - MINIMUM	mm/min	0.001		0.001	0.001
	in/min	0.00004		0.00004	0.00004
Crosshead Speed - MAXIMUM	mm/min	1500		1500	750
	in/min	60		60	30
Position Control Resolution	µm	0.05		0.025	0.025
	µin	1.9		0.9	0.9
Frame Axial Stiffness	kN/mm	72		150	161
	lbf/in	412,844		855,513	918,367
Vertical Test Space¹	mm	1270		1245	1220
	in	50		49	48
Total Crosshead Travel	mm	1162		1137	1111
	in	45.75		44.75	43.75
Column Spacing	mm	424		424	424
	in	16.7		16.7	16.7
Total Height	mm	1626		1626	1626
	in	64		64	64
Total Width	mm	787		787	787
	in	31		31	31
Total Depth	mm	736		736	736
	in	29		29	29
Test Frame Weight	kg	136		192	225
	lb	300		425	500
Load Measurement Accuracy	±0.5% of reading down to 1/1000 of load cell capacity. Starrett load cell sensors are supplied with a Certificate of Calibration traceable to NIST. Starrett recommends verification of load cell accuracy during installation per ASTM E4, ISO 7500-1 or EN 10002.				
Position Measurement Accuracy²	±0.001inch (±20 µm)				
Crosshead Velocity Accuracy	±0.1% of set speed at zero or constant load hold				
Data Sampling	1 to 2000Hz				
Digital I/O	12 total channels				
	Channel 1 & 2 for Power (5-24V)				
	Channels 3 thru 10 for either digital inputs or outputs				
	Channels 11 & 12 for Ground				
USB Interface	1 USB 2.0 connector				
Single Phase Voltage (Vac) ±10%		100-120Vac	220-240Vac	220-240Vac	220-240Vac
Maximum Power (A)	Amps	4.0	1.5	3.7	3.7
Frequency	50/60Hz				
Operating Temperature	°C	+10 to +38 °C +50 to +100 °F			
	°F				
Storage Temperature	°C	-40 to +66 °C -40 to +150 °F			
	°F				
Humidity	10% to 90%, non-condensing				
CE Compliance	MMD Series Systems meet all relevant CE standards				

Notes:

1 Total vertical space is the distance from the top surface of the base plate to the bottom surface of the crosshead, excluding load cell sensor, test fixtures, and clevis adapter.

2 Assumes Linear Error Correction and Deflection Compensation have been performed on test frame.

2.3 Common Specifications

2.3.1 Power Requirements

The power specifications for Starrett MMD and FMD Series testing frames are shown below.

Models	Electrical Phase Single Phase (Vac) $\pm 10\%$	Maximum Power (A)	Frequency (Hz)
MMD-10K FMD-10K	100-120Vac	4.0	50/60
MMD-10K FMD-10K	220-240Vac	1.5	50/60
MMD-30K FMD-30K	220-240Vac	3.7	50/60
MMD-50K FMD-50K	220-240Vac	3.7	50/60

Power Specifications



CAUTION

Your MMD Series requires “clean” and stable electrical power. Power fluctuations and surges may cause performance problems that may lead to extensive damage to your test frame.



NOTE

An in-line power surge protector is recommended for all installations.

2.3.2 Fuse Ratings

See Fuse Table (below).



HAZARD

Make sure to shut all power to your MMD or FMD Series test frame to OFF. Dangerous voltage may cause personal injury.



NOTE

The MMD-10K and FMD-10K Series used with 100V or 120V input power use two (2) 6.3A slow-blow fuses.



NOTE

All MMD and FMD Series used with 220-240V input power use two (2) 3.5A slow blow fuse.



WARNING

Always replace the fuse with the correct type and amp rating.

Model	Input Power	Frequency	Fuse Type	Fuse Size	Number Required	Littlefuse Brand Part Number
FMD-10K MMD-10K	100-120Vac 4.0A	50-60Hz 6.3A	Slow-Blo	5 x 20mm	2 each	021806.3MXP
FMD-10K MMD-10K	220-240Vac 1.5A	50-60Hz 3.15A	Slow-Blo	5 x 20mm	2 each	02183.15MXP
FMD-30K MMD-30K	220-240Vac 3.7A	50-60Hz 6.3A	Slow-Blo	5 x 20mm	2 each	021806.3MXP
FMD-50K MMD-50K						

Fuse Specifications

2.3.3 Noise Level Rating

The noise output for your MMD and FMD Series does not exceed 70dBa. Noise levels do not include noise from specimen breaks.



WARNING

Noise caused by sample fracture may exceed 70 dBa, therefore, personal ear protection is recommended for these types of applications.

2.3.4 Environmental Specifications

Your MMD and FMD Series is designed for use under normal laboratory conditions. Protective measures may be required if excessive dust, corrosive fumes, electromagnetic fields or hazardous conditions are encountered.

MMD Series	Specification
Operating Temperature	+10°C to +38°C (+50°F to +100°F)
Storage Temperature	-40°C to +66°C (-40°F to +150°F)
Humidity	10% to 90% non-condensing
Environmental Conditions	Designed for use under normal laboratory conditions. Protective measures maybe required if excessive dust, corrosive fumes, electromagnetic fields or Hazardous conditions are encountered.

Environment Specifications

2.3.5 Cyclic Testing

Cyclic testing is defined as tests where the frame constantly reverses direction. Cyclic testing on MMD and FMD test frames is limited to a continuous 24 hour duration @ 1Hz sampling.



CAUTION

The MMD and FMD test frames are not suitable for fatigue testing applications.

2.3.6 Load Hold Testing

Constant load testing is defined as tests where the frame maintains a constant load for a specified period of time, e.g. creep and relaxation applications. Cyclic testing on MMD and FMD test frames is limited to a continuous 24 hour duration at 1Hz sampling rate.

2.3.7 Frame Weights

MMD and FMD Series weights are listed below, including dimensions.

Model	Machine Weight	Shipping Weight ¹	Height mm/in	Width mm/in	Depth mm/in
MMD-10K FMD-10K	136 kg 300 lbs	~320 kg ~700 lbs	1626mm 64 in	787mm 31 in	736mm 29 in
MMD-30K FMD-30K	192 kg 425 lbs	~340 kg ~750 lbs	1626mm 64 in	787mm 31 in	736mm 29 in
MMD-50K FMD-50K	225 kg 500 lbs	~360 kg ~800 lbs	1626mm 64 in	787mm 31 in	736mm 29 in

Physical Weights and Dimensions

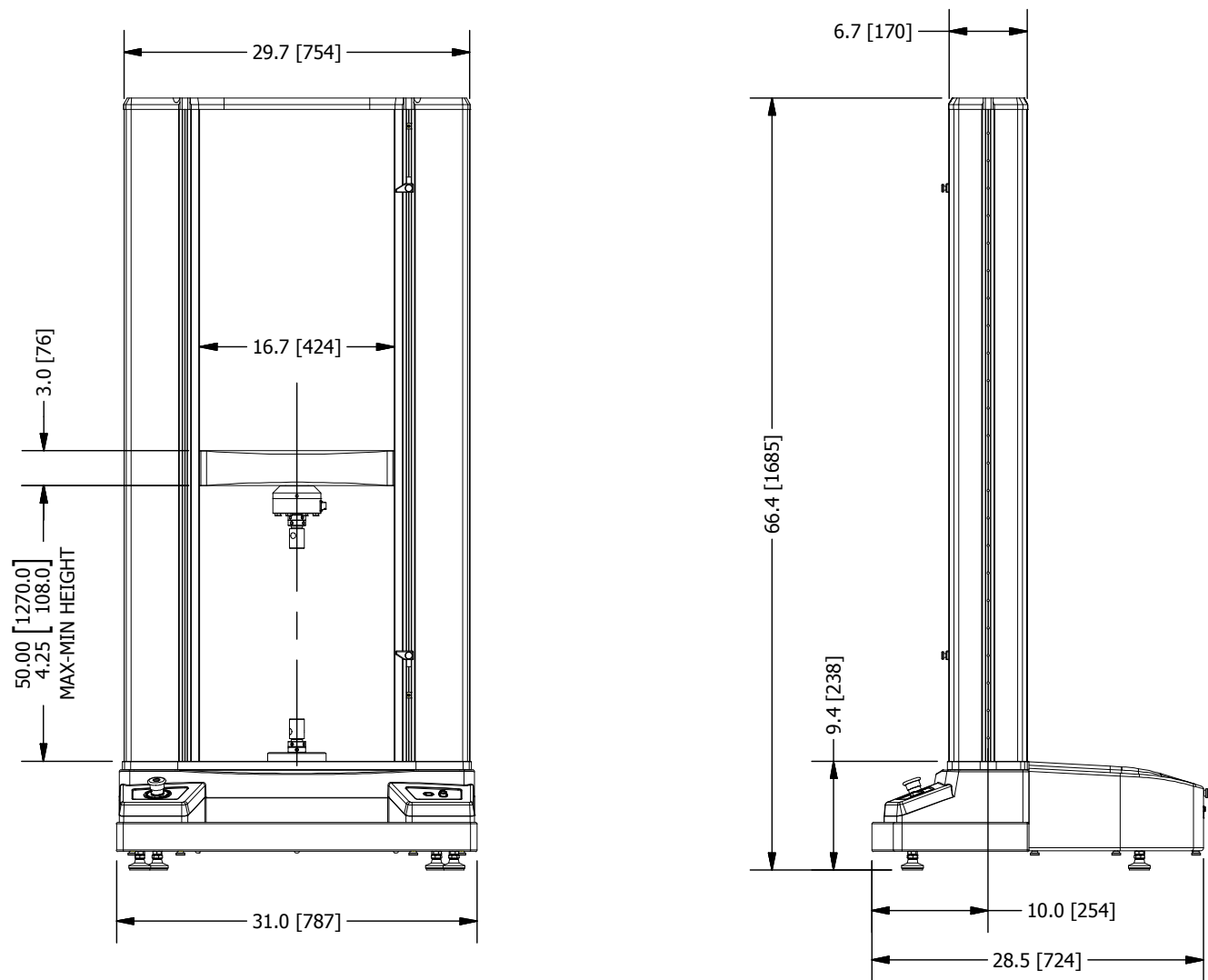
¹ The shipping weight will vary depending on the accessories included with your order. Accessories are packaged in a single shipping crate.



NOTE

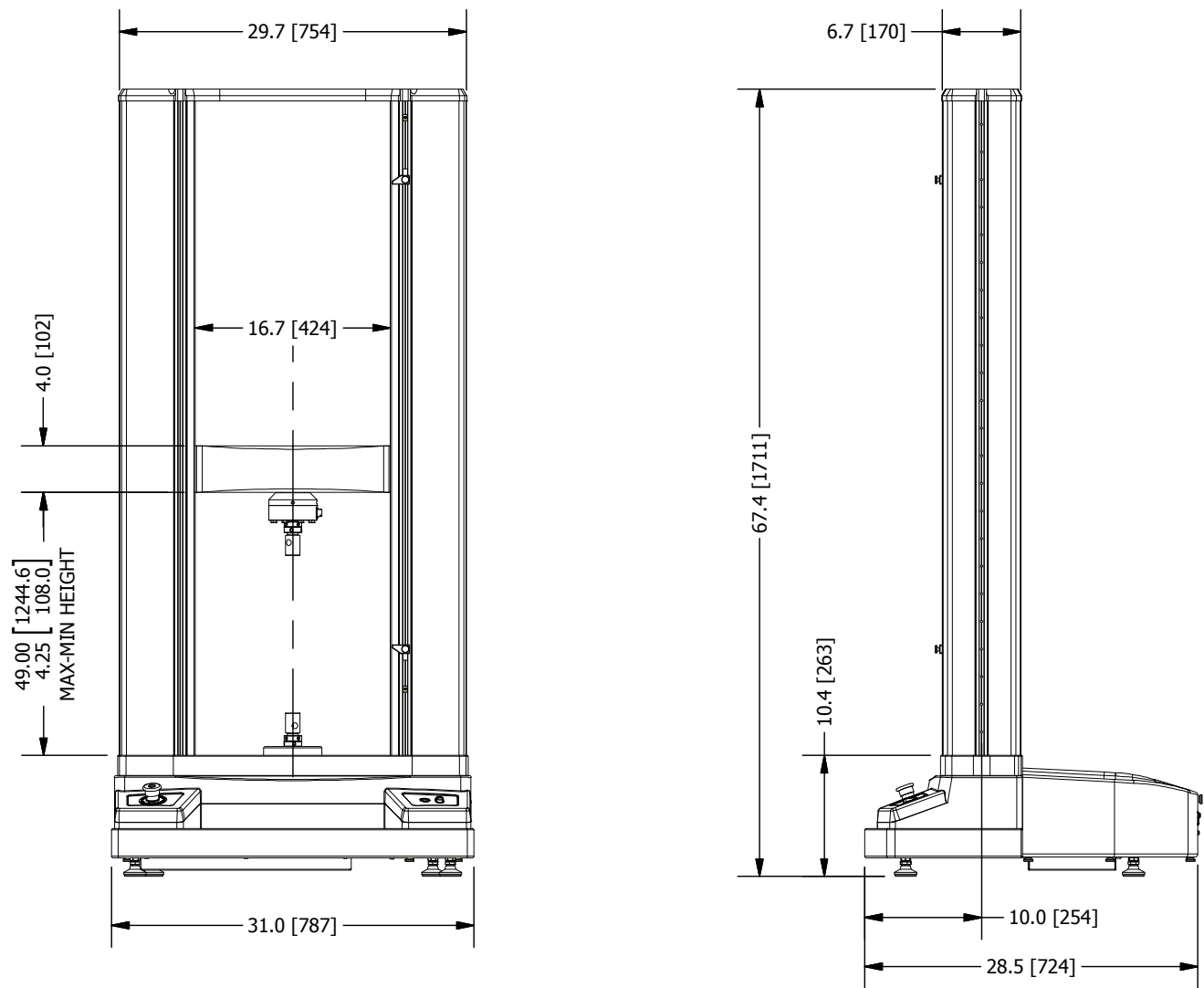
All shipping containers used for the 10K, 30K and 50K frames are 38.5" W x 36" D x 74" H (97.8 x 91.4 x 188.0 cm).

2.4 MMD and FMD Dimension Drawings



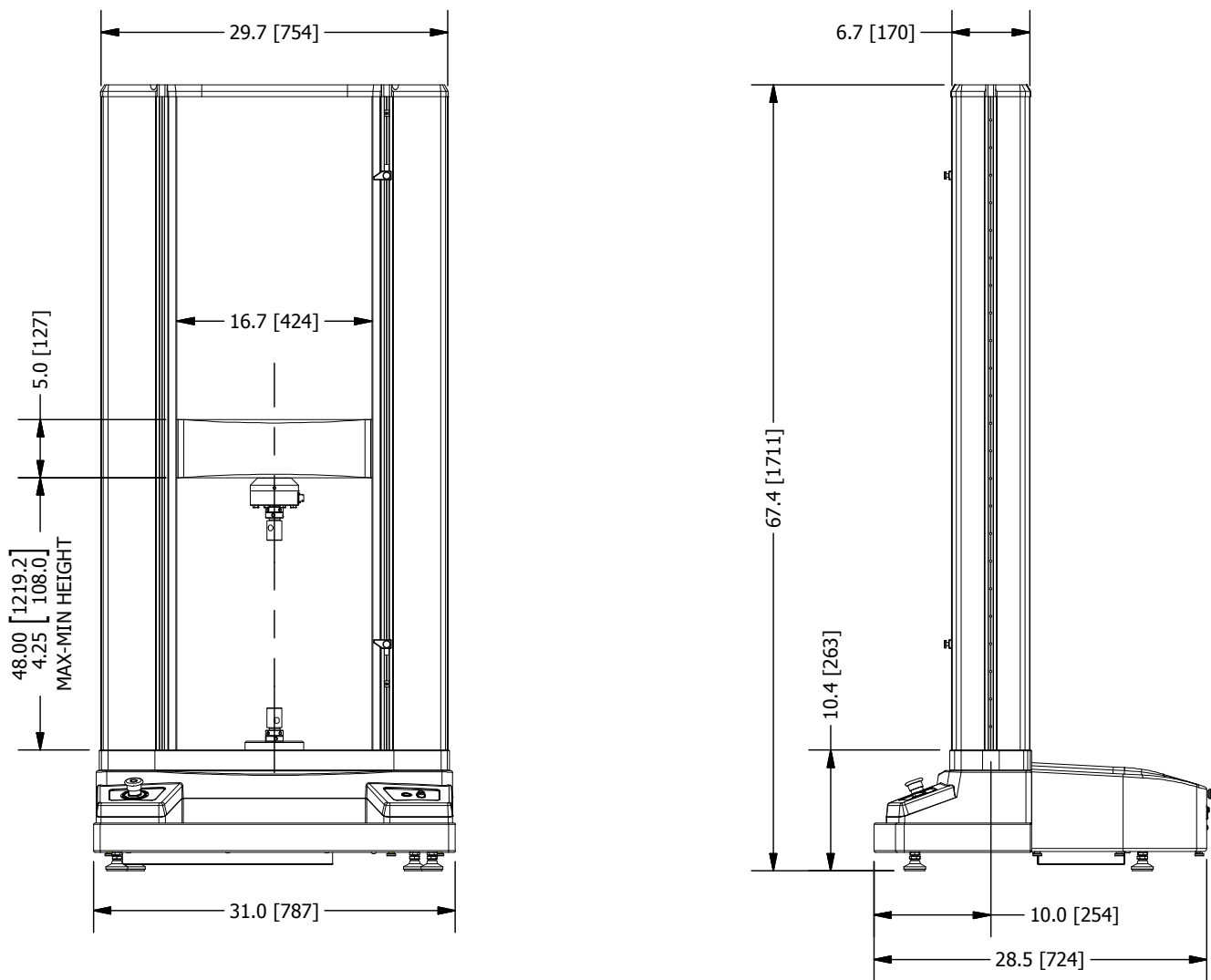
10kN Load Capacity Series Test Frames

MMD and FMD Dimension Drawings



30kN Load Capacity Series Test Frames

MMD and FMD Dimension Drawings



50kN Load Capacity Series Test Frames

3.0 Lifting and Handling

The MMD and FMD Series twin column testing frames are heavy. Any lifting and positioning should be done by authorized personnel in accordance to local safety standards, e.g. training required by Occupational Safety and Health Act (OSHA) in the United States, or comparable safety standards when installed internationally.

Proper rigging equipment is required for lifting and positioning all MMD and FMD Series test frames. Personnel responsible for test frame lifting and position must follow the instructions within this manual. Personnel should contact Starrett if they have any questions about how to safely lift and position the MMD or FMD Series test frames.

Starrett recommends leaving the MMD and FMD Series test frame in its packaging while moving the instrument to its final site location within your facility.



CAUTION

Make sure hallways and door openings are large enough to safely move your MMD and FMD Series to its final site location.

Make sure that floors leading to the final site location are rated to support the weight of the MMD and FMD Series while in its Starrett Packaging.



*Lift by Crosshead
Do NOT lift by top plate*

3.1 General Precautions

Starrett recommends that only individuals experienced with the operation of lifting equipment and rigging techniques should attempt to lift or move your MMD and FMD Series testing frames.

Equipment operators must have the appropriate licenses and have complied with your local safety standards (e.g. the appropriate training required by OSHA in the U.S. or appropriate safety institutions around the world).



WARNING

NEVER lift the frame by the top plate. This plate does not support the weight of the frame. The plate could break and cause personal injury and equipment damage.



WARNING

Do not use a lifting device or straps rated for less than twice the weight of the load frame. All lifting devices and straps must be rated for a capacity at least twice the weight of the load frame.



WARNING

Do not tilt an unsupported load frame more than 15-degrees when it is in the upright position.

3.2 Unpacking Your System

Starrett recommends that you wait to unpack your MMD or FMD Series once it has been located in its final site location.

Your MMD and FMD Series should be moved using a forklift or crane to its final site location.

Starrett uses environmentally safe portable crating systems to transport the MMD or FMD Series. These systems are reusable, so take care to store them flat when you are finished removing your test frame. Disassemble your packaging create as follows:

1. Remove the metal clips holding the top plate of the crate system.
2. Remove the wooden top plate.
3. Remove the metal side clips.
4. Remove one of the metal base clips.
5. Remove the wooden side where you removed the metal base clip.
6. Repeat steps 3-5 as your work around each side of the crate system.
7. Remove the shrink wrap vapor barrier around the test frame. **DO NOT USE A KNIFE.** Take care not to cut the shrink wrap as you may accidentally damage the surface finish.
8. Review the Packing List to ensure all components have been shipped. Contact Starrett if you find any accessories or components missing.
9. Remove all accessories and components from the base and save to a side location. Do NOT disassemble or remove any components or parts from the Accessory packages. Retain all packaging materials until the system is satisfactorily installed and all parts, components and accessories are accounted for and located.
10. Prepare to move the MMD or FMD test frame to its final site location.



Starrett Crate Tool



WARNING

When removing the wooden sides from the crate system, you should work with the help of an assistant to keep the opposing sides from falling off the bottom skid.

Once the top and sides of the crate system have been removed, leave the MMD or FMD test frame in the base on the skid. The skid is required if you choose to life the frame under the base.



Starrett Crate System



Remove Clips (Start with top clips)



Plastic sheet protects frames

3.3 Moving Your System

Before you move your MMD or FMD Series test frame, make sure you have reviewed the Site Requirements and verified that the location meets all requirements for safe and functional operation. Specifically, make sure of the following:

- Personnel moving the equipment are authorized and have been trained on your local safety standards;
- The forklift or crane to be used can fit through all hallways, door opening, etc.
- There is adequate clearance between the ceiling and the top of the load frame, including clearance for lifting the frame using a forklift or crane;
- All loose accessories and components within the shipping crate have been removed;
- The floor where the test frame will be located, and any floor encountered during transporting to the test frame's final site location have a sufficient load capacity;
- There is sufficient packaging material to protect the test frame when moving it to its final site location.

There are different APPROVED methods for transporting your MMD or FMD Series test frame to its final site location. Below are listed the methods for transporting.

Forklift Method

Use a forklift with padded forks to lift the test frame from under the crosshead as shown.



WARNING

NEVER lift your MMD Series test frame using a forklift by placing the forks under the test frame base. Lifting the frame in this manner can cause extensive damage to your test frame.

IMPORTANT

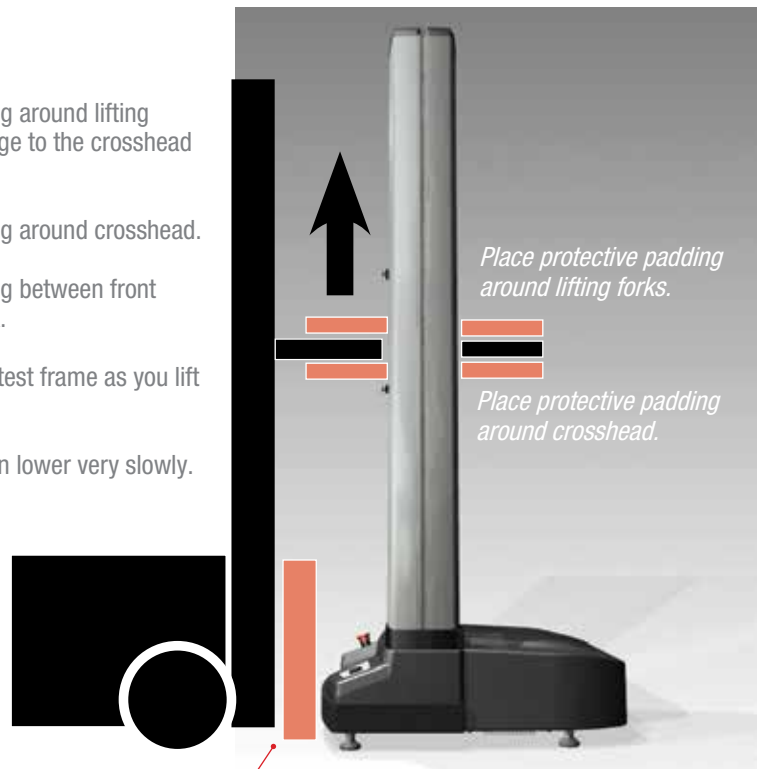
Place protective padding around lifting plates to prevent damage to the crosshead when lifting.

Place protective padding around crosshead.

Place protective padding between front panel and fork lift truck.

Guide and balance the test frame as you lift it very slowly.

Position test frame, then lower very slowly.



Place protective padding between test frame's front panel and fork lift truck.

Lifting the MMD/FMD Series using a forklift

Crane Method

Use a crane to lift the upright test frame from the crosshead. If this method is used, Starrett strongly recommends using certified riggers experienced in moving heavy industrial equipment.

3.4 Positioning Your System for Use

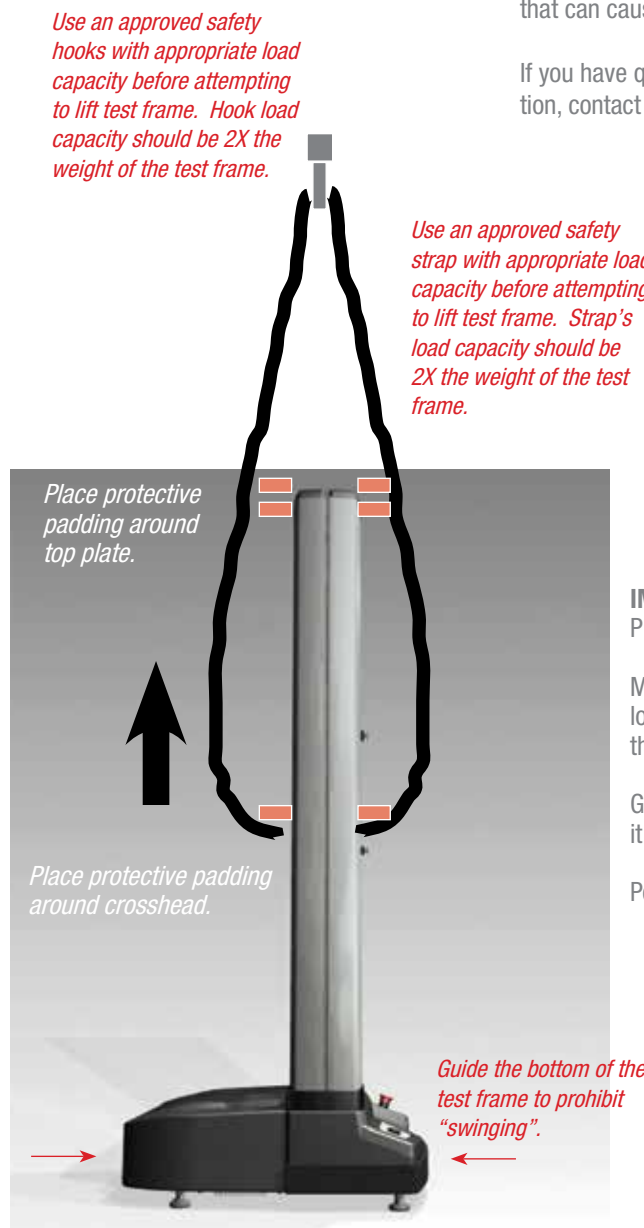
The position you select for the final site location should be in an area that allows the system to be accessible from all sides. Users must have unobstructed access to the power sources for the system and all associated system components and accessories.

The final site location should be in a well-ventilated, preferably air conditioned room free of dust, debris, oils, etc. A temperature controlled laboratory environment is recommended.

The final site location must be away from any machinery or equipment that can emit electromagnetic interference.

The final site location must be away from any machinery or equipment that can cause excessive vibration such as pumps, generators, etc.

If you have questions about the suitability of a location prior to installation, contact your Starrett representative for assistance.



*Lifting the MMD/FMD Series
using a crane*

IMPORTANT

Place protective padding around crosshead.

Make sure lifting hook and strap have a load capacity greater than 2X the weight of the test frame.

Guide and balance the test frame as you lift it very slowly.

Position test frame, then lower very slowly.

4.0 Installation

This section will provide you with installation guidelines for your MMD Series material testing system. Starrett recommends that your authorized Starrett Representative be responsible for installing and commissioning your system at your location.



NOTE

Starrett recommends that your authorized Starrett Representative installs and commissions your MMD Series material testing system.

4.1 Customer Responsibilities

The customer is responsible for the following :

Site Preparation

The customer is responsible for the site preparation prior to the system being moved to its final site location. The customer must ensure that the site requirements are satisfied prior to scheduling the installation.

Handling and Transporting

Unless specifically arranged otherwise, it is the customer's responsibility to arrange the off loading, unpacking and moving of the testing system to the final site location.

Insurance and Safety

The shipping terms for your Starrett system and all components purchased from the L.S. Starrett Company are FOB Factory (Ex Works), meaning ownership and liability for the testing system transfers to the customer at Starrett's loading dock. Under these terms, the customer is responsible for securing the applicable transit insurance on the shipment and arranging safe transport to the final destination.

When transporting a test frame within the customer's own premises, the customer is responsible for its safe transport. Your Starrett representative can supervise the transportation to the test frame's final site location.

Material Disposal

The customer is responsible for the proper disposal of any waste materials generated from the system installation.

4.2 Starrett Responsibilities

The L.S. Starrett Company is responsible for the following:

Insurance

Your system is shipped FOB Factory, meaning ownership and liability for the system transfers from Starrett to the customer at the Starrett shipping dock. Unless other shipping terms are specified in the customer's purchase order, and accepted by the L.S. Starrett Company, FOB Factory shipping terms apply. Under these terms, the L.S. Starrett Company is responsible for insurance coverage while the system is in the Starrett factory until it reaches the Starrett shipping dock. The customer assumes insurance responsibility as soon as the system is at the Starrett shipping dock.

Installation

Starrett, or the authorized L.S. Starrett dealer, is responsible for the complete installation of the test frame and all associated components and accessories that were purchased from the L.S. Starrett Company. The customer is NOT to make any attempt to install any system components or accessories without the authorization and supervision of the Starrett representative responsible for the installation.

Initial Operation

The Starrett representative responsible for the system installation will perform an initial operational check and verification once installation is completed. This initial operation will include a verification of the calibration and will include a functional acceptance check to be witnessed by the customer.

On-site Training

The Starrett representative may be required to train customer personnel on the proper operation of the system and all components purchased from the L.S. Starrett Company. Training will typically require one day (1 day) and is structured to accommodate up to three (3) individuals. Customized training, and extended training for larger groups of users can be scheduled through your Starrett representative. A service fee is charged for training outside the one day orientation.

Documentation

The L.S. Starrett Company provides all the documentation required to operate the system, including manuals for the test frame, components and associated software products (L2 or L3 Series software).

Additional copies of manuals are available and can be ordered through your Starrett representative.

4.3 Site Considerations

It is important that you make proper site preparations before moving the MMD or FMD Series to its final site location. This will ensure that the equipment operates in accordance to its specifications. Please adhere to the following when locating your MMD or FMD Series test frame:

Location

The MMD or FMD Series test frame must be located so that there is proper air ventilation around the entire frame. The test frame must NOT be located directly against a wall or where other equipment or objects can interfere with air circulation or the ability of your personnel to reach all safety related facilities including the emergency stop, power switch, stop/start button, power cord and travel limits.

Bench top Positioning

Starrett recommends that your MMD or FMD Series be mounted on a Starrett test bench. If a non-Starrett approved bench is used, you must verify that the bench is able to support the weight of the test frame with all of its components and accessories, including computer workstation, testing fixtures, tools, etc. Your bench should have leveling feet. The location of the bench must be free of vibrations coming from adjacent equipment or activities taking place within or near the site location.

Ceiling Clearance

Ensure that there is adequate ceiling clearance for your MMD or FMD Series test frame. Also, take into consideration the ceiling clearance required for lifting and positioning the test frame on to your bench top.

Power Supply

The power source should allow for directly plugging the power cord from the test frame to the outlet. The outlet and power cord must be located so that the cord can quickly and easily be unplugged in the event of an emergency.



CAUTION

Your MMD Series requires “clean” and stable electrical power. Power fluctuations and surges may cause performance problems that may lead to extensive damage to your test frame.



NOTE

An in-line power surge protector is recommended for all installations.



HAZARD

NEVER use an extension cord or power strip for connecting power to your MMD or FMD Series. The power cord to the MMD or FMD Series should be plugged directly into an outlet to supply the correct power input.



CAUTION

ALWAYS make sure that personnel have quick and immediate access to the power cord for your MMD or FMD Series test frame. Personnel must be able to unplug the power cord quickly in the event of an emergency.

Environmental Conditions

The MMD and FMD Series are considered laboratory instruments and are designed for use under normal laboratory conditions. They should be located in a temperature-controlled environment that is free of dirt, debris, oils, etc. Protective measures may be required if excessive dust, fumes, electromagnetic interference or hazardous conditions exist. Contact Starrett for assistance.

4.4 Input Source Power



CAUTION

The MMD-10K and FMD-10K may be operated using 100, 120, 220, 230-240V supply voltage.



CAUTION

The MMD-30K, MMD-50K, FMD-30K and FMD-50K must be operated using 220-240V supply voltage only.



CAUTION

Always verify that your MMD or FMD Series test frame is compatible with the main power source BEFORE connecting the machine's power input to the power source supply.



CAUTION

Your MMD or FMD Series test frame uses a 3-wire, grounded main power cable. The test frame operates from a single phase, two-wire grounded power source that applies 240V or less between the supply conductors or between the un-grounded supply conductor and earth ground.



CAUTION

Make sure your MMD or FMD Series power cable is compatible to the plug configuration necessary to safely connect to the power source supply.



NOTE

Make sure your MMD Series power cable can reach your power outlet, allowing some slack in the cable, and allowing for personnel to easily and quickly access the cable in the event of an emergency.



WARNING

NEVER use a power extension cord with your MMD Series system.

Your MMD and FMD Series requires “clean” and stable electrical power. Power fluctuations and surges may cause performance problems that may lead to extensive damage to your test frame.



NOTE

An in-line power surge protector is recommended for all installations.

MMD-10K and FMD-10K Series	Specification
Maximum Power (A)	4.0
Single Phase Voltage (Vac) $\pm 10\%$	100-120Vac
Frequency	50/60 Hz
Power Cord Length	2.4m (8 ft.)
MMD-10K and FMD-10K Series	Specification
Maximum Power (A)	1.5
Single Phase Voltage (Vac) $\pm 10\%$	220-240Vac
Frequency	50/60 Hz
Power Cord Length	2.4m (8 ft.)

MMD-10K and FMD-10K Series Power Specification

MMD-30K, FMD-30K, MMD-50K and FMD-50K Series	Specification
Maximum Power (A)	3.7
Single Phase Voltage (Vac) $\pm 10\%$	220-240
Frequency	50/60 Hz
Power Cord Length	2.4m (8 ft.)

MMD-30K, FMD-30K, MMD-50K and FMD-50K Series Power Specification

4.4.1 Verifying Your Input Power Source

You must verify your input power to your MMD or FMD Series BEFORE connecting the machine to the power source. The machine’s voltage and power plug are set at the factory according to the supply power indicated on the original purchase order. The Data Tag for your test frame will identify the Input Power that is configured for your system. If the input power source differs from the Data Tag information on your machine, you must setup the machine using the following procedure:



CAUTION

Make sure you use a 3-wire , grounded mains power cable between the source power outlet and the MMD or FMD Series frame.



NOTE

The connector on the power cable must be compatible with your power source. If the power cable supplied with your MMD or FMD Series does not fit the power source outlet, add a new male connector to the cable that is compatible to the voltage and wire in accordance to CEE wire code:

Wire Color	Function	
Brown	High	Live
Light Blue	Low	Neutral
Green and Yellow	Earth	Ground

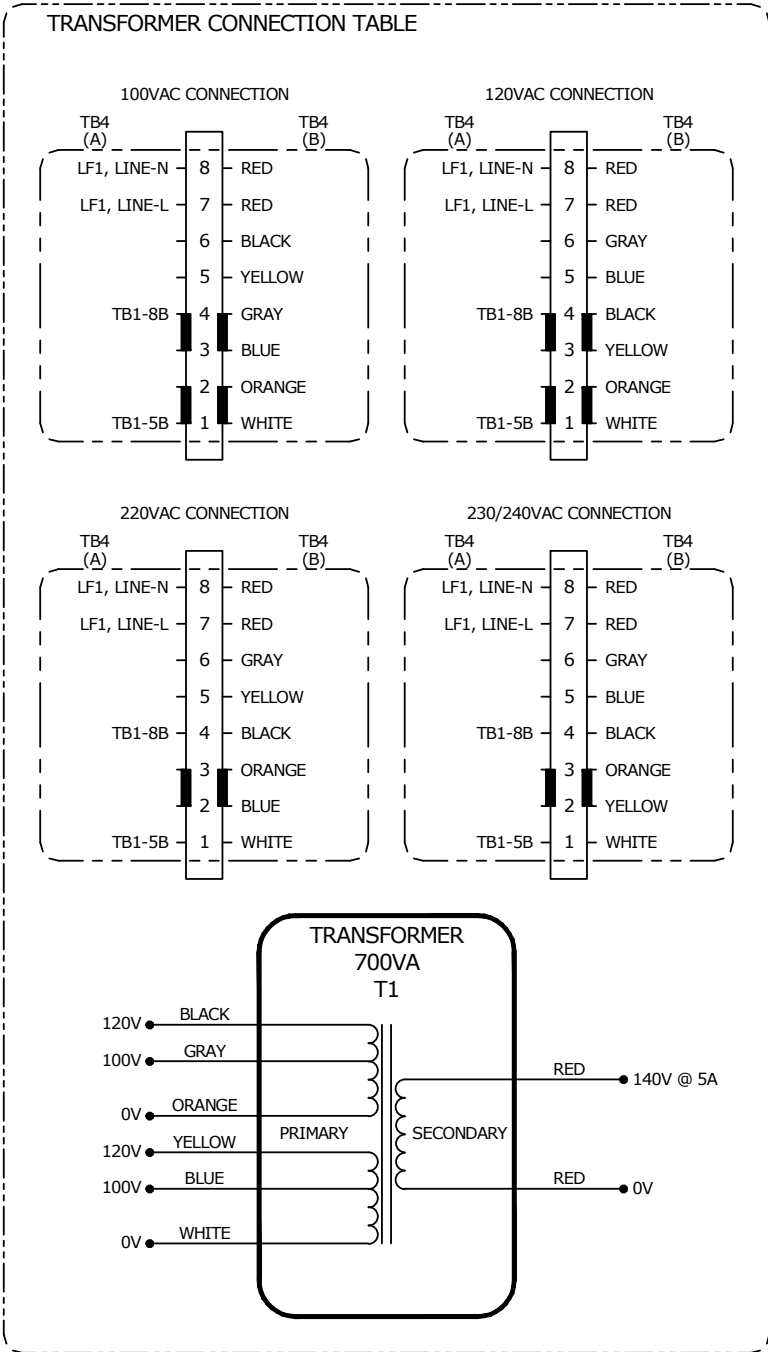
Connector Wire Scheme

4.4.2 Setting Input Voltages

The MMD-10K and FMD-10K may be setup using 100V, 120V, 220V and 230-240V input source power.

The MMD-30K, MMD-50K, FMD-30K and FMD-50K must use 220-240V input source power. These test frames cannot use 100V or 120V power.

The Transformer Connections are illustrated below.



Power Transformer Connection Diagram

4.5 Connecting System Components

This section will describe how to connect the main components to your MMD Series testing frame.

4.5.1 Installing the L3/L2 Plus Workstation

The L3 and L2 Plus workstation is an all-in-one touchscreen desktop computer system suitable for office and laboratory environments. The L3 workstation connects directly to your MMD or FMD Series testing frame using a USB 2.0 cable supplied with your system. The L2 Plus workstation connects directly to your MMD or FMD Series testing frame using a USB 2.0 cable supplied with your system.

The L3 and L2 Plus Workstation should be placed on a level work surface or on a suitable mounting stand available from Starrett.

Attach the L3/L2 Plus Workstation as follows:

1. Connect the USB 2.0 cable to the associated testing frame.
2. Connect the USB 2.0 cable to the Workstation. When you launch the L3 or L2 Plus applications, press the crosshead jog switch. If the Workstation and software are communicating properly, the crosshead will move at a rated speed. If no communications are present, the crosshead will move extremely slowly, indicating that communications is not taking place between the devices. Check your cable connections if this occurs.



NOTE

If the crosshead on your MMD or FMD Series frames moves very slowing once the Workstation is connected and the software is launched, it is indication of a communication hardware error. Check you USB cable connections.



NOTE

Make sure your MMD Series power cable can reach your power outlet, allowing some slack in the cable, and allowing for personnel to easily and quickly access the cable in the event of an emergency.



WARNING

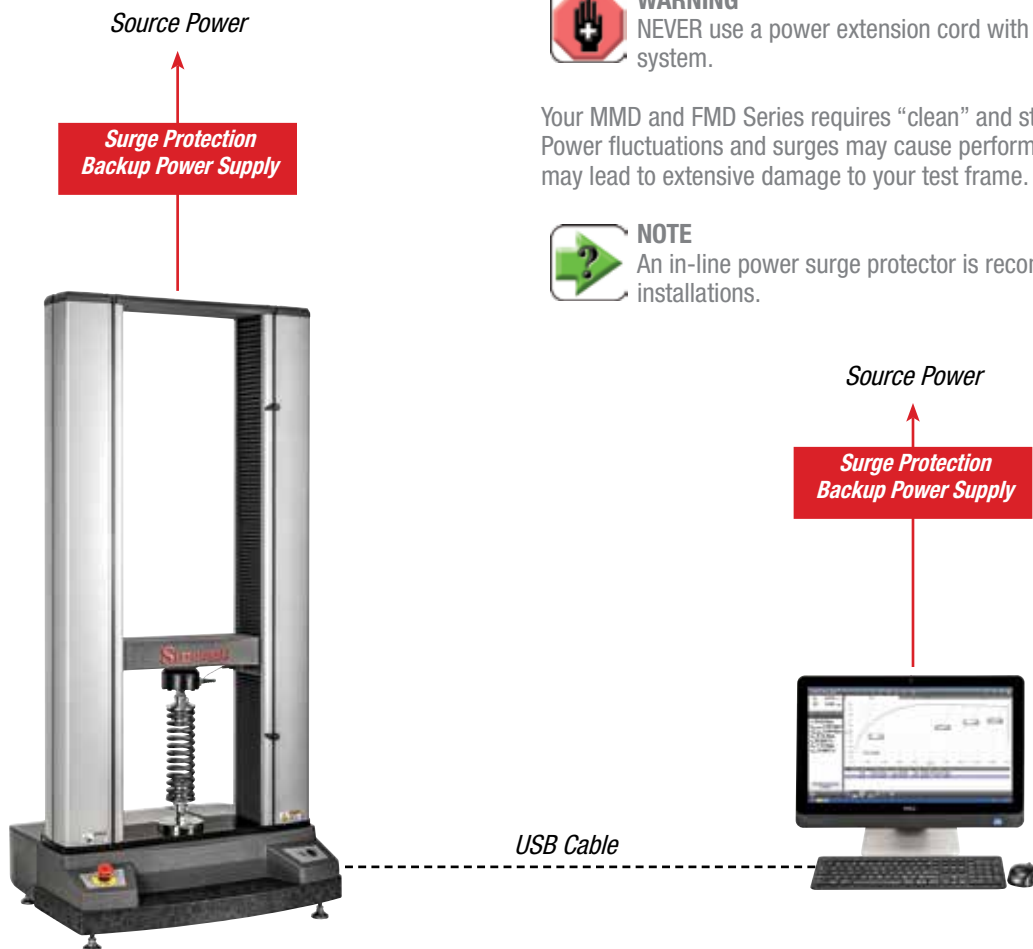
NEVER use a power extension cord with your MMD Series system.

Your MMD and FMD Series requires “clean” and stable electrical power. Power fluctuations and surges may cause performance problems that may lead to extensive damage to your test frame.



NOTE

An in-line power surge protector is recommended for all installations.



Connecting L2 Plus or L3 Workstation

4.5.2 Installing the L2 Tablet

Starrett L2 Series software for force measurement operates on tablet computer called the L2 Controller. L2 Series software features a Windows operating system and is designed specifically for force measurement applications in the laboratory or on the production floor. The tablet computer is connected to the USB connector located on the back of the MMD or FMD Series. For more information about our L2 Series software, please read the associated User's Manual.

The L2 Controller attaches to the MMD or FMD Series column. The column is fitted with a ball joint. The L2 Controller attaches to a plate with a ball joint. An adjustable RAM arm attaches to both ball joints. The RAM arm lets you position the L2 Controller for maximum comfort and easy operation.

Attach the L2 Controller as follows:

1. Connect the ball joint to either side of your MMD or FMD Series by sliding the ball joint into one of the slots.
2. Position the ball joint at your desired height and tighten the top and bottom screws to secure the ball joint inside the slot. Be careful not to OVER-TIGHTEN the ball joint to the slot.
3. Fit the table computer onto the base plate and secure the tablet using the special, tamper-resistance screws.
4. Attach the ball joint arm to the ball joint on the column.
5. Attach the table to the ball joint arm.
6. Use the manual adjustment screw to tighten the tablet at the angle that is desirable for safe operation.
7. Connect the tablet computer to the MMD or FMD Series test frame using the supplied USB 2.0 cable. Connect the cable to the tablet and to the MMD or FMD Series test frame's USB connector.



Install Ball Joint



Fix spring clip onto both balls and tighten

4.5.3 Installing Base Clevis Assembly

The base clevis assembly threads onto the MMD Series base plate. The clevis should screw all the way into the base plate for a secure fit. Once the clevis is threaded onto the base plate, then screw the two locking rings onto the clevis. The locking rings are used to secure your bottom test fixture and allow you to align your test fixture to your preference.



Clevis Assembly

4.5.4 Installing Load Cell Sensor

All Starrett load cell sensors are “plug & play” and are TEDS compliant to IEEE 1451.4. All load cells have a 9-inch (230mm) length cable with a bayonet-style threaded connector.

Connect the load cell sensor to the mating connector located on the MMD Series test frame (located beneath the crosshead on the right-hand side). The load cell sensors must be aligned on the crosshead so that the load cell sensor's cable has sufficient slack.



Load Cell Connector

ULC Series Load Cell Sensors

Starrett ULC Series load cell sensors are ultra-high precision sensors for material testing applications. These sensors have a measurement accuracy of up to $\pm 0.02\%$ of full scale and feature a very low deflection (0.002", 0.05mm) at full scale. These sensors are temperature and barometric compensated. They are supplied with a base adapter that ensures proper alignment to the test frame's crosshead. Ideal for tensile or compressive testing. Display resolution is 10,000:1.

Model Number	Load Capacity			Thread
	N	kgf	lbf	
ULC-5000	5000	500	1124	M16 x 2-4H
ULC-10K	10,000	1000	2250	M16 x 2-4H
ULC-30K	25,000	2500	5620	M16 x 2-4H
ULC-50K	50,000	5000	11,250	M16 x 2-4H

ULC Series Low Profile Load Cell Sensors



Load Cell Sensor Plug Connector



ULC Series

MLC Series Load Cell Sensors

Starrett MLC Series load cell sensors are general purpose sensors for material testing applications. These sensors have a measurement accuracy of up to $\pm 0.05\%$ of full scale. These sensors are temperature. Ideal for tensile or compressive testing. Display resolution is 10,000:1. Starrett recommends the optional base adapter plate be used with these sensors.

Model Number	N	Load Capacity		Thread
		kgf	lbf	
MLC-125	125	12.5	28	M6 x 1-6H
MLC-250	250	25	56	M6 x 1-6H
MLC-500	500	50	112	M6 x 1-6H
MLC-1000	1000	100	225	M6 x 1-6H
MLC-1500	1500	150	337	M16 x 2-4H
MLC-2500	2500	250	562	M16 x 2-4H
MLC-5000	5000	500	1124	M16 x 2-4H
MLC-10K	10,000	1000	2250	M16 x 2-4H
MLC-25K	25,000	2500	5620	M16 x 2-4H
MLC-50K	50,000	5000	11,250	M16 x 2-4H

MLC Series Low Profile Load Cell Sensors



MLC Series

FLC Series Load Cell Sensors

Starrett FLC Series are S-beam type, full-bridge strain gauge load cell sensors. These sensors have a measurement accuracy of up to $\pm 0.1\%$ FS. Three models are available: Premium, Sealed and Economy.

Premium sensors are for low load capacity testing. These sensors feature a 1000% safe overload.

Model Number	N	Load Capacity		Thread
		kgf	lbf	
FLC-05P	0.5	0.05	0.1	M6 x 1-6H
FLC-1P	1	0.1	0.2	M6 x 1-6H
FLC-2P	2	0.2	0.4	M6 x 1-6H
FLC-5P	5	0.5	1	M6 x 1-6H
FLC-10P	10	1	2	M6 x 1-6H
FLC-25P	25	2.5	5	M6 x 1-6H
FLC-50P	50	5	11	M6 x 1-6H
FLC-100P	100	10	22	M6 x 1-6H
FLC-250P	250	25	56	M6 x 1-6H

FLC "Premium" Series S-beam Load Cell Sensors

Sealed sensors are environmentally sealed making them more suitable for applications where dirt, dust or other environmental conditions may be present. These sensors have a safe overload rating of 150% FS.

Model Number	N	Load Capacity		Thread
		kgf	lbf	
FLC-500	500	50	112	M6 x 1-6H
FLC-1000	1000	100	225	M6 x 1-6H
FLC-2000	2000	200	450	M6 x 1-6H
FLC-2500	2500	250	562	M6 x 1-6H
FLC-5000	5000	500	1124	M6 x 1-6H

FLC "Sealed" Series S-beam Load Cell Sensors

Economy sensors are general purpose sensors making them ideal for most applications where economy is important. These sensors have a safe overload rating of 150% FS.

Model Number	N	Load Capacity		Thread
		kgf	lbf	
FLC-50E	50	5	11	M6 x 1-6H
FLC-100E	100	10	22	M6 x 1-6H
FLC-200E	200	20	44	M6 x 1-6H
FLC-500E	500	50	112	M6 x 1-6H
FLC-1000E	1000	100	225	M6 x 1-6H
FLC-2000E	2000	200	450	M6 x 1-6H
FLC-2500E	2500	250	562	M6 x 1-6H
FLC-5000E	5000	500	1124	M6 x 1-6H

FLC "Economy" Series S-beam Load Cell Sensors



FLC-E Series

4.5.5 Installing Load Cell Clevis Assembly



CAUTION
ALWAYS install the clevis assembly with the appropriate load capacity consistent with the load capacity of your load cell sensor.

The load cell clevis assembly threads into your load cell sensor. Use the top locking ring to tighten the clevis against the load cell. Use the bottom locking ring to tighten down on the test fixture attached to the clevis assembly.



CAUTION
When tightening the locking rings to an S-beam load cell sensor, take care not to apply too much torque as this torque can stress the internal strain gauge, and damage the sensor.

4.5.6 Installing Testing Fixture

Starrett has hundreds of different types of testing fixtures from which to choose for your application. Our fixtures easily install onto the clevis adapter that is fitted to the load cell sensor and onto the base of your testing frame. Two clevis adapters are available. Test fixtures slide onto the clevis and are aligned and secured using a grip pin and two locking rings.



Clevis adapter attached to load cell sensor

Model Number	Diameter mm	Load Capacity			Thread
		kN	kgf	lbf	
KIT-CLEVIS15-S-M16	15.9	10	1000	2250	M16
KIT-CLEVIS31-S-M16	31.8	50	5000	11,250	M16

Clevis Adapters

Part Number	Diameter	Length	Load Capacity	Material	Fits Clevis
GPIN-08	8mm	120mm	10kN	Steel	KIT-CLEVIS15-S-M16
GPIN-12	12mm	120mm	50kN	Steel	KIT-CLEVIS31-S-M16

Grip Pins

Test fixture installation guidelines:

1. Mount the fixture onto the clevis.
2. Align the test fixture if required. Use the top locking ring to tighten the test fixture into the desired position and orientation against the load cell sensor used.
3. Tighten the bottom locking ring to tighten the bottom test fixture to the base.
4. Check to ensure top and bottom fixture are aligned.

4.5.7 Installing an Extensometer

Starrett MMD Series have two (2) connectors for applications requiring extensometers. The MMD Series and L3 Series software allows the use of extensometers for strain measurements.

Starrett MMD Series will support extensometers with the following specifications:

- Excitation: 5 to 10Vdc recommended, 12Vdc or Vac max
- Output: 2 to 4 mV/V nominal
- Temperature Range: -40°C to +100°C (-40°F to 210°F)

Extensometer installation guidelines:

1. Connect the extensometer to the connector on the test frame's back panel.
2. Verify that the extensometer is communicating- the extensometer icon will appear on the L3 software header along with the extensometer's gauge length.
3. Mount the extensometer to your sample.



Extensometer Application

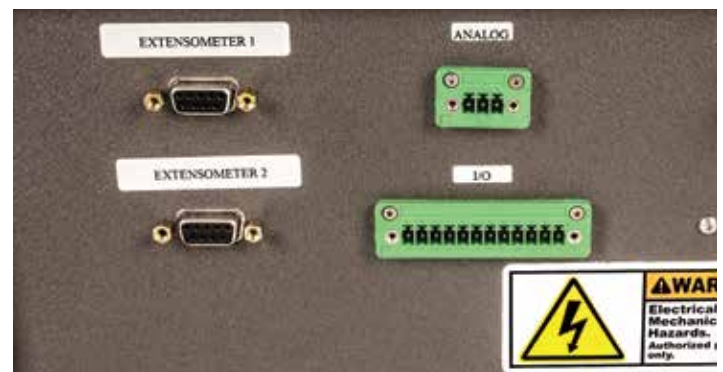
4.5.8 Installing a Printer

If a printer is used with your system, connect the printer to one of the L3 workstation's USB ports. Detailed information about printing can be found in either the L2 or L3 Series User Guides.

When an extensometer is connected to the test frame, the extensometer symbol is displayed with the measuring range of the extensometer shown beneath the symbol.



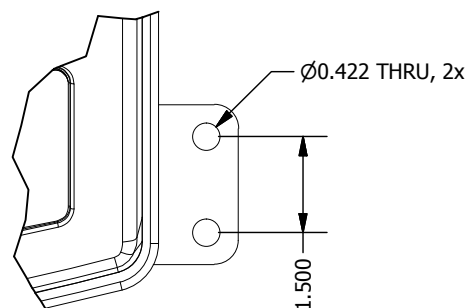
Extensometer Info Symbol



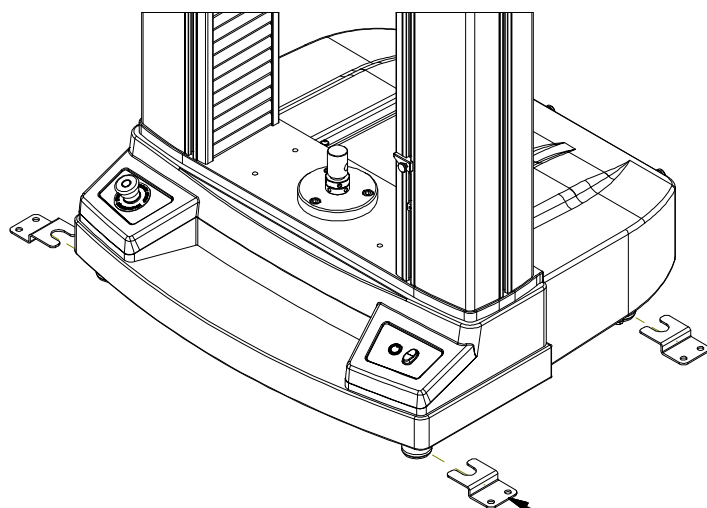
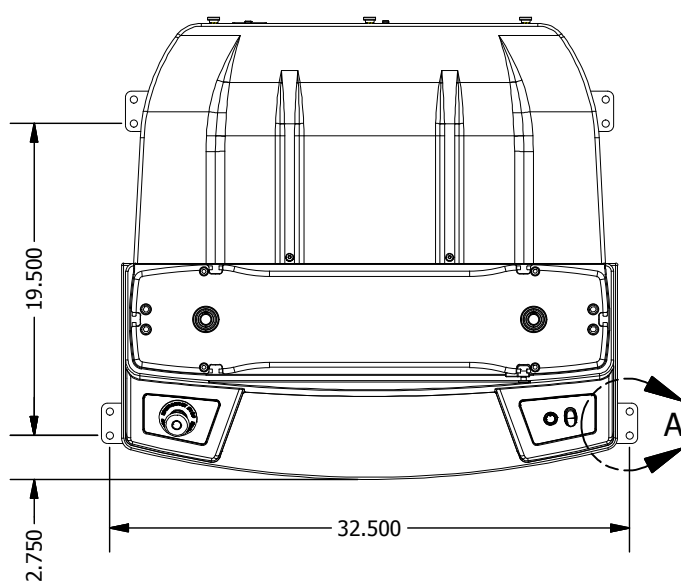
Extensometer Connectors (2)

4.5.9 Installing Bench Mounting Clips

Bench clips are optional accessories used to mechanically secure your MMD Series to a work surface. The clips fit onto the leveling feet and then get screwed into the work surface.



Bench Clip Hole Pattern



Installation of optional Bench Clips

4.5.10 Using an Optional Splinter Shield

The MMD/FMD Series may be fitted with an optional splinter shield. The splinter shield is designed to help contain material fragments that may occur during a test.

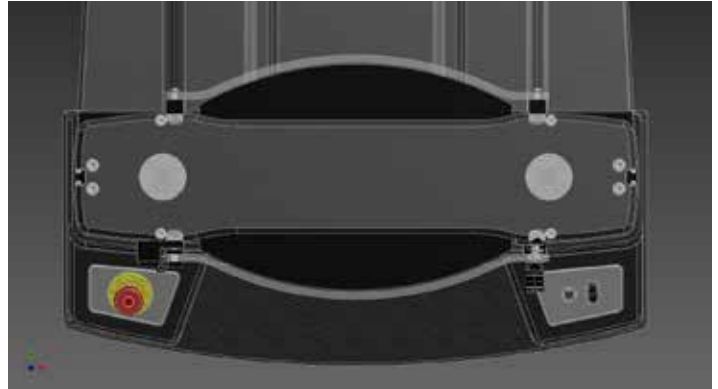
The optional splinter shield (P/N MMD-SHIELD) has an electronic interlock that prevent crosshead movement during your test when the door is opened.

Contact your Starrett representative for more information about the optional splinter shield.



NOTE

Starrett can custom make our splinter shield to your required dimensions to fit your sample's depth.



Top View Depiction of Splinter Shield



*Front Depiction of Splinter Shield
with Door Open*



Back Depiction of Splinter Shield

5.0 System Operation

This section will describe some of the basic system operating methods using your MMD Series test frame when used with either L2 or L3 Series software. For complete operating instructions, please refer to either the L2 or L3 Series User Guide.

5.1 Operating Principles

MMD Series control is performed using L3 software and a computer workstation. The computer is an all-in-one, touchscreen computer that communicates to the MMD Series test frame using USB communications.

Load measurements are performed by high accuracy Starrett load cell sensors per ASTM E4, ISO 7500-1 and EN 10002-2. Load measurements are conditioned by the MMD Series controller and displayed in various views for analysis. An internal, high resolution encoder is used to measure position and velocity. Two (2) extensometer ports let you connect extensometers for applications requiring more precise strain measurements per ASTM E83, ISO 9513 or EN 10002-4.

5.2 MMD and FMD Series Controls

This section will describe the manual controls located on your MMD Series test frame.

5.2.1 Emergency Stop Switch

The Emergency Stop Switch is located on the left-hand side of the MMD Series base. This switch interrupts power to the electrical drive system and brings the system to a stop as quickly as possible.



WARNING

Engaging the Emergency Stop Switch does not remove power to the system. When the Emergency Stop Switch is engaged, power to the drive system is interrupted. No crosshead movement is possible.

When operated, the Emergency Stop Switch locks down into a closed position. The crosshead movement is disabled.

To reset or disengage the Emergency Stop Switch, press down and turn counter-clockwise. The switch will release upwards and return power to the drive system.



Press E-stop to Engage



MMD/FMD Series Front Panel

5.2.2 Mains Power Switch

The main power switch for your MMD or FMD Series frame is located on the back of the machine.



WARNING

ALWAYS make sure the power switch is in the OFF position before plugging the test frame into a power source.

1. Connect the machine to a source power outlet.
2. Turn the On/Off switch to the ON position to operate.
3. When your machine is not being used, turn the power switch to the OFF position.



Mains Power On/Off Switch

5.2.3 Crosshead Jog Switch

The Jog Switch lets you manually move the crosshead UP and DOWN. When using the Jog Switch, pressing the switch cause the crosshead velocity to increase from zero to full velocity in about 3 seconds. You may restrict the maximum velocity using the L3 Series software Motion Setting.

JOG UP - press the up portion of the switch to cause the crosshead to move upward. Release the switch to stop motion.

JOG DOWN - press the down portion of the switch to cause the crosshead to move downward. Release the switch to stop motion



Press Jog Switch Down

5.2.4 Test Start/Stop Push button

Use the START/STOP Switch to start or stop a test. An LED on the START/STOP Switch illuminates to show that a test is in progress or that the tester is ready to perform a test.

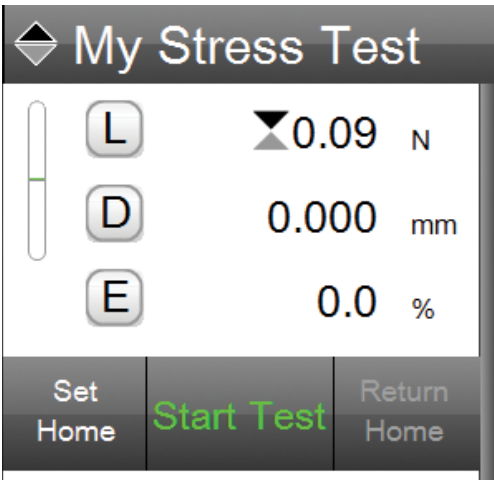
When an extensometer is used and recognized by your L3 Series software, the Start/Stop push button also allows for a third state called PAUSED. During a test, you have the option of pausing your test in order to remove the extensometer from your sample prior to the sample break. Pressing the Start/Stop push button will cause the crosshead to stop moving; the LED will flash yellow and you may remove the extensometer from the sample. Press the Start/Stop push button to resume the run.



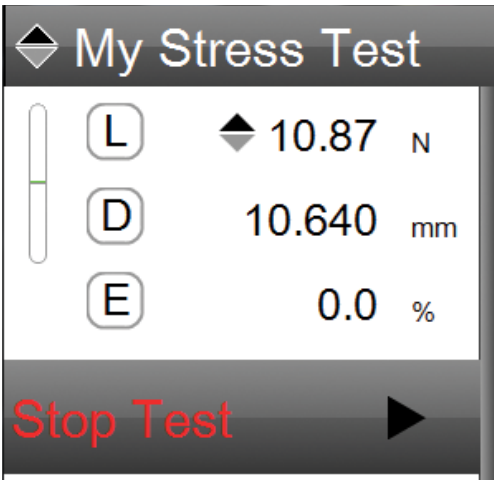
NOTE Starrett recommends that you use the START/STOP Switch to start or stop your test setups.

Push button Color	State
Green - Solid	Crosshead is ready to Start a run
Green - Flashing	Crosshead is moving, test is active
Yellow - Flashing	Crosshead in NOT moving (paused), test is active
Red - Solid	Crosshead is stopped

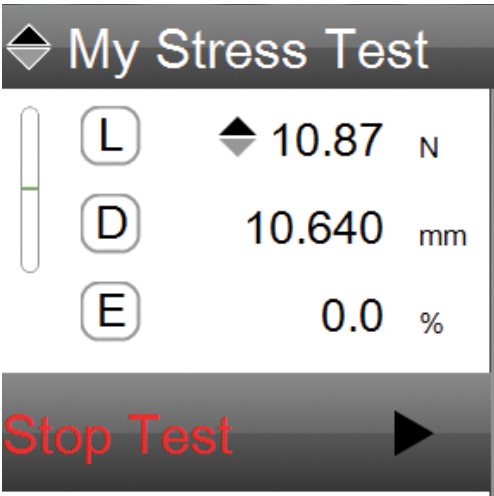
Start/Stop Push button States



Ready to Start



Paused Run



Stopped Test

5.2.5 Over-travel Limit Switches

Limit Switches are located on the side of the column and used to restrict crosshead travel. Position your upper and lower travel limit switches so that they are approximately 2-3 inches above/below where your crosshead will stop during a normal test procedure. These travel limits will stop the crosshead should the crosshead come into contact with one of the limits.



MMD /FMD Series Crosshead Travel Limits

6.0 Using Your MMD Series Test Frame

Detailed instructions for using your MMD Series tester are included in the User Guides for the L3 Series Material Test software, L2 Plus Force Analysis software, or the L2 Series Force Measurement software. Included in the following paragraphs are basic instructions for some of the key operating functions of your system.

6.1 System Settings Options

The following are basis setup instructions for your MMD Series test frames. Many of these settings may be performed using L2, L2 Plus or L3 Series software.

6.1.1 Setting Crosshead Travel Limits

Crosshead travel limits are used to prevent over-travel conditions that can lead to load cell sensor damage or damage to your test fixture.

Two magnetic travel limits are located on your MMD Series test frame. One switch is used to prevent crosshead movement upward beyond the location of this limit. The other limit is to prevent crosshead movement downward beyond the location of this limit. The crosshead limits slide up/down and feature a magnetic sensor that senses when the crosshead is at a position equal to the switch position. When the switch senses the crosshead position, the crosshead stops. The jog switch will only allow operation away from the travel limit location, e.g. if moving up when the switch was activated, only the jog down direction is enabled.

The Travel Range is established between the two Travel Limits. The crosshead will automatically stop when it reaches a travel limit.



CAUTION

ALWAYS set the travel limits so that the total travel range fits the grip string and the maximum travel expected for the test.



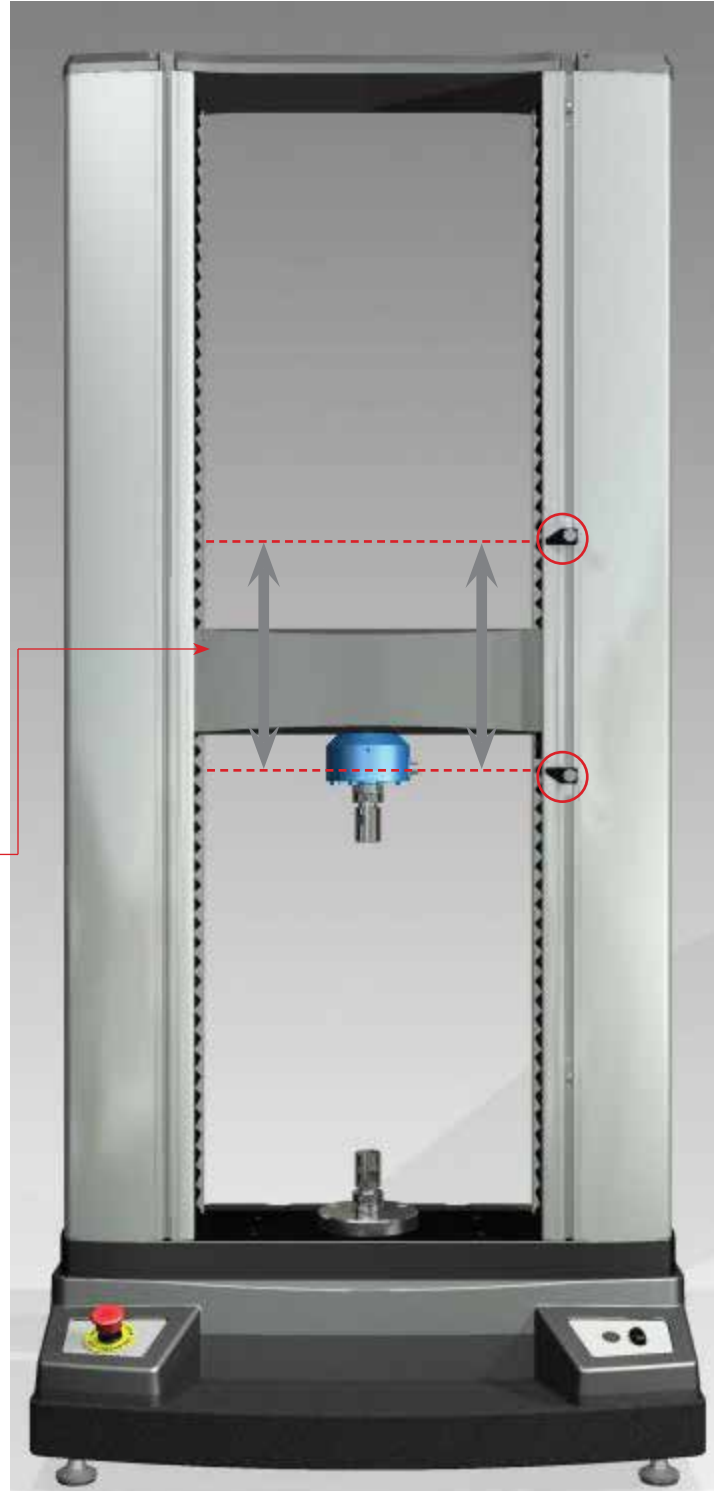
CAUTION

The bottom travel limit should take into consideration operator safety. This limit should be set to prevent pinch hazards.



WARNING

NEVER reach within, or place any of your body within the travel range when the crosshead is moving.



Bottom Limit Switch

6.1.2 Setting Crosshead Maximum Velocity

Using Lx Series software, you may adjust the maximum crosshead travel velocity. The minimum velocity is factory set at 0.001mm/min (0.00004 in/min).

The crosshead will move at the minimum speed when the test frame is not connected to your Lx Series workstation to prevent accidental overload conditions.

Your MMD and FMD Series can operate at its specified full velocity at full load.

You can reduce full velocity as follows:

- 1. With your Lx Series software, access the Main Settings menu by selecting the Lx symbol.
- 2. Select the Settings symbol.
- 3. Select the Motion setting.
- 4. Adjust the Max Velocity setting to your desired highest velocity.
- 5. Select Done.



Set Crosshead Maximum Velocity as follows:

- 1. Select Lx Symbol for Main Settings Menu
- 2. Select MOTION setting
- 3. Enter value for the maximum allowed crosshead velocity you prefer
- 4. Select DONE



NOTE
The factory default setting is the maximum allowed velocity for your system.

Model	Maximum Crosshead Velocity	
	mm/min	in/min
MMD-10K, FMD-10K	1524	60
MMD-30K, FMD-30K	1524	60
MMD-50K, FMD-50K	762	30

Maximum Crosshead Velocities

6.1.3 Setting Grip Protection

The Lx Series software lets you add load limits on your testing fixture to help minimize potential damage to the test fixture due to overloading.



NOTE

In many applications, the weakest component is the test fixture, having a load capacity rating that is less than the load cell sensor being used. Grip protection helps ensure that the test fixture is protected from accidental overloading, which can permanently damage the fixture.

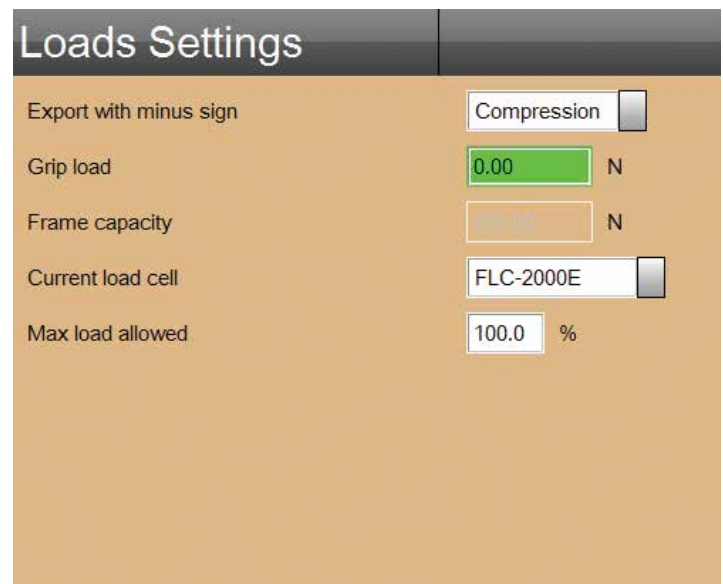
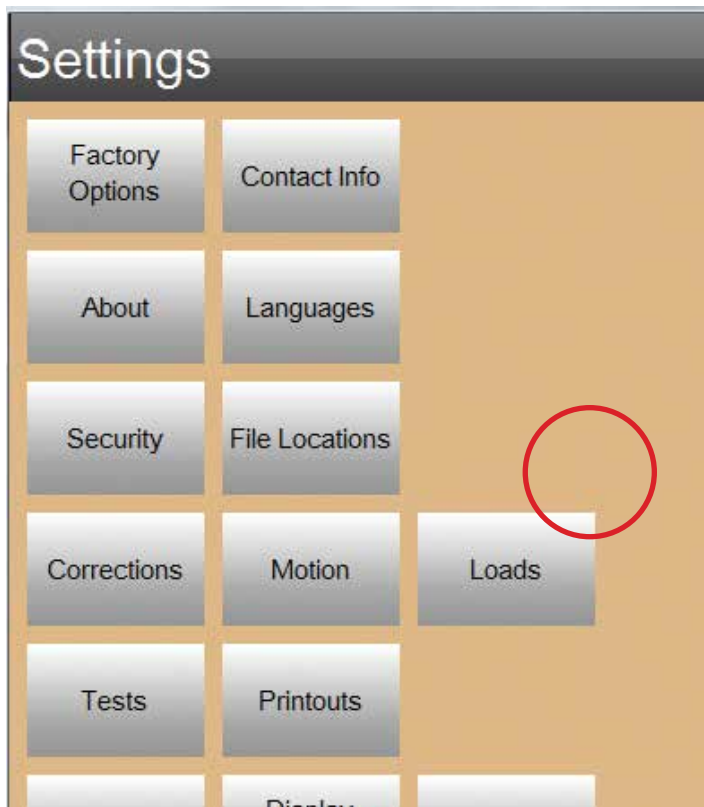


NOTE

Sudden shock loads to the test fixture may not protect the test fixture from damage even when Grip Protection is used. Shock loads can occur when operating at high velocity.

You can help minimize test fixture damage by setting Grip Protection as the maximum load allowed for your load string as follows:

1. With your Lx Series software, access the Main Settings menu by selecting the Lx symbol.
2. Select the Settings symbol.
3. Select the Loads setting.
4. Set the Grip load to a load value that is less than the test fixture's rated maximum load capacity. Starrett recommends a Grip Load value of 10% less than the rated capacity. If your test fixture has a rated full scale capacity of 1000N, we recommend you set your Grip load at 900N.
5. Select Done.



Set Grip Protection as follows:

1. Select L3 Symbol for Main Settings Menu
2. Select LOADS setting
3. Enter value for the maximum load based on the full scale load capacity of the test fixture/grip being used.
4. Select DONE

6.1.4 Setting Load Cell Sensor Limit

The Lx Series software lets you add load cell limits to help minimize potential overload conditions. You can specify the maximum load that the load cell can measure. Once this limit is achieved, the crosshead movement will stop preventing further increased loading onto the load cell sensor.



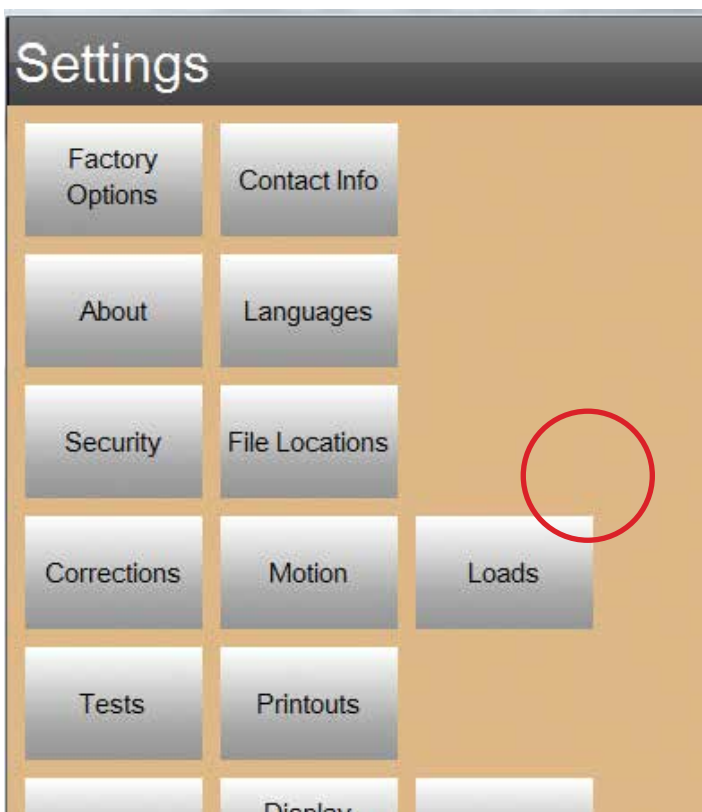
NOTE

Limiting the load cell measurement cannot eliminate overload conditions due to shock on the load cell sensor or load cell overloading at very high speeds. Some overload may occur and in most situations, preventing permanent damage to the load cell sensor's electrical bridge is achieved.



CAUTION

Load cell overload is caused by operator error due to the manner in which the test machine is operated and how the test setup is constructed. Always exercise extreme care when creating a test or when operating your machine. Starrett load cells damaged due to misuse are not covered by our standard warranty.



You can help minimize load cell damage by setting a load cell limit as follows:

1. With your Lx Series software, access the Main Settings menu by selecting the Lx symbol.
2. Select the Settings symbol.
3. Select the Loads setting.
4. Adjust the Max Load Allowed setting to your desired %. 100% is the default. This means the load cell is allowed to measure up to 100% of its rated load capacity. Changing to 80% means the load cell sensor can measure up to 80% of its rated capacity. Once 80% of the capacity is measured, the Lx software will issue a message and stop any further crosshead movement or applied load to the sensor.
5. Select Done.



Set Load Sensor Limit as follows:

1. Select Lx Symbol for Main Settings Menu
2. Select LOADS setting
3. Enter value for the maximum % of full scale load allowed for the attached load cell sensor.
4. Select DONE



NOTE

The load cell sensor limits is based on the load cell sensor installed on the machine. 100% is the factory default meaning the load cell is allowed to measure to full scale. If 50% is entered and the sensor has a 2000N capacity, the sensor will measure up to 1000N. If 1000N is measured, a measured load beyond 1000N causes the test to stop.



NOTE

The load cell sensor limits helps prevent overloading. However, overloading at high rates of speed, even with load sensor limit applied, may result in an overload of your sensor.

6.1.5 Using Deflection Compensation

Deflection compensation is especially useful when operating your MMD Series in Height mode and in applications where the measured height of the sample is critical.

Deflection compensation effectively compensates for the deflection in the MMD Series and the components used in the load string: load cell sensor, clevis adapters, and test fixture. For best results, you should perform deflection compensation using the accessories for your sample. In addition, you should know the applied load that is being used with your sample. For example, if you are testing a spring, you should know what the load at your desired distance is prior to using deflection compensation. Use this load as your load setpoint.

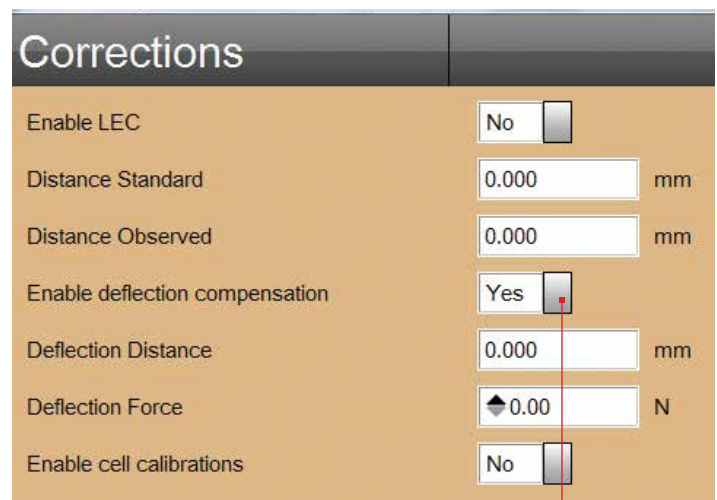
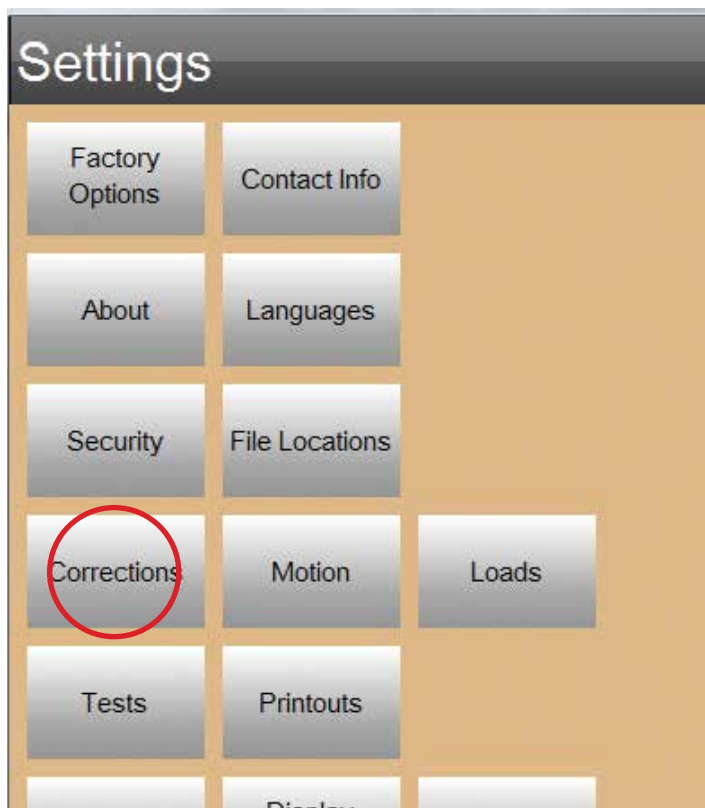


CAUTION

Deflection compensation involves the compression of the load string onto a solid surface. Extreme care should be used so as not to overload the load cell sensor during your manual control of the crosshead.

Instruction Guidelines:

1. Place the MMD Series into Height mode.
2. Affix the load cell sensor and test fixture (platens) that will be used in your testing.
3. Set the datum using the automatic datum function in your Lx Series software.
4. Once the datum is established, place a solid hard object that is parallel to the top platen that is connected to the load cell.
5. Place the MMD Series in slow speed mode:
Using L3 or L2 Plus Series software, select the speed icon and set to slow speed.
Using L2 Series software, select the arrows on the tablet and set to slow speed.
6. Zero both the Load (L) and Distance (D) on the controller view (L3) or the tablet (L2).
7. **USE EXTREME CAUTION-** using the down jog key, slowly lower the crosshead observing the applied load. Move the crosshead downward until you reach the desired load on which to compensate for deflection. Stop immediately once your controller or tablet indicate this setpoint load value.
8. Record the applied Load value (L) and the Distance value (D).
9. Go to Settings - Corrections. Enter the Load value (L) into the DEFLECTION FORCE field. Enter the Distance value (D) into the DEFLECTION DISTANCE field.
10. Select DONE.



Activate Deflection Compensation by selecting YES.

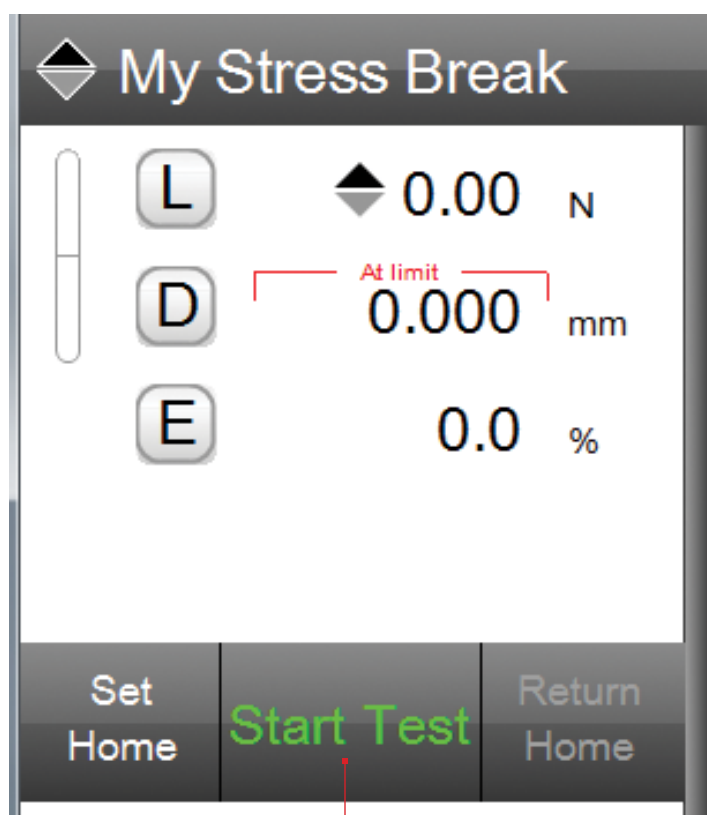
6.2 Using Lx Series Software

Your MMD Series should be operated using either L3 Series software or L2 Plus Series software and an all-in-one computer workstation, or using L2 Series software with a tablet computer.

Your MMD Series test frame features a Stop/Pause/Stop push button. This button features an LED indicator that indicates that crosshead status- whether or not the crosshead is active, moving or stopped.

6.2.1 Starting an L3 Test Setup

Starrett recommends using the Start/Stop push button to start a test when using Lx Series software. Optionally, you may use the Start Test/Stop Test target on the Lx Series controller view (See Lx Series software manual for detailed instruction on How to Perform Lx Testing).



Press Start/Stop switch or press START TEST target to start a test run.

6.2.2 Pausing an L3 Test Setup

When an extensometer is used and recognized by your system, a symbol displays in the header tool bar showing an active extensometer and the instrument's rated gauge length. When an extensometer is used, it allows the user to momentarily "pause" a test using the Start/Pause/Stop push button or by utilizing the pause function within your L3 Series software. It is sometimes necessary to pause a test in order to remove an extensometer from a sample that is about to rupture/break in order to protect the extensometer from potential damage.

To Pause an active test, press the Start/Pause/Stop push button until the LED displays a flashing RED indication. This indicates that the crosshead has stopped moving, but the test remains active. Pressing the Start push button restarts the run.



NOTE

When a run is paused, the run state is also displayed by the controller view. Selecting the Start symbol immediately starts the run.



WARNING

Never remove a sample while the sample is under load. When the Pause function is used, the sample may still be under load and should never be touched.



NOTE

The Pause function is not available in L2 or L2 Plus Series software.



6.2.3 Stopping an L3 Test Setup

You can stop a test by using the Start/Stop push button on your MMD Series test frame. Optionally, you may use the Start Test/Stop Test target on the L3 Series controller view (See L3 Series software manual for detailed instruction on How to Perform L3 Testing).



7.0 Using Your FMD Series Test Frame

The FMD Series test frame may be used with either L2 Plus Force Analysis software or with L2 Force Measurement software. The FMD Series has no extensometer interface, therefore, it cannot be used to calculate stress or strain when an external extensometer is required for measuring sample elongations. Unlike the MMD Series test frame, the FMD Series test frame also does not support analog inputs or outputs. The FMD Series does support digital inputs and outputs when used with the optional Application Builder software.



NOTE

The FMD Series test frame may be used with L3 Material Test software provided you are not using an external extensometer or analog inputs or outputs.

7.1 Using L2 Plus Force Analysis Software

L2 Plus Series software is designed for force measurement and analysis applications. L2 Plus Series software is very similar to our L3 Material Test software except it cannot be used for stress-strain testing.

L2 Plus Series software is ideal for detailed force analysis performed in the Engineering or Quality laboratory. L2 Plus Series software has a variety of graphical analysis tools that allow for measurements and analysis to be performed from the graph trace of your test.

L2 Plus Series software operates using the Windows® operating system on an all-in-one personal computer with touchscreen display.

7.1.1 Starting an L2 Plus Test Setup

Starrett recommends using the Start/Stop push button to start a test when using L2 Plus Series software. Optionally, you may use the Start Test/Stop Test target on the L2 Plus Series controller view (See L2 Plus Series software manual for detailed instruction on How to Perform L2 Plus Testing).

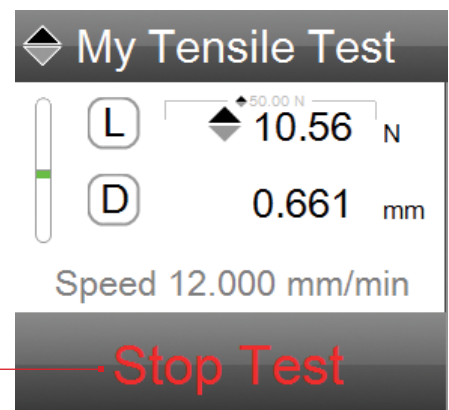
7.1.2 Stopping an L2 Plus Test Setup

You can stop a test by using the Start/Stop push button on your FMD Series test frame. Optionally, you may use the Start Test/Stop Test target on the L2 Plus Series controller view (See L2 Plus Series software manual for detailed instruction on How to Perform L2 Plus Testing).



NOTE

You cannot pause a testing using L2 Plus Series software.



Press to start a test run

Press to stop
a test run



L2 Plus operating display

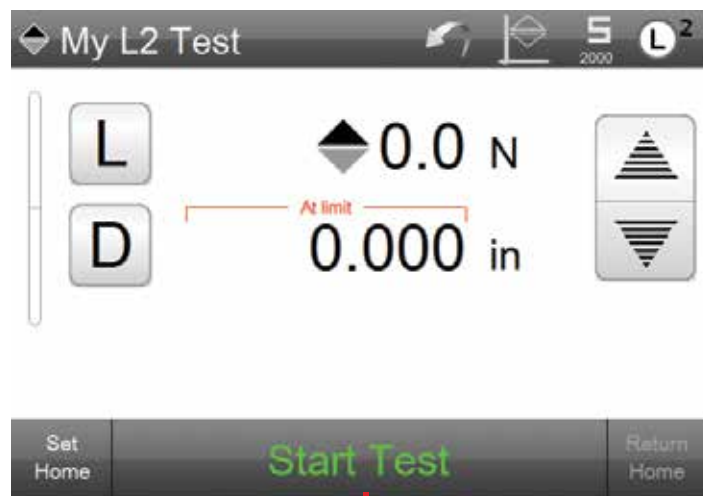
7.2 Using L2 Series Force Measurement Software

Starrett L2 Series software uses a tablet computer as the user interface. L2 Series software and the tablet may be used with the MMD Series for force measurement applications. The compact footprint makes it ideal for production environments where space is limited.

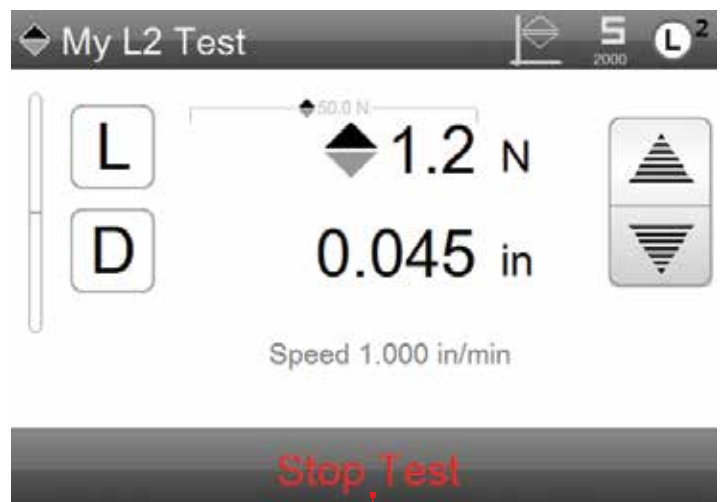
7.2.1 Starting an L2 Test Setup

When using L2 Series software and a tablet computer for force measurement, Starrett recommends using the Start/Pause/Stop push button to initiate your test.

Optionally, you may use the Start Test/Stop Test target on the L2 Series tablet (See L2 Series software manual for detailed instruction on How to Perform L2 Testing).



Press Start/Stop switch or press START TEST target to start a test run.



Press Start/Stop switch or press STOP TEST target to stop a test run.

7.2.2 Stopping an L2 Test Setup

You can stop a test by using the Start/Stop push button on your MMD Series test frame. Optionally, you may use the Start Test/Stop Test target on the L2 Series tablet (See L2 Series software manual for detailed instruction on How to Perform L2 Testing).

8.0 System Maintenance

Your MMD Series should be maintained by an authorized Starrett service representative. Annual verification, validation and calibration are recommended.

8.1 Preventive Maintenance

Preventive maintenance includes activities you can perform annually, monthly or daily to help ensure your MMD Series operates at its published specification for its intended applications.

8.1.1 Daily Maintenance Checklist

Starrett recommends the following daily maintenance routines for your MMD Series.

Check Daily	Description
1	Emergency Stop Operation
2	Power Cord Connection
3	Load Cell Sensor Connection
4	Travel Limits Operation
5	Test Fixture Alignment and Tightness
6	Signal Wire Connections between Components
7	Crosshead Travel in both Directions
8	Safety Shield Interlocks (if equipped with Safety Shield)

8.1.2 Authorized Field Maintenance

Starrett recommends that you have your system maintained, at least annually, by your authorized Starrett representative. Your Starrett Service Representative will inspect, verify, calibrate and perform any necessary maintenance to ensure that your system operates safely and to its published specification. For information on Starrett Field Services, please contact your Starrett representative.

8.1.3 Cleaning

Clean the surfaces of your MMD Series with a damp cloth. Never use abrasive cleaning products or products that can leave oily residue. Simply use a damp cloth to remove dust and dirt.

Use a cover to protect the test frame from dust when not in use.

8.1.4 Lubrication

The ball screw and bearings should be lubricated every two (2) years depending on usage.

The lubricant must be a Lithium-based NLGI Grade 2 grease.

Starrett recommends Mobilith® SHC220 or equivalent.

Ball screws should be greased through the ball nut fittings.

Rails can have a light coating applied directly to the guides.

Your Starrett service representative will lubricate your system during an annual calibration and verification service call if needed or scheduled.

8.2 Maintenance Procedures

The following are routine maintenance procedures that may be performed by the user or by a non-authorized Starrett representative. Starrett recommends that other types of maintenance procedures be performed by your Starrett service representative.

8.2.1 Travel Limits

Both crosshead travel limits should be tested daily (minimally) or before each shift in a multi-shift plant operation. To test the upper switch, locate the switch so that the switch is about 25mm (1 inch) above the crosshead. Position the lower switch so that this switch is located about 25mm (1 inch) below the crosshead.

Use the jog switch to manually move the crosshead upward. When it makes contact with the upper travel limit switch, the crosshead should stop and the up jog switch should be inactive. Press the jog switch down and the crosshead should travel down, away from the upper travel limit. Continue to press the down jog switch until the crosshead makes contact with the lower travel limit switch. Again, the crosshead should stop and the down jog switch should become inactive. Use the up jog switch to move the crosshead off the lower travel limit.



HAZARD

If the crosshead does not stop when it makes contact with a travel limit switch, DISCONTINUE using the test frame. Contact your Starrett service representative for immediate service.

8.2.2 Emergency Stop

The emergency stop switch should be tested daily (minimally) or before each shift in a multi-shift plant operation. To test, manually position the crosshead up or down. While the crosshead is in motion, depress the emergency stop switch. The crosshead should stop. Press and rotate the emergency stop to release. Press the jog switch to position the crosshead up or down. The crosshead should move normally.

8.2.3 Fuse Replacement

See the Fuse Specification chart on page 14.



HAZARD

Make sure to shut all power to your MMD or FMD Series system to OFF. Dangerous voltage may cause personal injury.



NOTE

The MMD and FMD Series used with 110/120V input power use two (2) 6.3A slow-blow fuse.



NOTE

The MMD and FMD Series used with 220,230, or 240V input power use two (2) 3.15A slow blow fuse.



WARNING

Always replace the fuse with the correct type and amp rating.

To change the fuse, perform the following:

1. Ensure that power to your MMD or FMD Series is removed entirely.
2. Ensure that the Power On/Off switch on your MMD or FMD Series is in the OFF position.
3. Ensure that the Emergency Stop Button is in the Stop (Down) position.
4. Verify that power to the machine is OFF. View the Start/Stop button and make sure no light is displayed. Use the jog key and make sure there is no crosshead movement.
5. Locate the Power Entry Module on the back panel of your MMD or FMD Series frame.
6. Using a small flat screwdriver, remove the cap from the Power Entry Module that covers the Fuse Compartment.
7. Grasp and remove the Fuse Holder.
8. Install a new fuse into the Fuse Holder. **WARNING- the replacement fuse MUST be the factory-specified type and rating as the original.** An incorrect fuse may damage the electrical circuits inside your machine.
9. Re-insert the Fuse Holder.
10. Place the protective cap onto the Power Entry Module.
11. Reconnect the power cable to the MMD or FMD Series.
12. Dis-engage the Emergency Stop Button.
13. Turn the main Power Switch to ON.

9.0 Calibration and Verification

Factory testing is performed on your MMD or FMD Series test frame prior to shipment to you. Starrett calibrates and verifies MMD and FMD Series performance specifications using calibration equipment traceable to international standards, e.g. National Institute of Standards and Technology (NIST). This testing and calibration is to verify your system will operate to its published specifications.

A complete calibration of your MMD or FMD Series test frame should be performed on-site at the time of installation per your preferred or required international standard, e.g. ASTM E4, ISO 7500-1, EN 10002-2, etc. This calibration should be performed by Starrett or an authorized Starrett representative. Starrett recommends that your system undergo a calibration and verification at least annually.

If your MMD or FMD Series test frame is physically moved, a calibration and verification is necessary.

A Starrett calibration compares the actual load values measured by your MMD or FMD Series system and its applied load cell sensor to a known "standard or artifact" that is traceable to national standards and ensures that the load measurement complies with your particular standard, e.g. ASTM, ISO, etc.

A Starrett verification ensures that your measurements are reading correctly or within the published specifications. Verification of the following measurements are provided during a Starrett calibration:

- Force (ASTM E4)
- Displacement (ASTM E2309/E2309M)
- Crosshead Velocity (ASTM E2658)



NOTE

Strain verification (on Extensometers) is not performed by the L.S. Starrett Company. We recommend that customers who use extensometers with our testers obtain Strain verification from their service organizations.





Corporate Headquarters

The L. S. Starrett Company
121 Crescent Street
Athol, MA 01331 USA
Tel: 978-249-3551

Starrett Metrology Division

Starrett Kinematic Engineering, Inc.
26052-103 Merit Circle
Laguna Hills, CA 92653 USA
Tel: 949-348-1213