

UMPIRE STATIC

Rifle Recoil Test Stand
User Manual (rev. 1)



MANDATORY WARNINGS

- **ENSURE THAT ANY FIREARM IS UNLOADED BEFORE INSERTING OR REMOVING IT FROM THE TEST FIXTURE.**
- **IN THE EVENT OF A MISFIRE OR HANGFIRE, HAVE A QUALIFIED GUNSMITH CLEAR MALFUNCTION BEFORE REMOVING THE FIREARM FROM THE REST.**
- **USE ONLY THE PROPER REAR STOCK ADAPTERS THAT FIT THE RIFLE BEING TESTED**
- **NEVER USE THIS REST FOR ANY REASON BEYOND ITS INTENDED USE AS A R&D TOOL TO MEASURE RECOIL AND BUTTPAD DISPLACEMENT.**
- **NEVER USE THIS REST WITHOUT PROPERLY SECURING THE FIREARM PRIOR TO FIRING.**
- **READ AND UNDERSTAND ALL INSTRUCTIONS BEFORE USE**

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Mounting UMPIRE Static Recoil Test Stand

The UMPIRE Static Recoil Test Stand shall be mounted to a rigid, immovable surface capable of withstanding repeated recoil loads without deflection or displacement. Acceptable mounting surfaces include permanently installed workbenches, steel tables, or reinforced concrete slabs.

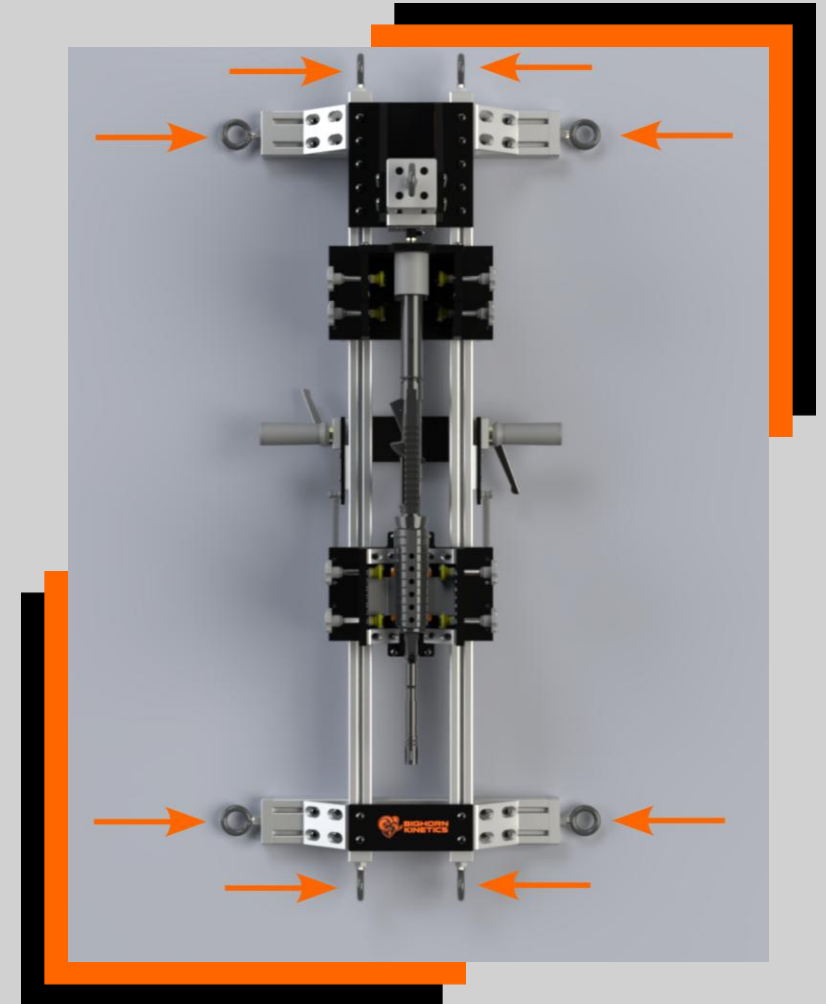
For accurate and repeatable test results, the mounting surface must be structurally sound and free of vibration. System performance is directly dependent on the rigidity of the mounting interface; any movement or compliance in the base will degrade measurement fidelity.

Mounting Methods

The fixture may be secured using one or more of the following methods, provided the system is rigidly constrained in all directions:

- Mechanical fastening to a bench or concrete surface using appropriate anchors or bolts
- Ratchet straps connected to the integrated mounting links
- Weighted stabilization methods such as sandbags, when combined with positive restraint

The mounting links on the UMPIRE frame are designed as primary anchor points for restraint systems.



Mounting UMPIRE Static Recoil Test Stand (cont.)

Recommended Configuration

A minimum of two ratchet straps is required to properly secure the fixture:

- One strap positioned forward of the test stand
- One strap positioned to the rear of the test stand

Straps shall be tensioned to eliminate all observable movement of the fixture under load. The direction of restraint should oppose the expected recoil impulse.

For higher energy test conditions, including heavy recoiling rifles or extended firing schedules, additional straps or anchoring methods are strongly recommended to ensure system stability and safety.

Verification

Prior to testing, verify that:

- The stand does not shift, rock, or translate when subjected to manual force
- All straps or fasteners are properly tensioned and secured
- The mounting surface remains stable under anticipated loading conditions

Failure to adequately secure the test stand may result in reduced data quality, equipment damage, or unsafe operating conditions.

Installation of Recoil Load Cell

General

The recoil load cell is a critical measurement component used to capture recoil force during testing. Proper installation and alignment are required to ensure accurate and repeatable data. The sensor must be mounted securely, aligned with the recoil axis, and placed in full contact with the rear interface of the test article.

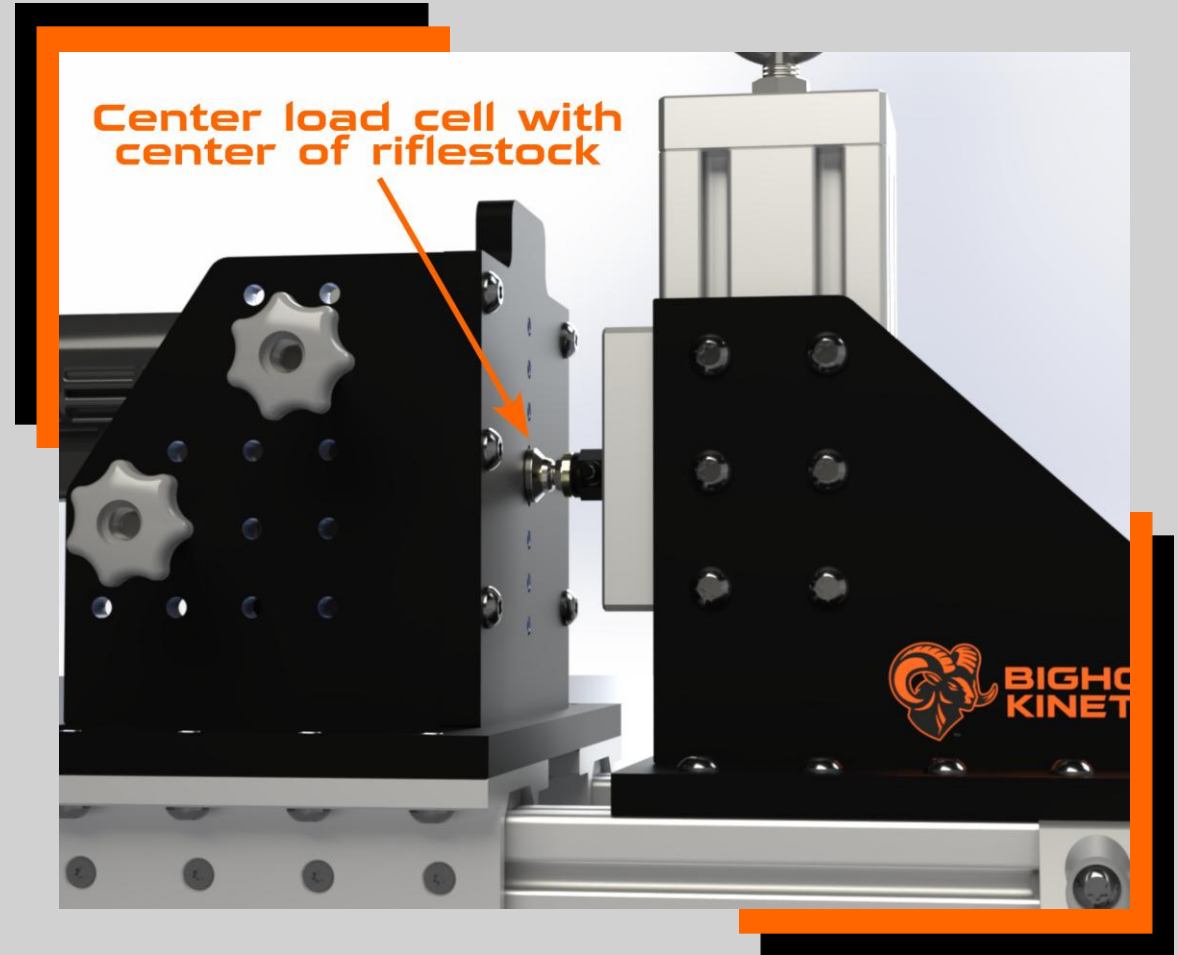
Mounting Procedure

Install Load Cell on Vertical Rail

Mount the PCB 208C04 (or equivalent) load cell to the vertical rail of the recoil fixture using the appropriate hardware. Ensure the sensor is oriented such that the measurement axis is aligned with the direction of recoil. A temporary block is mounted on the recoil stand during shipment, with included hardware and stud.

Position at Center of Load Axis

Adjust the vertical position of the load cell so that it is centered on the recoil load path. This corresponds to the centerline of the firearm stock or rear contact surface. Proper alignment at this location ensures that measured forces are representative of true recoil loading and are not influenced by off-axis moments.



Installation of Recoil Load Cell (cont.)

Establish Contact with Rear Rest

Position the load cell so that it makes full, even contact with the rear rest or recoil interface surface. The contact surface should be flat and free of debris. Any gaps, misalignment, or point loading conditions will introduce measurement error and reduce repeatability.

Tighten and Secure

Secure all mounting hardware to ensure the load cell is rigidly fixed in place. Fasteners shall be tightened to the manufacturer's recommended torque specifications. The sensor must not shift or rotate under load.

Alignment and Verification

Prior to testing, verify the following:

The load cell is centered along the recoil axis and aligned with the firearm bore direction

The contact surface between the load cell and rear rest is uniform and fully engaged

No lateral offset or angular misalignment is present

The sensor is rigidly mounted with no observable movement under light preload

Notes

Improper installation, including off-axis positioning or insufficient contact, can result in inaccurate force measurements and inconsistent test results. Careful alignment and secure mounting are essential for capturing reliable recoil data.

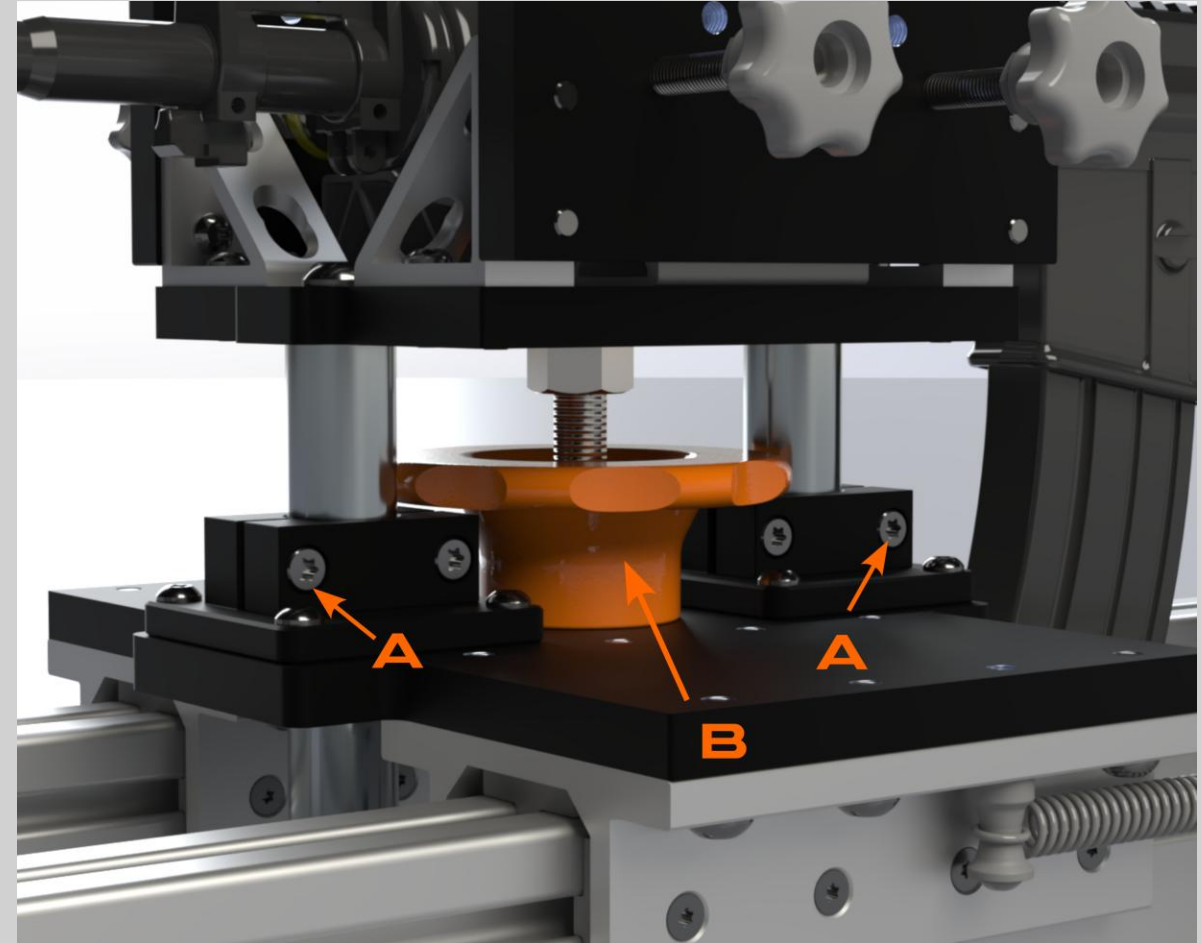
Mounting Rifle to Test Stand

Ensure the front rest assembly moves freely with minimal resistance and is not obstructed by bumpers, straps, or other equipment. Free motion of the front rest is critical for accurate recoil measurement.

Position the rifle by first seating the rear stock into the adapter cup. Confirm that the adapter provides proper fit with slight clearance on all sides (page 13). Slide the rear assembly back until the stock and rear rest are in firm, continuous contact with the recoil load cell. No gap should be present.

Support the fore-end of the rifle using either the provided TPU insert or Caldwell sandbag. These interfaces protect the firearm finish and assist with alignment. Do not fire the rifle without a front restraint system in place.

To adjust elevation, loosen one screw (A) on each shaft clamp approximately one half to one turn. Rotate the adjustment wheel (B) until the muzzle is aligned with the target, then retighten both screws to lock the position.



Mounting Rifle to Test Stand (cont.)

Restraining the Front Assembly

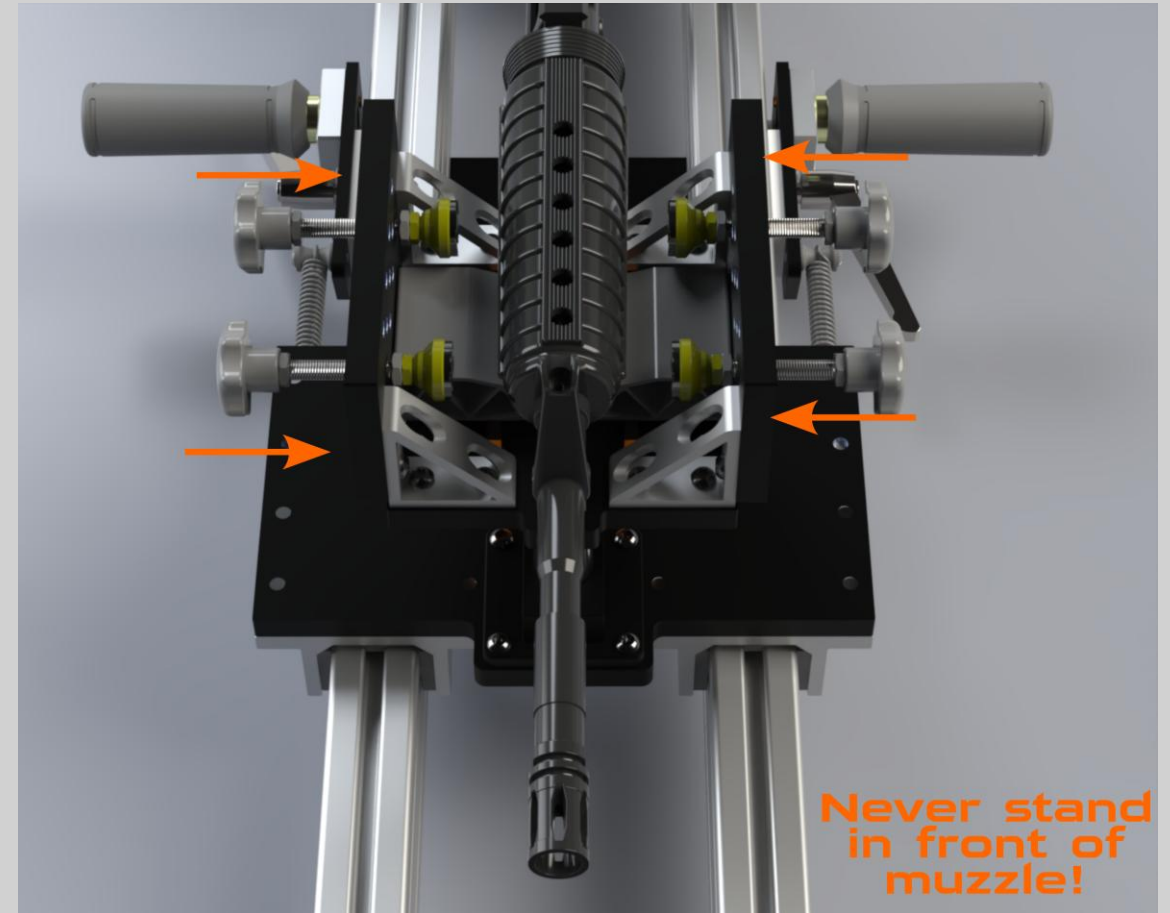
The front rest must securely constrain the rifle fore-end to ensure smooth and repeatable operation. Multiple restraint methods are provided to accommodate different firearm geometries.

Threaded clamps may be installed on either side of the fore-end. Tighten each clamp evenly and symmetrically to avoid introducing lateral bias.

For narrow or irregular fore-ends, the included rest pads may be used; however, pads must always be used in conjunction with clamps or straps.

Straps may be routed through the front assembly anchor points to provide additional restraint. This is recommended for heavy recoiling firearms or multi-shot testing.

For pump-action shotguns, restraint method selection is critical. Improper clamping may allow the action to partially cycle under recoil. A combination of clamps and straps is recommended to prevent unintended movement of the fore-end.



Mounting Rifle to Test Stand (cont.)

Restraining the Rear Assembly

The rear assembly is designed to maintain alignment of the rifle while allowing controlled compression during recoil. Proper setup of the rear restraint is critical to ensure accurate measurement and correct function of the recoil interface.

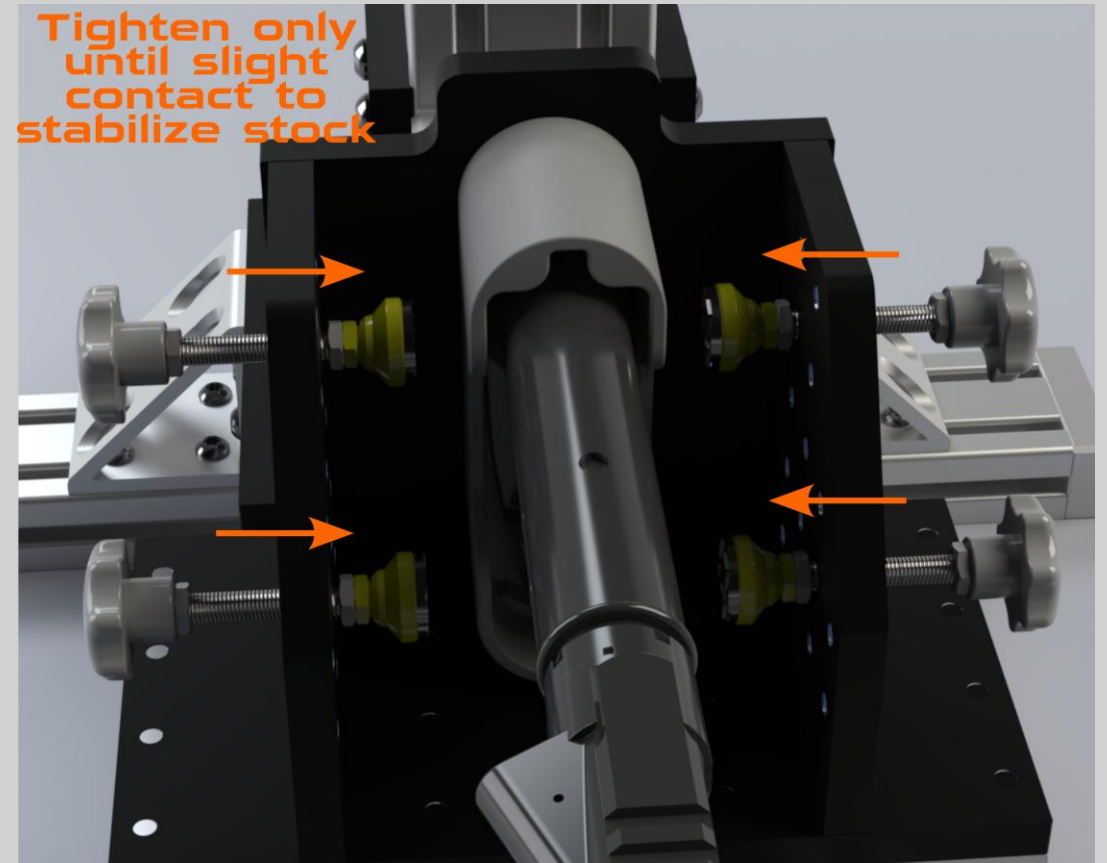
Threaded clamps at the rear stock interface shall be tightened only enough to maintain alignment of the rifle within the fixture. Clamps should be snug, but not rigidly fixed. Over-tightening the rear clamps will restrict rearward motion of the assembly and prevent the recoil pad from compressing as intended.

The rear assembly must be free to move under load to allow full compression of the recoil pad and proper transfer of force into the load cell. Restricting this motion will result in inaccurate recoil measurements and may alter the dynamic response of the system.

Prior to testing, verify that:

- The rifle is properly seated in rear adapter and aligned with the recoil axis
- The clamps are lightly tightened and not constraining rearward motion
- The rifle is properly seated in the rear adapter and aligned with the recoil axis

Proper rear restraint ensures that recoil energy is absorbed and measured through the intended load path, preserving both data fidelity and system performance.



Test Configurations

Sliding Configuration

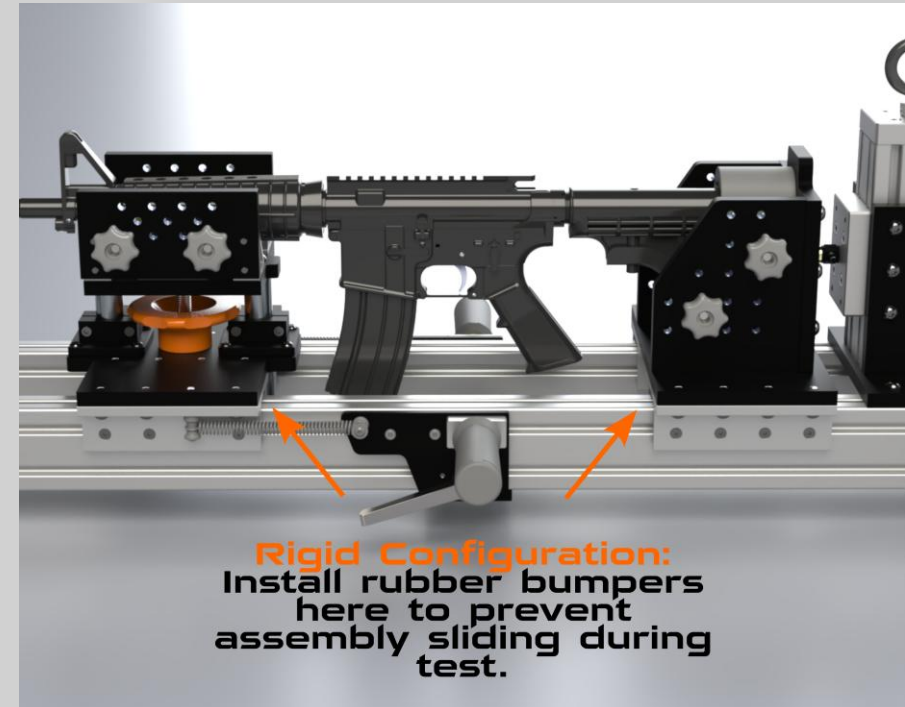
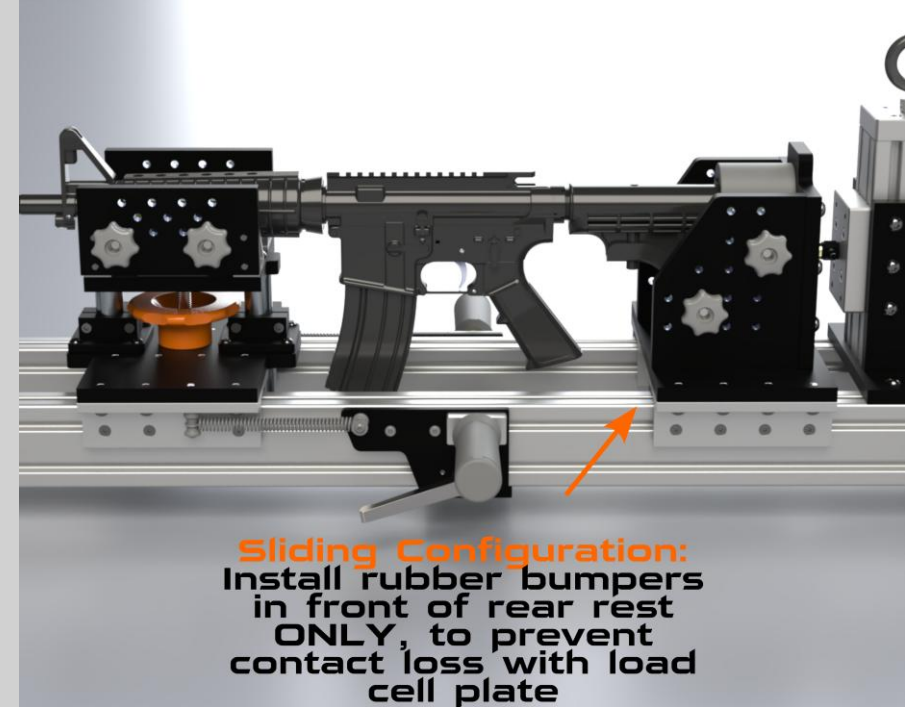
The sliding configuration is the standard test mode and is used for recoil measurement. This setup allows controlled rearward motion of the rifle, enabling evaluation of recoil energy, recoil pads, and muzzle devices.

Ensure that rubber bump stops are not in contact with the front sliding assembly and that sufficient clearance exists to allow unrestricted motion during firing.

Rigid Configuration

The rigid configuration is used for function or accuracy testing where recoil measurement is not required. Install rubber bumpers behind the front sliding assembly and against the rear assembly to prevent movement during firing.

Recoil data collected in this configuration will not be accurate, as the bumpers absorb and redistribute recoil forces. This mode is intended for functional testing only.



Preloading Fixture

Preloading Assembly

Preloading ensures consistent contact between the rifle and load cell and is critical for repeatable measurements. The preload sliders apply a constant rearward force to maintain alignment and prevent separation during recoil.

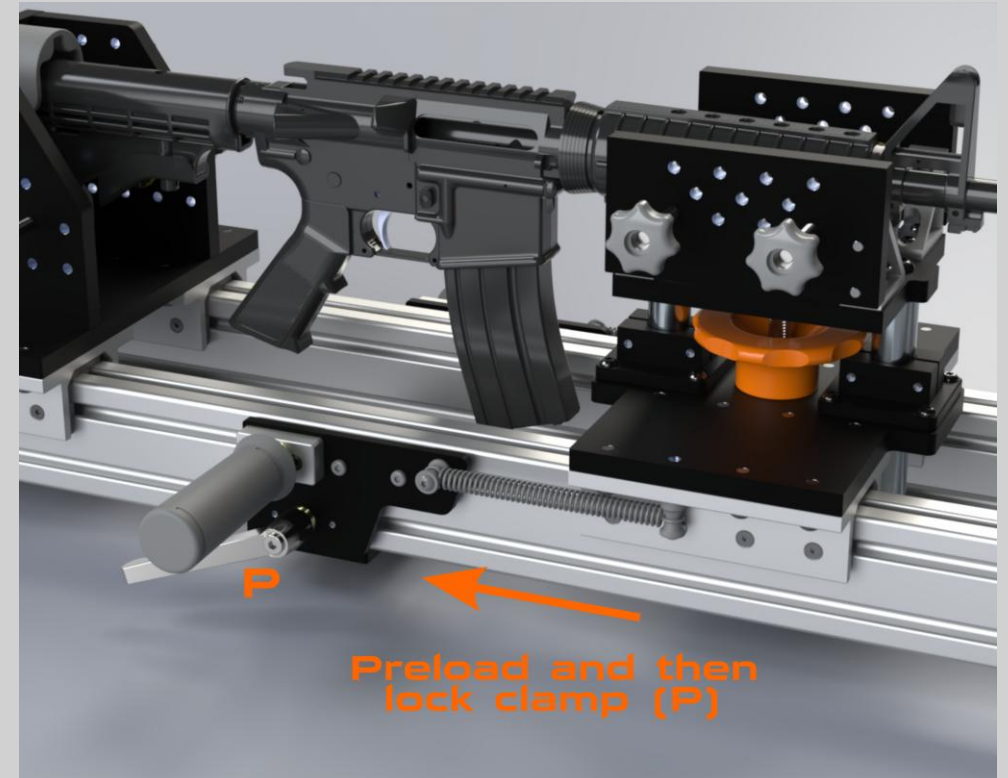
Unlock the frame clamp levers (P) on both sides. Pull the preload sliders rearward to apply tension, targeting approximately 25 to 40 pounds of preload force. Use the measurement scales on each rail to ensure equal displacement on both sides and prevent binding. Once set, firmly relock the clamp levers.

During extended testing, periodically verify preload to ensure it has not changed due to system settling. Variations in preload can affect measurement consistency.

If a data acquisition system is connected, zero the load cell prior to applying preload. Use the live readout to confirm the applied preload force is within the recommended range.

Note: When testing is complete, unlock frame clamp levers (P) first and release preload tension before loosening firearm constraints.

SAFETY NOTE: Never attempt to remove a loaded rifle from the test stand. Ensure magazine is removed and chamber is empty before safely removing rifle from fixture.



Printing Stock Adapter Cups

To ensure proper load transfer and accurate recoil measurement, a custom stock adapter cup should be used to interface the rifle recoil pad with the test stand. The adapter cup should be designed to match the geometry of the specific stock being tested, allowing for full and uniform contact across the recoil pad surface.

A slight clearance between the stock and adapter cup is recommended, typically in the range of 1–3 mm, to allow for proper fitment without binding. The design should avoid point loading and maintain consistent contact during recoil.

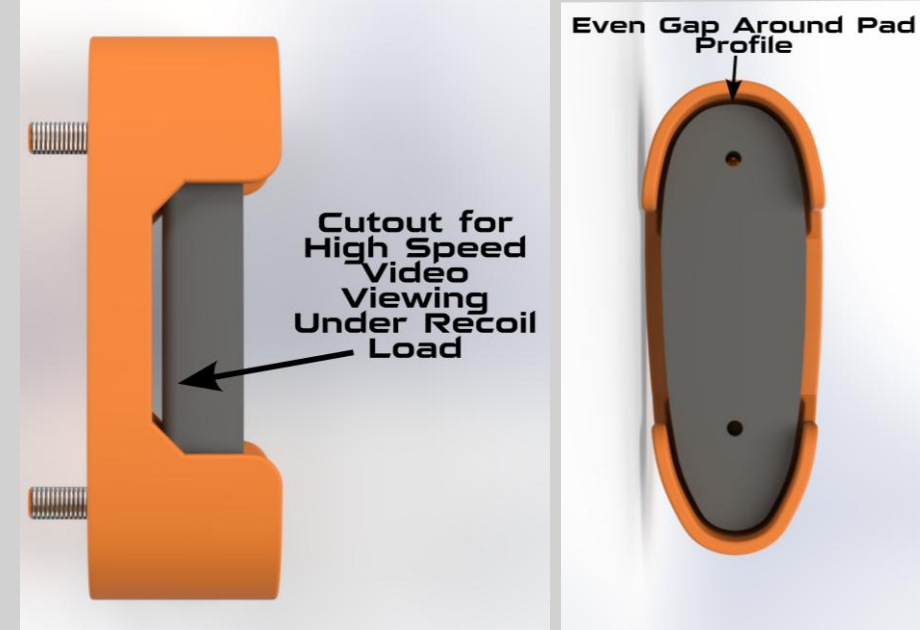
Custom adapter cups may be produced using additive manufacturing methods. For printed components, use a structurally suitable material such as fiber-reinforced nylon or ABS with high infill density to ensure stiffness and durability under repeated loading.

The adapter cup is mounted to the rear assembly using the provided hole pattern consisting of M8 tapped holes at 15 mm spacing. Any mounting configuration is acceptable provided a minimum of two mounting points are used. Ensure all fasteners are properly tightened and that the adapter is rigidly secured to the fixture.

Prior to testing, verify that the adapter cup maintains full contact with the recoil pad and does not introduce gaps, tilt, or uneven loading, as this may affect measurement accuracy.

Custom Adapter Support

If assistance is required in designing or manufacturing a custom stock adapter cup, Bighorn Kinetics offers a custom adapter printing service. Please contact info@bighornkinetics.com for additional information.



Maintenance

General

Routine maintenance of the UMPIRE Static Recoil Test Stand is required to ensure reliable operation, accurate data collection, and long-term durability. All components should be inspected prior to testing and serviced as needed based on usage and environmental conditions.

Load Cell and Instrumentation

- Verify that all load cell mounting screws are properly installed and torqued in accordance with the sensor manufacturer's specifications
- Inspect all electronic cables for damage, including kinks, abrasion, or exposed conductors
- Ensure all cable connections are secure and free of contamination prior to testing

Structural Hardware

- Inspect all mounting hardware on the test stand and confirm that fasteners are secure and properly tightened
- The test stand is supplied with all required tools for adjustment and maintenance; use these tools to verify hardware integrity before each test session

- Confirm that bumper placement does not interfere with the free motion of the front or rear sliding assemblies, as any obstruction may affect measurement accuracy

Linear Shaft Assemblies

- Periodically apply a light coating of lubricating oil to the front linear shafts to maintain smooth operation
- A high-quality general-purpose oil is recommended; standard gun oil is acceptable
- Ensure only a thin film is applied to avoid debris accumulation
- Increased lubrication frequency may be required in humid or corrosive environments to prevent oxidation and maintain performance

Inspection Frequency

Maintenance should be performed prior to each test session and more frequently under high-use or harsh environmental conditions. Any worn, damaged, or loose components should be addressed before operation.

Warranty and Safety Information

SAFETY ADVISORY

Safety with firearms is the responsibility of the user
– exercise extreme caution while using this product.

Do not use the UMPIRE Static Recoil Test Stand for any purpose except as outlined in this manual.

We guarantee the exercise of reasonable care in manufacturing, but assume no further responsibility.

BIGHORN KINETICS WARRANTY

Bighorn Kinetics products are warranties against defective parts or defective craftsmanship for a period of one (1) year.

An RMA# (Return Merchandise Authorization) is required in order to send any products back for any reason. If you should have a problem with your unit, or any other products, please email BIGHORN KINETICS at info@bighornkinetics.com.



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