Operations Manual

Hip ROM Test Fixture

V00039

Hip ROM Test Fixture Operations Manual V00039-9900 [Rev. A]

HUMANETICS®
Innovative Solutions

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Section 1. Introduction

1.1 Safety Instructions

Read and understand this manual before attempting to use the equipment. The operator is responsible for reading and following the procedures described in this document. The proper installation and use of the equipment is the responsibility of the operator. The equipment should be fully installed and inspected before performing tests.

The Safety Alert Symbol is used to indicate hazards and to inform the operator as to any and all safety related information that could or will, if not heeded, lead to death, injury or equipment damage. The Safety Alert Symbols in this manual are structured and defined as follows:

	DANGER Refers to an immediately dangerous situation, which may lead to death or serious injury if not prevented.
	WARNING Refers to a potentially hazardous situation, which may lead to death or serious injury if not prevented.
	CAUTION Refers to a potentially dangerous situation, which may lead to minor or moderate injuries or material damage if not prevented.
	NOTICE Indicates useful tips, recommendations and information for an improved or more efficient and trouble-free operation.

Section 2. Product Description

The Humanetics Hip ROM (Range Of Motion) Test Fixture is a fully automated, stand- alone testing stand for verifying the performance of the Hybrid III 50th% (HIII-50M) pelvis assembly. The standard fixture includes a stand-alone frame, digital controller unit, (1) force and (1) angle transducer, mounting brackets and controller power supply.

In the mid 1990's the Society of Automotive Engineers (SAE) task group for the Hybrid III family dummy was called upon by the National Highway Traffic Safety Administration (NHTSA) to develop a certification test for the Hybrid III 50th% (HIII-50M) pelvis-femur assembly. It was discovered that under severe testing conditions the HIII-50M pelvis femur assembly was binding and causing 'false' acceleration data in the thoracic spine region. The root of the problem is the lack of symmetry of the HIII-50M pelvis bone from the left iliac to the right. However, due to several issues the problem was dealt with by adding a urethane 'bumper' pad to the femur bone. The femur bumper pad reduced the possibility of contact between the femur and pelvis bones and provided a cushioning effect to remove the 'false' spine acceleration data.

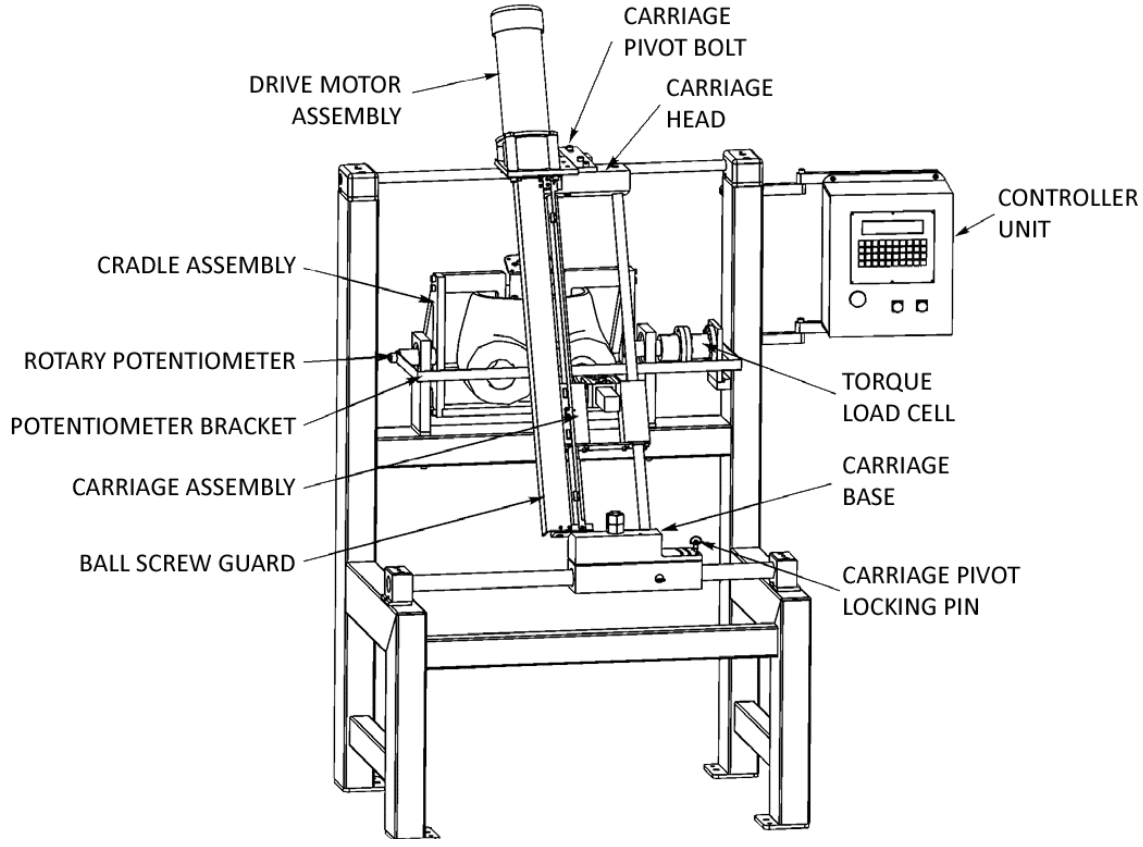


Figure 2.1 Hip ROM Test Fixture

Section 3. Fixture Assembly

The test fixture is shipped partially disassembled due to packaging concerns. The following instructions are meant to be a guide to assembling and checking the Hip ROM Test Fixture. Listed in the figure below are the hardware components.

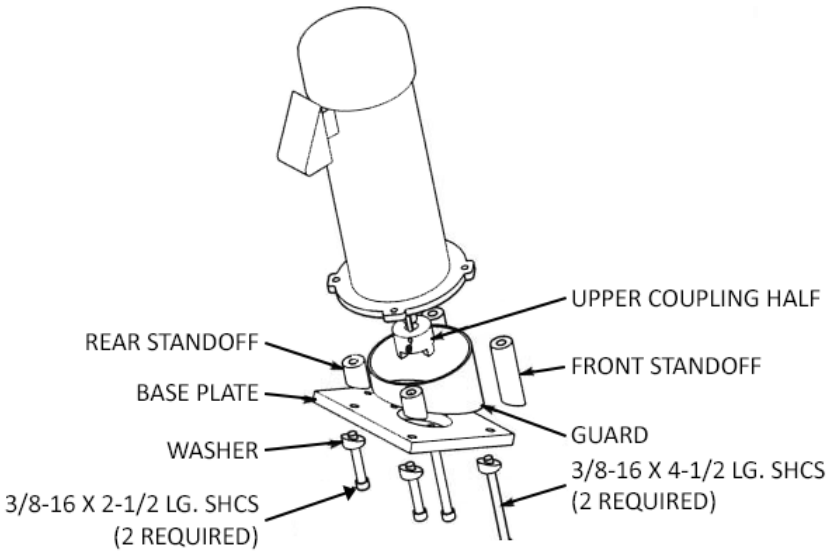


Figure 3.1 Motor Assembly

Table 3.1 Recommended Tools

Recommended Tools
'Ball' end Hex wrenches ("Allen")
'T' Handle Hex wrenches
Open end wrenches: 5/16" – 1-1/2" Screwdriver
Standard Tip Pliers
Level, Precision

3.1 Motor Mounting

The variable speed motor assembly is mounted to the top of the sliding carriage assembly with three 3/8-16 X 2-1/2 LG. SHCS from under the carriage head. To attach the motor assembly first position the motor assembly on top of the carriage in the proper orientation and slide the upper half of the coupling down on to the lower half. Make sure the rubber boot insert is installed between the two coupling halves. Insert the three 3/8-16 SHCS into the carriage head and motor assembly base plate. With the three SHCS installed and the coupling in place, tighten the SHCS. Check the fit between the upper and lower coupling halves. If adjustment is necessary both halves of the shaft coupling can be adjusted to ensure maximum engagement however, if the upper half is to be adjusted the plastic guard will have to be removed first. To do this, remove the four 3/8-16 SHCS that secure the motor housing to the base plate. A reference dimension of 1.25" ±0.05 [32 mm ±1] from the bottom of the motor housing to the top of the upper coupling half is used when the fixture is assembled at Humanetics. To adjust the lower coupling half, loosen the two 1/4- 20 X 1/4 LG. SSFP on the lower coupling and slide the coupling on the drive shaft until there is maximum contact between the two coupling segments.

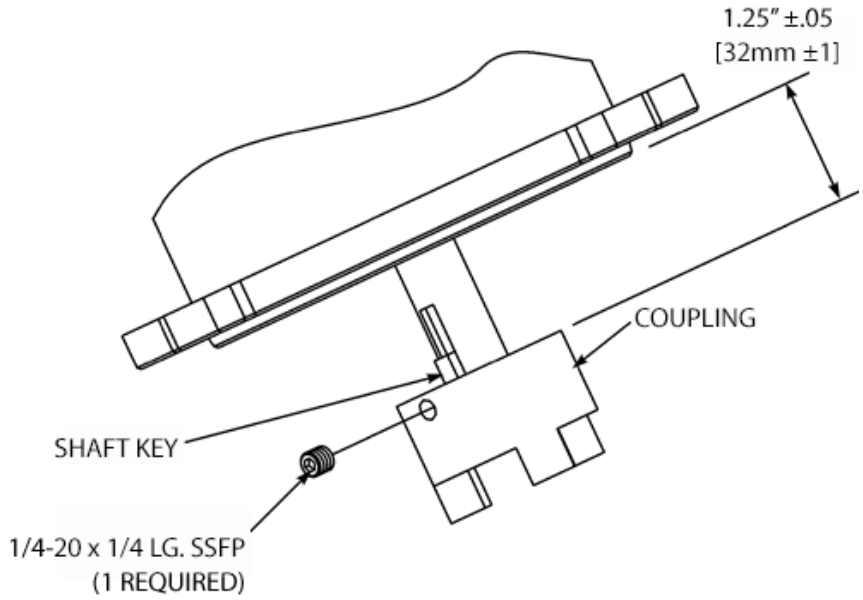


Figure 3.2 Coupling Attachment

3.2 Controller Mounting

To attach the controller unit to the fixture first secure the controller box to the two (2) attaching extending brackets using four 1/4-20X5/8 LG. BHCS. Once the box is securely attached to the extending brackets the assembly can be attached to the fixture using four 3/8-16X1 LG. SHCS.

3.3 Caster Mounting

The casters can be mounted at the base of each leg of the fixture using four 5/16-18X5/8 LG. SHCS, with locking washers. Shims can be added between the caster base and the leg frame to aid in leveling the fixture.

3.4 System Check

Once the controller unit and motor assembly are reinstalled on the fixture, the system sensors should be checked to verify correct operation. Refer to the Diagnostic section of the Hip ROM Test Fixture Controller Software Operations portion of this manual.

Check that the fixture sensors are operating properly by using the “Manual Mode Jog” screen on the controller. Push on the pelvis cradle to read the change in force on the load cell and move the potentiometer bracket to see the change in angle. Using the “Digital I/O Diagnostic” screen, check the limit sensors placing a magnet near the switches at the top and bottom of the Carriage Assembly. There is also a “Zero” switch located near the bottom limit switch that should also be checked. This is done by placing a piece of paper in between the emitter and collector of the switch and watching the change on the controller’s screen. Even though the original transducer sensitivity values have been entered into the controller, the values should be verified. Refer to the SETUP section of the Hip ROM Controller Software Operations portion of this manual.

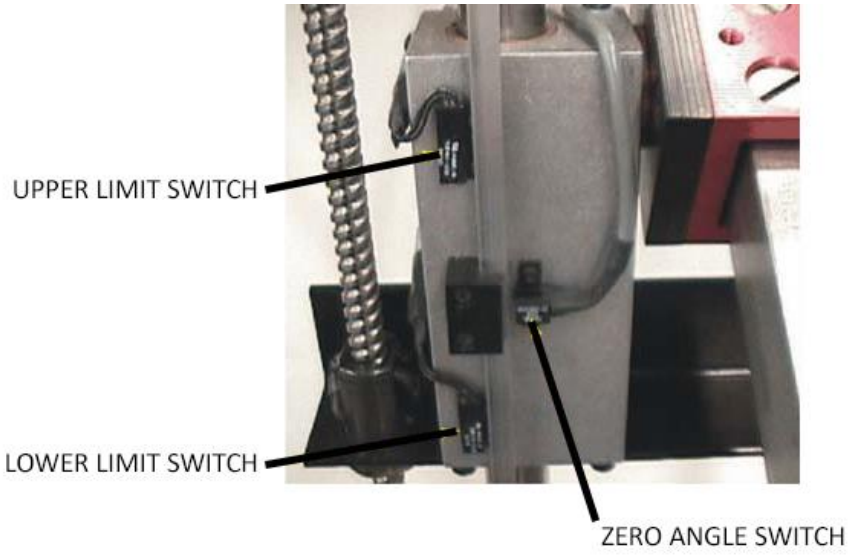


Figure 3.3 Switch Locations

Section 4. Fixture Setup

4.1 Connections

There are six (6) connections necessary for the Hip ROM Test Fixture to be performed: Moment transducer, Angle transducer, Angle Ø light switch, Limit switches, Motor and AC power. The Torque. Load Cell is connected to the channel labeled “Moment Trans.” The rotary Potentiometer is connected to the “Angle Trans.” connector. The Limit switches are connected to “Limit Switches”. The “Angle Ø light switch” connects the Zero Angle switch of the controller.

4.2 Test Setup

To begin, the pelvis assembly has to be removed from the dummy. However, the lumbar assembly does not have to be removed from the pelvis. The Humanetics Hip ROM Test Fixture is designed to allow the operator to perform the flexion test with the complete pelvis assembly intact. If an older pelvis is being tested check to ensure that the femur assemblies are up to the current revision level. To attach the pelvis with the lumbar assembly in place, use adapter post P/N: HF-103 (3.47” long, 88.1 mm).

If the lumbar assembly is removed, attached the pelvis using a 1/4” (6.4 mm) spacer (part number: V00597) inserted between the pelvis attachment posts (2 required) and the pelvic adapter bracket. To attach the pelvis assembly with the lumbar load cell a different adapter post is used, P/N: V00600 (3.35” long, 85.1 mm).

4.3 Pelvis Preparation

To attach the pelvis assembly to the flexion fixture it is necessary to install the adapter posts with a lumbar adapter and pelvis attachment bracket. Replace the two 3/8-16 X 3/4 LG. SHCS at the front of the lumbar adapter block with the adapter posts. The rear accelerometer mount and cover are replaced with a pelvic rear adapter. Remove the four #10-24 SHCS hold the cover in place and take out the 3/8-16 SHCS that fastening the accelerometer mount to the pelvic bone. Replace the mount with the rear adapter and secure it in place using four #10-24 X 5/8 LG. SHCS. The two (2) femur friction plungers inside the abdominal cavity must be loosened or removed (*optional*) so that no force is exerted on the femur ball.

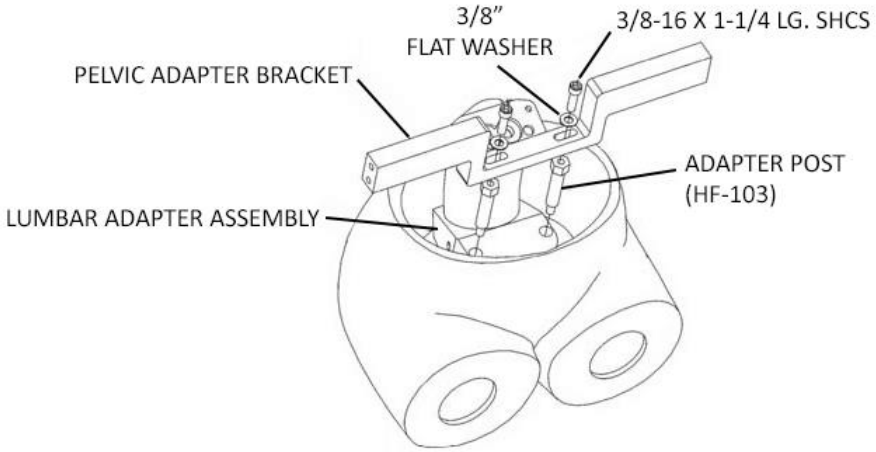


Figure 4.1 Pelvis Lumbar Adapter

4.4 Installing the Pelvis

The pelvis assembly is installed in a cradle that attaches to the Hip ROM Test Fixture at the pivot shafts located on either side of the cradle assembly. To install the pelvis in the cradle, attach the pelvic adapter bracket to the adapter post as shown.

Next, from the rear of the test fixture place the pelvic rear adapter on the rear- positioning block. The pelvis should be pulled back so that the pelvic adapter is against the rear surface of the pocket before beginning to tighten the screws. This is the reference surface. Insert the 3/8-16 X 2-1/2 LG. SHCS but do not completely tighten until all the adapter screws are inserted and started. Align the pelvic adapter bracket and insert the 3/8-16 x 1-1/4 LG. SHCS on each end of the bracket.

Do not tighten any of the screws until all are inserted. Once the pelvis assembly is installed in the cradle all the screws should be tighten starting with rear positioning block.

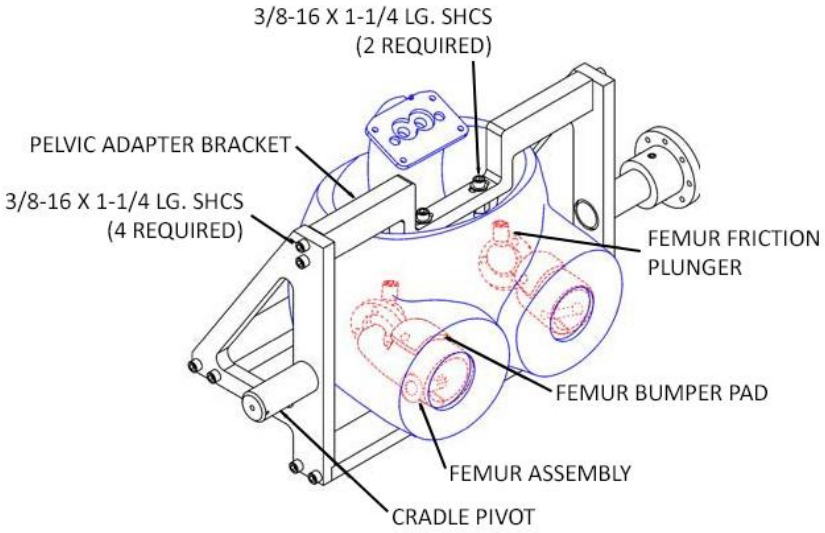


Figure 4.2 Pelvis Attachment

4.5 Inserting the Femur Adaptor

The femur adapter assembly is attached to the pelvis assembly at the femur assembly. The adapter is secured to the femur assembly using a 5/8” x 1-3/4” SHSS. To move the adapter assembly, loosen the two (2) thumb screws on the horizontal slides and slide the entire carriage assembly until it is approximately centered on the femur. Move the carriage vertically by using the “Manual Mode Jog” screen on the controller. It is easier to insert the femur adapter into the pelvis if you remove the pivot locking pin first. After the 5/8" SHSS is inserted, then re-insert the locking pin. After the femur adapter is installed the potentiometer bracket is moved so that it is allowed to rest on the adapter.

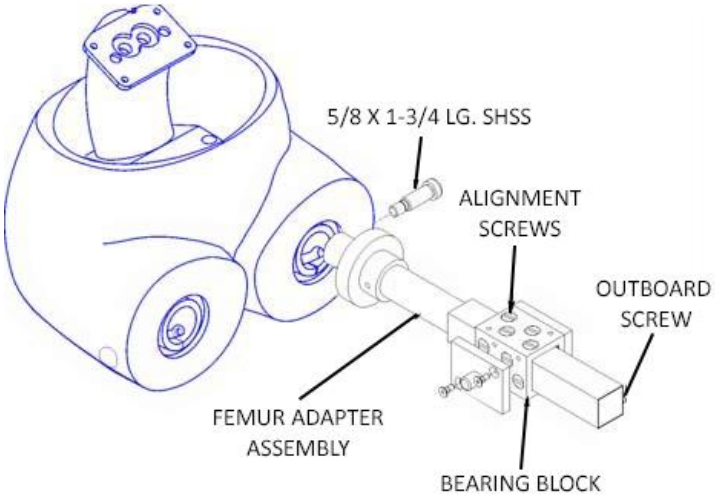


Figure 4.3 Femur Adapter

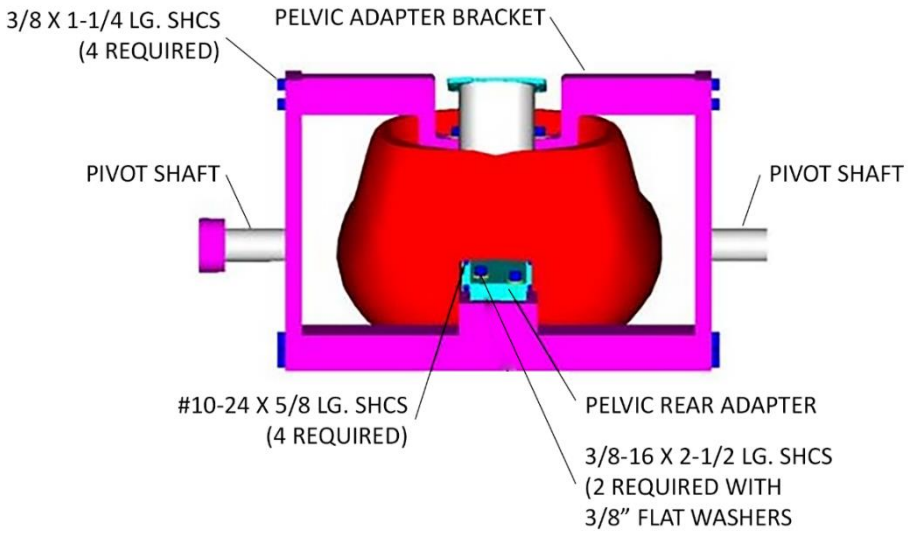


Figure 4.4 Pelvis Adapter Bracket

Section 5. Hip ROM Test Fixture Controller Software Operations

The Humanetics Hip ROM Test Fixture is driven by a user friendly controller that allows the operator to run the standard NHTSA or SAE tests without changing any test setup parameters. The flexible programmability that the controller offers allows the operator to use the “standard” setups and/or system parameters but also provides the means for customizing test setups, corridors and system parameters. The following sections will describe the four main controller functions. The four main controller functions are listed below.

- Setup
- Start Test
- Test Data
- Diagnostics

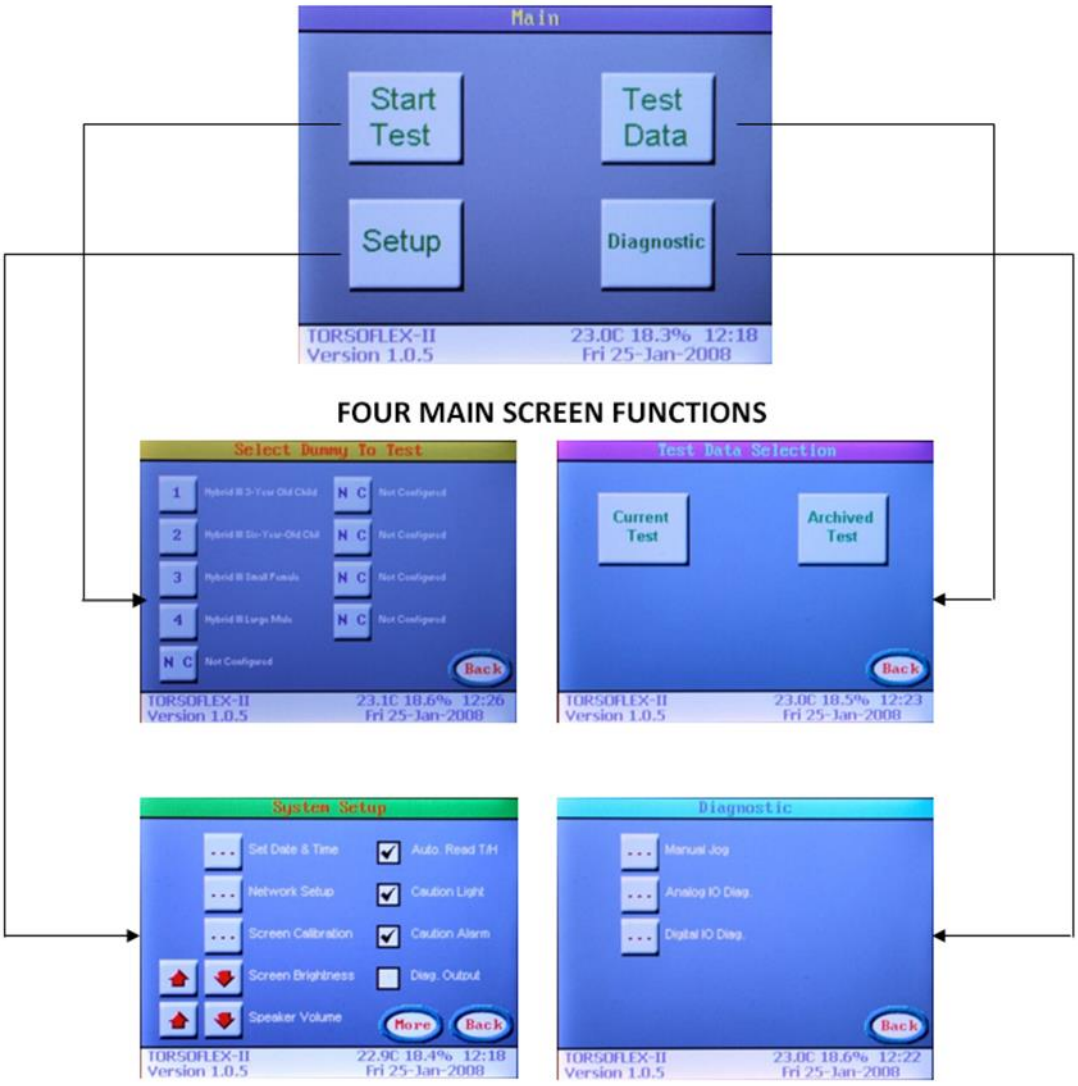


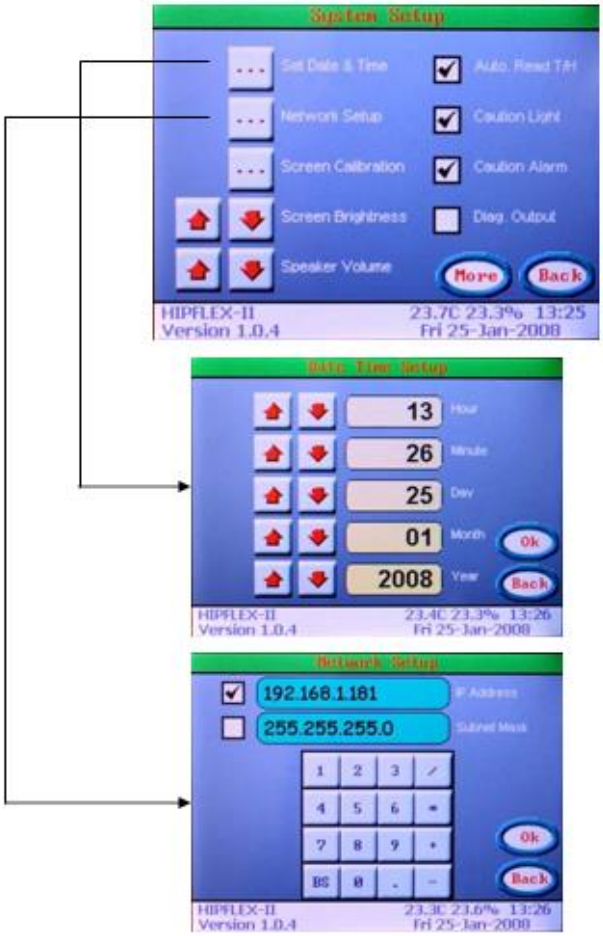
Figure 5.1 Four Main Screen Functions

5.1 Setup

System setup is password protected. Enter password to access setup functions.

Figure 5.2 Systems Setup Password

5.1.1 Setup Screen #1



Check Auto Read T/H if using Temp/Humid probe, else manually enter T/H at test time. Note: this item must be checked when performing the A to D (ADC) calibration.

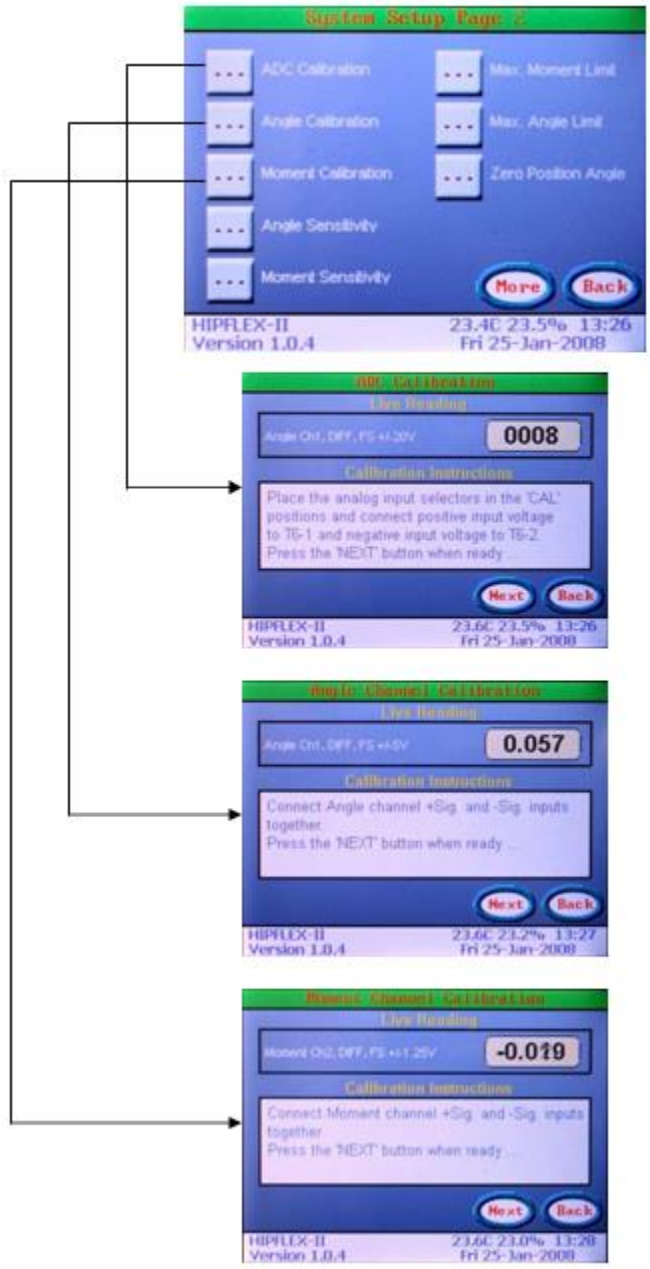
Enable/Disable caution light and/or alarm. Note: Diag. Output should remain unchecked unless otherwise instructed.

Set system time and date.

Set system IP address.

Figure 5.3 Setup Screen #1

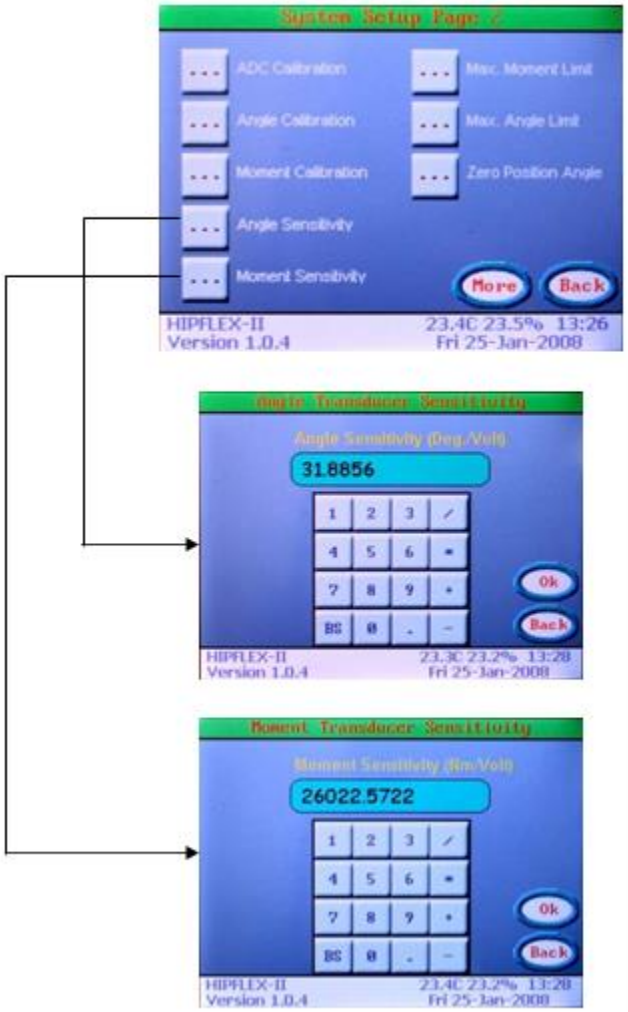
5.1.2 Setup Screen #2



The controller ships from the factory completely calibrated, but periodically should be re- calibrated.

Using a precision 4 ½ digit DVM, voltage source and supplied calibration cables, follow the on screen prompts for performing A to D, Angle, and Moment channel calibrations.

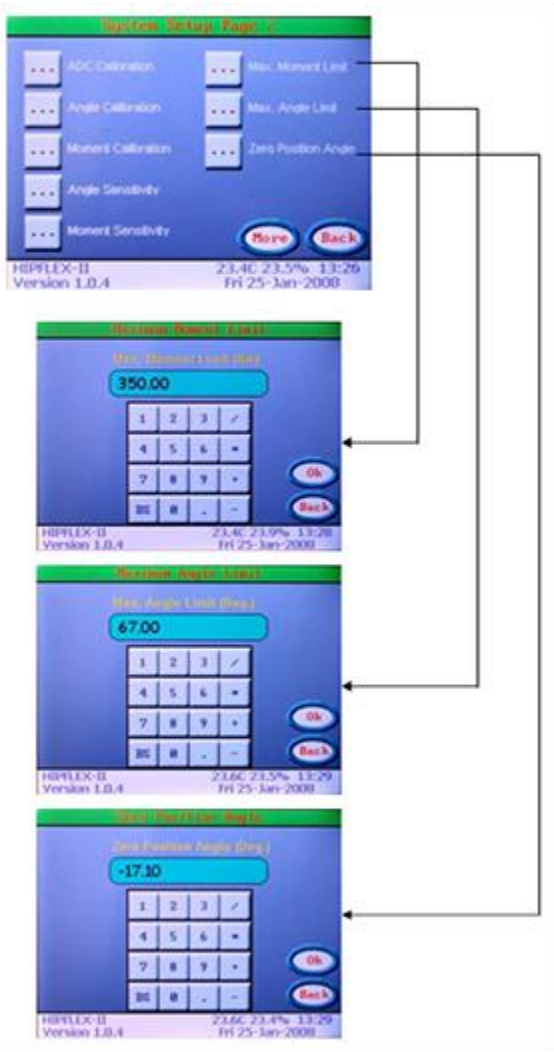
Figure 5.4 Setup Screen #2, Calibration



The correct sensitivities are entered at the factory, but will need to be re-entered whenever the angle (potentiometer) and/or moment (load cell) sensors are sent out for calibration. Angle sensitivity is entered as Degrees/Volt.

Moment sensitivity is entered as Newtons/Volt.

Figure 5.5 Setup Screen #2, Sensitivity



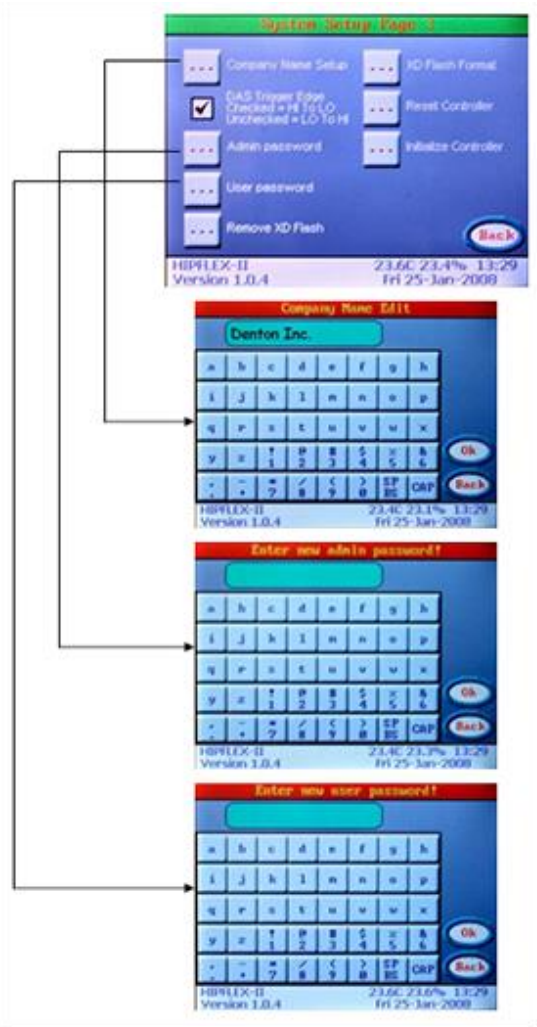
Enter the maximum moment limit in Newton Meters. This is a system safety limit. If exceeded in manual operation or during a test, the operation will be aborted.

Enter the maximum angle limit in Degrees. This is a system safety limit. If exceeded in manual operation or during a test, the operation will be aborted.

Zero Position Angle is the measured angle of the femur adapter centerline with respect to the top surface of the pelvis when the adapter is in position to trip the zero position switch. (See Zero Position Angle Measurement)

Figure 5.6 Setup Screen #2, Max Moment, Max Angle, and Zero Position Angle

5.1.3 Setup Screen #3



Enter your company name in order to identify your test data.

The administrator password is required for viewing and editing of dummy test and corridor parameters.

The user password is required for gaining access to system parameters.
Note: the user may view dummy test and corridor parameters, but may not edit them.

Figure 5.7 Setup Screen #3, Company & Password Setup for Test Data Viewing

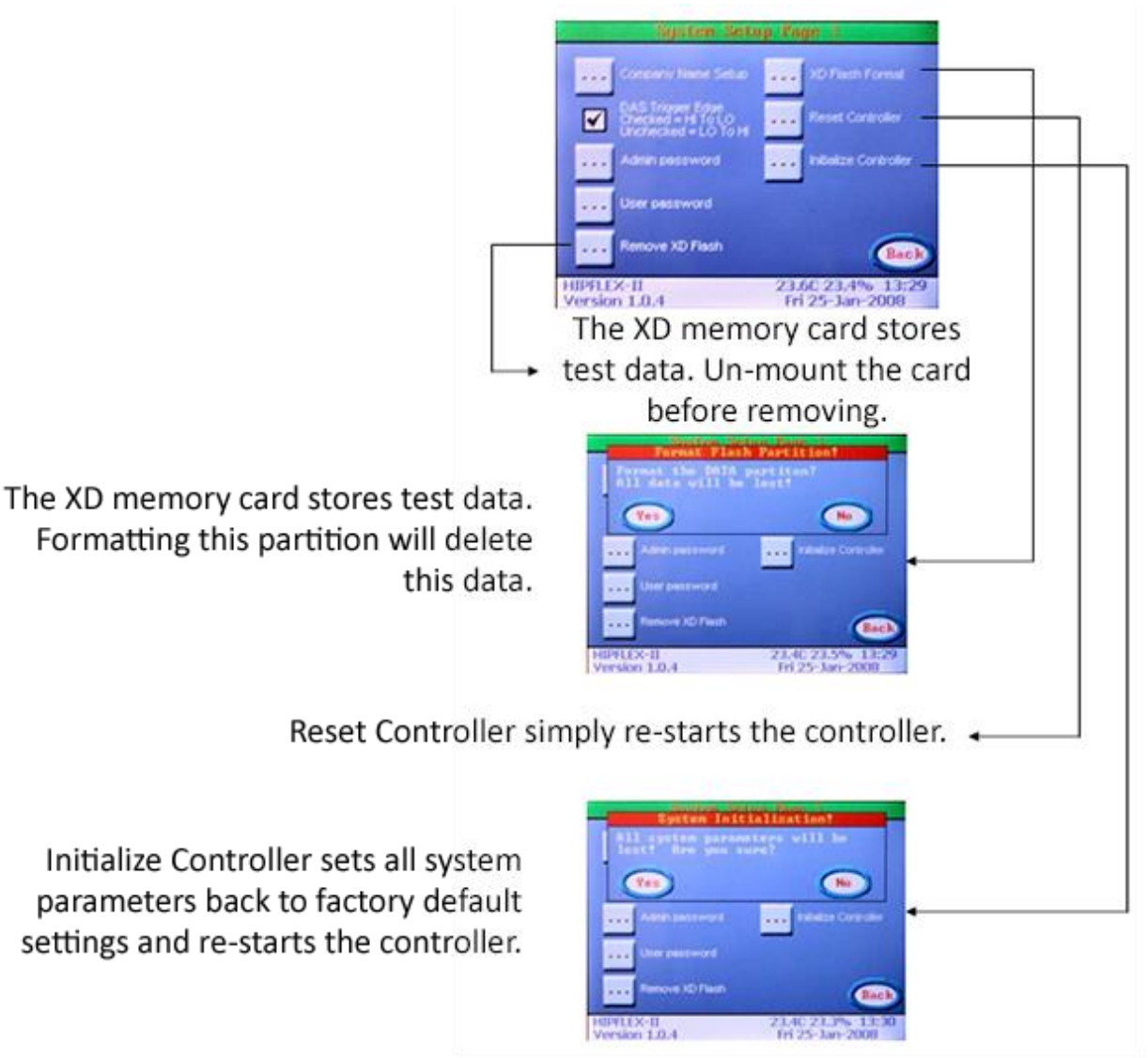
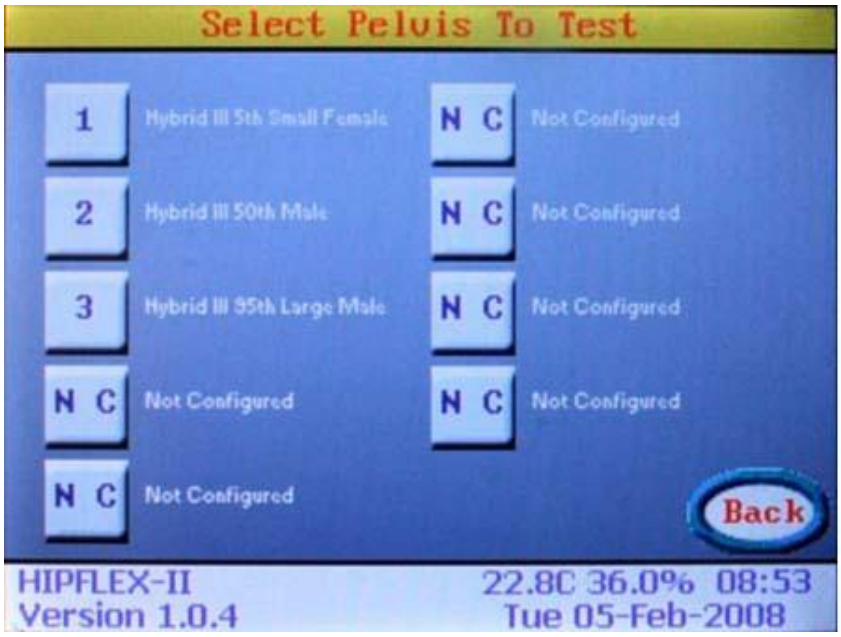


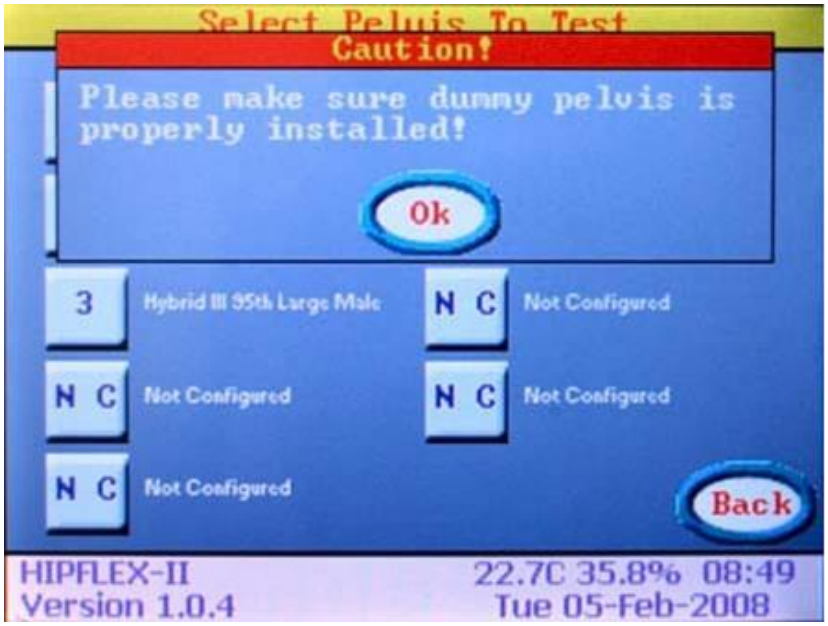
Figure 5.8 Setup Screen #3, XD Memory

5.2 Start Test



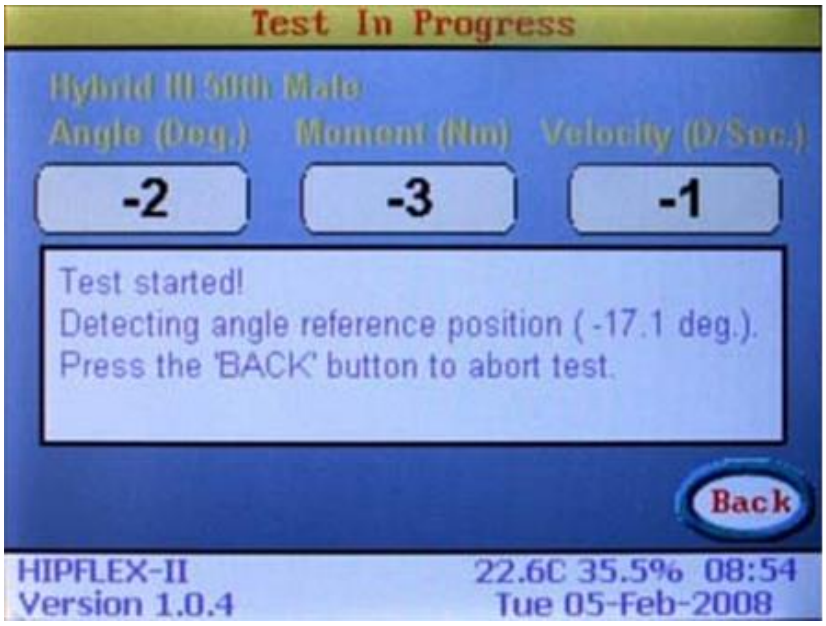
Select dummy to test.

Figure 5.9 Start Test, Select Dummy to Test



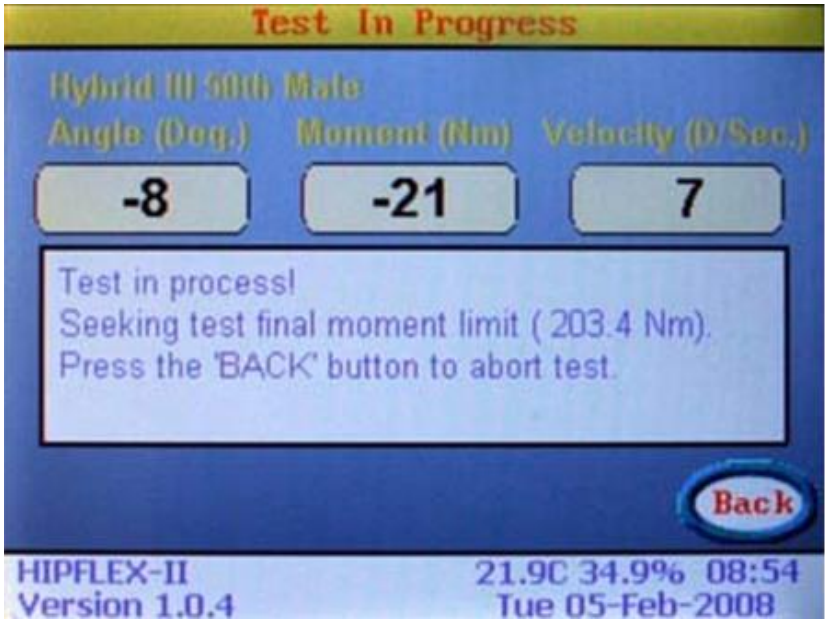
Make sure that the pelvis is positioned properly. If the controller is connected to a DAS, make sure that the DAS is armed and ready to collect data before proceeding.

Figure 5.10 Start Test, Pelvis Positioned Properly



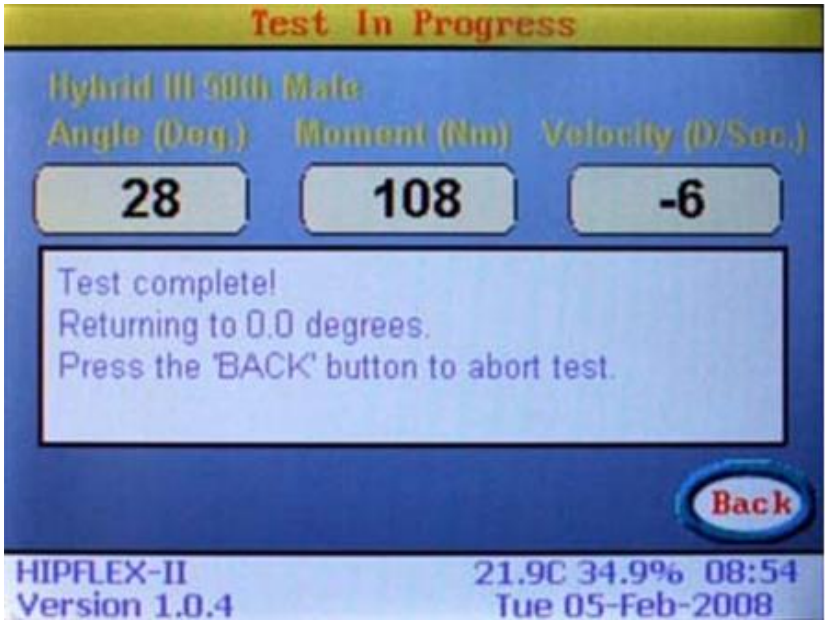
Shortly after the test strobe light begins to flash, the motor turns on to move the femur adapter/bearing block assembly downward toward the zero position switch.

Figure 5.11 Start Test, Zero Position Switch



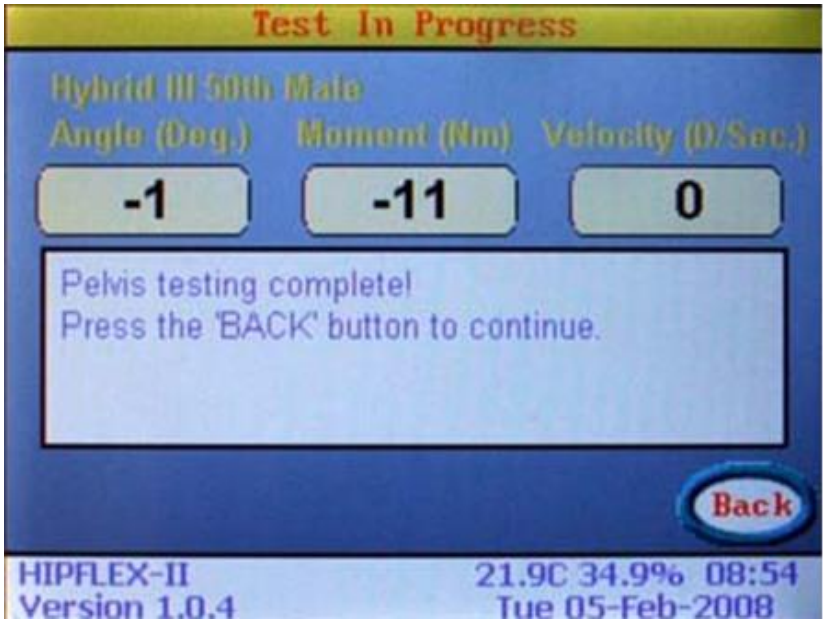
Once the zero position switch is detected, the motor reverses direction moving the femur adapter/bearing block assembly upward until one of the End of Test limits are found.

Figure 5.12 Start Test, End of Test Limits



After the End of Test limit is achieved, the motor will again reverse direction moving the femur adapter/bearing block assembly back to it's "at rest" position (around zero degrees).

Figure 5.13 Start Test, "At Rest" Position



A message will indicate when the test is complete.

Figure 5.14 Start Test, Test Complete

Should it become necessary to stop the test for any reason, press the large red button on the controller unit. The motor will shut off and if raised above zero degrees, the femur adapter/bearing block assembly will return back to its “at rest” position (around zero degrees). Note: the preferred method of stopping a test while in progress is by pressing the BACK button.

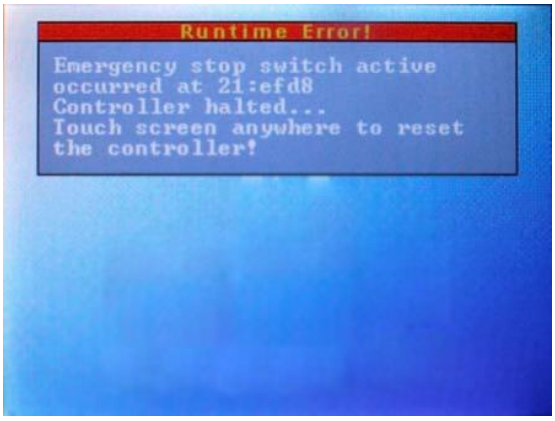


Figure 5.16 Emergency Stop

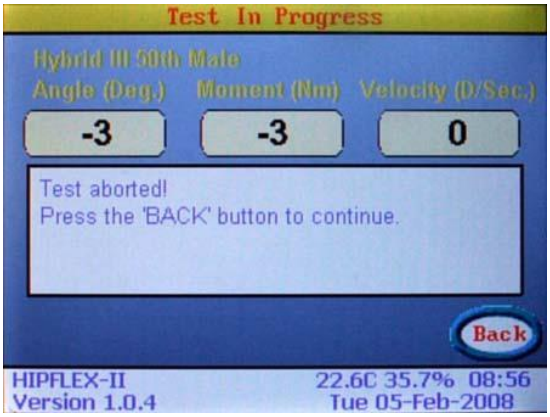
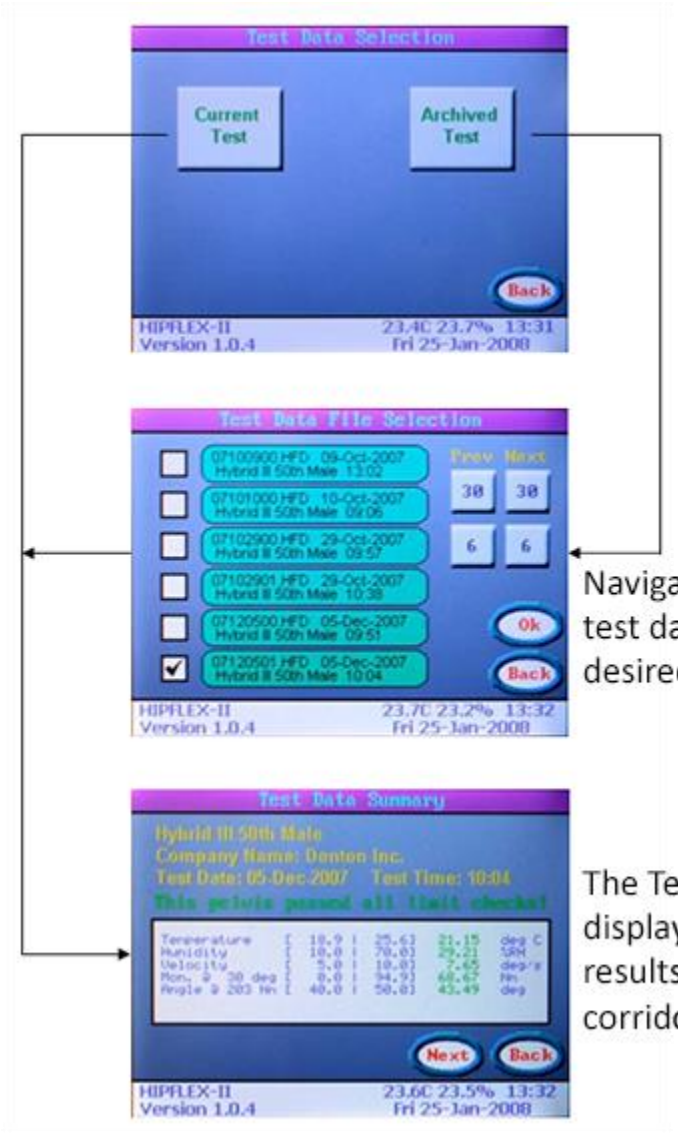


Figure 5.15 Test Aborted

	CAUTION Be aware that aborting the test by using the BACK button will immediately stop the test.

	CAUTION In order to prevent injury and/or entanglement from possible unexpected release of the ATD, keep all personnel, tools and material away from the test surface and test specimen.

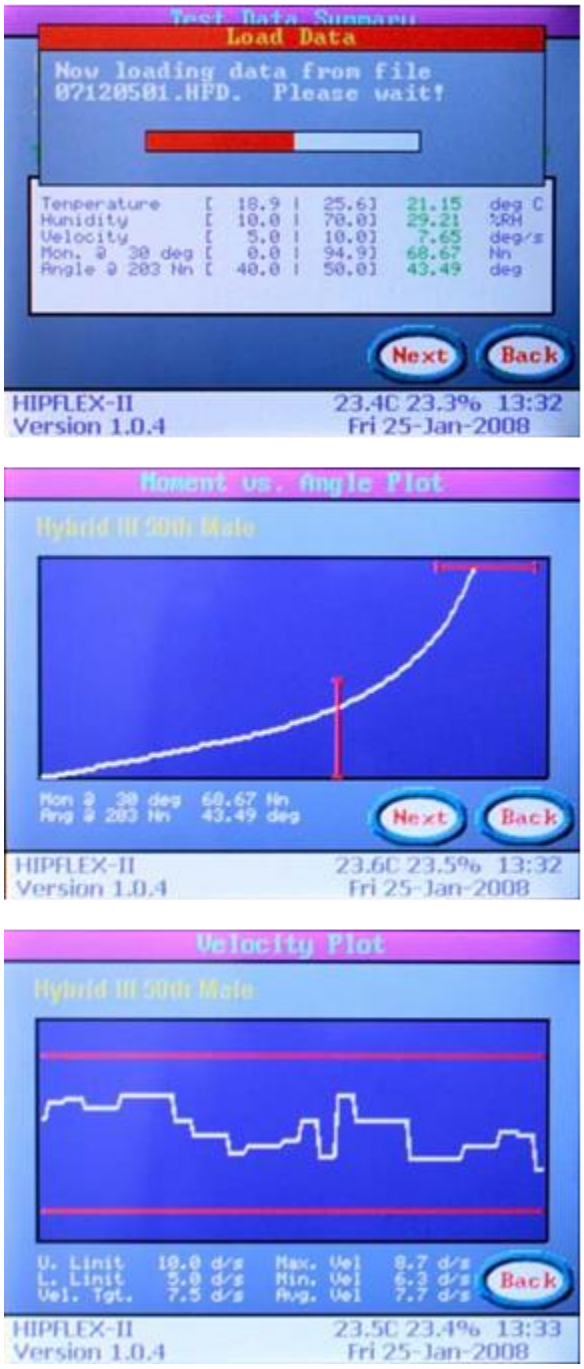
5.3 Test Data



Navigate through the archived test data files and check the desired selection.

The Test Data Summary screen displays test measurement results as well as measurement corridors.

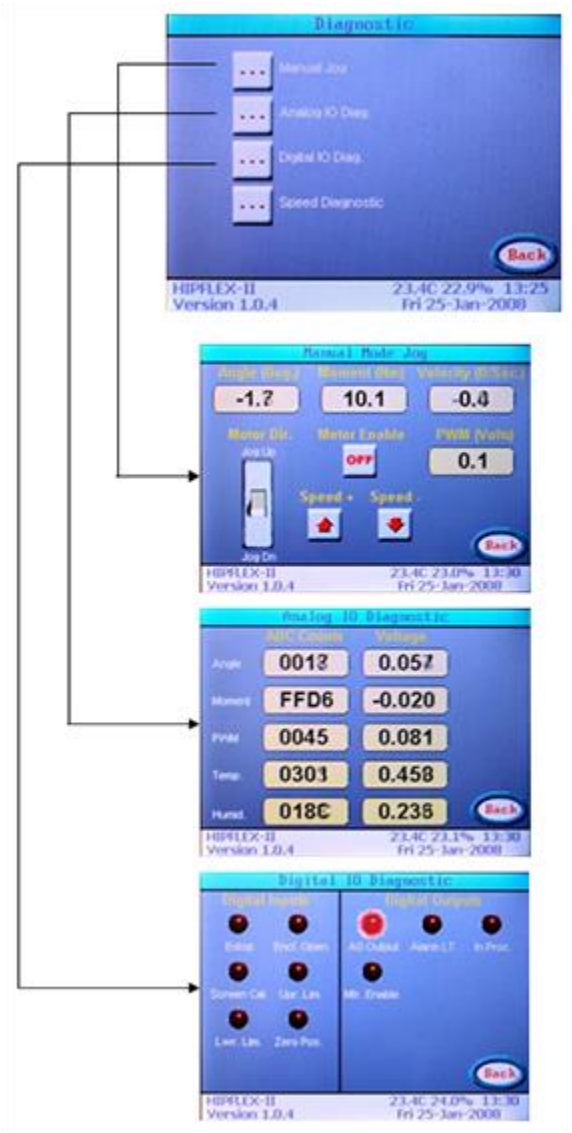
Figure 5.17 Test Data Selection



Press Next to generate and view Moment vs. Angle plot and Velocity Plot.

Figure 5.18 Test Data, Moment vs. Angle Plot and Velocity Plot

5.4 Diagnostic

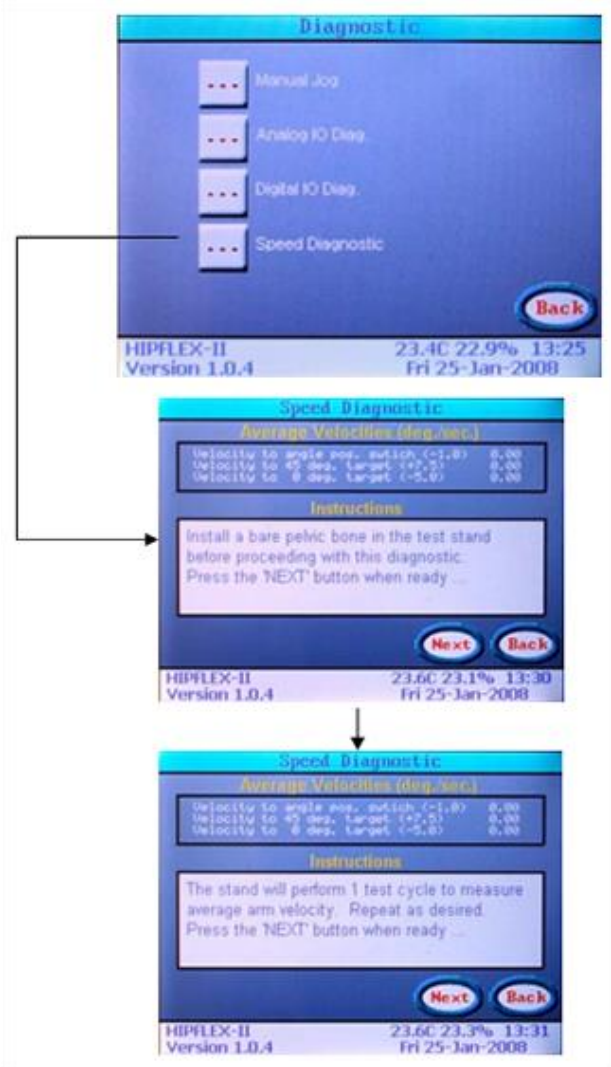


Use this screen to manually enable/disable the motor to advance/retract the femur adapter. The PWM (pulse width modulation) voltage controls the motor speed. This screen may also be used to check operation of the transducers.

Use this screen to monitor the transducer and PWM live channel output voltages.

This screen may be used to monitor the status of the system inputs and manually enable/disable system outputs.

Figure 5.19 Diagnostic



A Speed Diagnostic test may be run in order to check the average velocity of the femur adapter/bearing block arm assembly. This test is available to aid in setting up the KB model KBMG-212D motor controller.

The motor controller is set up at the factory and further adjustments should not be necessary. If adjustments do become necessary run the diagnostic test using a BARE PELVIC BONE ONLY.

Figure 5.20 Speed Diagnostic

The motor controller trim pot default settings as set for the Hip ROM Test Fixture.

Figure 5.21 Hip ROM Test Fixture Motor Controller Trim Pot Default Settings

Section 6. Zero Position Angle Measurement

The zero position angle is a reference point used by the controller in determining when the femur adapter/bearing block arm assembly is at zero degrees (test starting position). Install a bare pelvic bone (bone only, no flesh) or pelvic bone simulator in the test stand. (Not included with fixture). Ensure that the Hip ROM stand is level, a digital angle gage may be positioned on the Pelvic Adapter Bracket as shown.

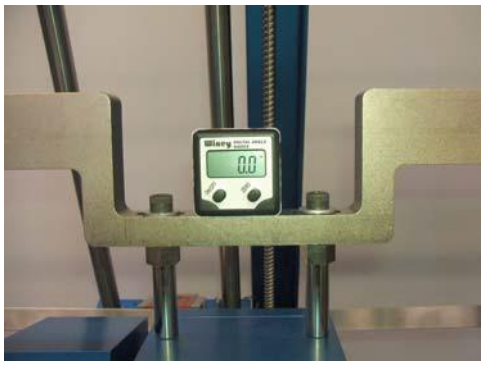


Figure 6.1 Test Starting Position

Figure 6.2 Zero Angle Position

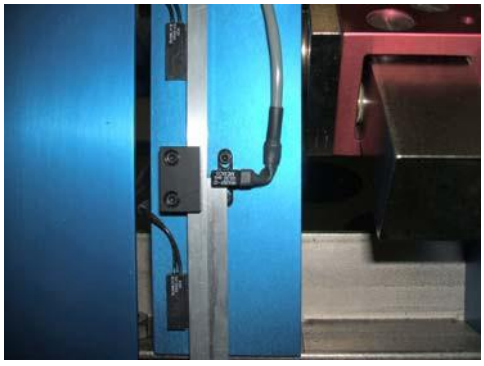


Figure 6.3 Move Femur Adapter/Bearing Block

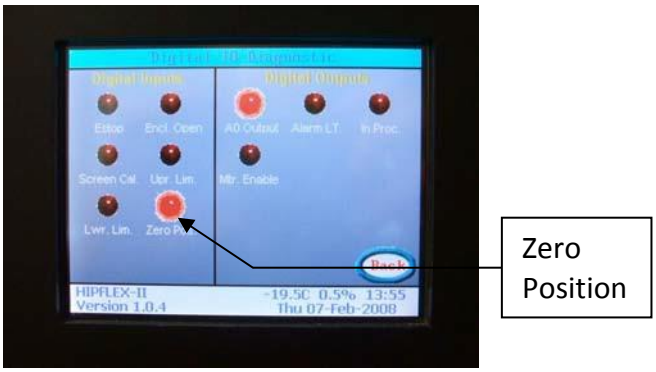


Figure 6.4 Zero Position Icon Button

While viewing the Digital I/O Diagnostic screen, manually move the femur adapter/bearing block arm assembly downward until the Zero Position switch is just barely activated. Turn the ball screw just slightly to raise and lower the arm to a position where the indicator fluctuates between on and off. This is the zero reference position. Use a digital angle meter as shown to measure the zero position angle (should be around –16 to –17 degrees).

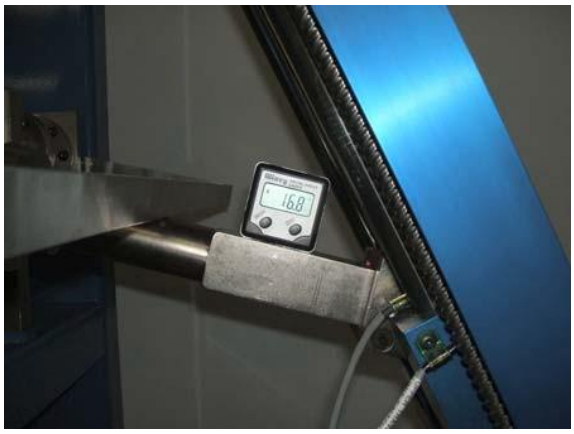


Figure 6.5 Use a Digital Angle Meter to Measure

Section 7. Maintenance

Besides calibrating the measurement devices (pot. and load cell), maintenance on Hip ROM Test Fixture is limited to rust prevention. It is recommended that the measurement devices be calibrated every six (6) months or whenever the device performance is questionable.

The square bearing assembly attaches the femur adapter to the carriage. On the square bearing there are (8) eight alignment screws. These alignment screws are adjusted at the factory and under “normal” circumstances should never need to be adjusted. However, if they should need to be adjusted, the square bearing assembly can be removed from the carriage by first removing the femur adapter from the assembly and then rotating the square bearing until the 1/4-20 X 5/8 LG. FHCS on each side are accessible. Remove these screws and the bearing assembly can slide out of the carriage.

To adjust the square bearing alignment, insert the femur adapter assembly into the square bearing and hold the square edges against the sides away from the screws. Turn the adjustment screw so that the femur adapter is held against the pads inside the square bearing but the adapter must be able to slide freely through the bearing. All the alignment screws should be equally adjusted so that there will be a minimum of side-to-side motion inside the bearing.

7.1 Lubrication

While lubrication of the Hip ROM Test Fixture is primarily for rust prevention there are several points where friction can be reduced through vigilant cleaning and lubrication. Cleaning the carriage horizontal and vertical shafts should be done with isopropyl alcohol and allowed to dry thoroughly before applying a light coating of lightweight machine oil. The ball screw and motor shaft should be lightly oiled to prevent rust or other corrosion.

7.2 Fuses

There are two (2) fuses in the AC power connector on the rear of the controller unit:

- 10 amp for 120 VAC
- 5 amp for 220 VAC

7.3 Adapter Packages

7.3.1 5th % Small Female

To perform the Hip ROM test on the HIII 5th Female dummy the pelvis is assembled much like the HIII 50th. However, an adapter plate must be secured to the top of the pelvic bone to allow the pelvis to be attached to the cradle. This adapter plate is attached to the pelvic bone at the two (2) holes toward the front of the pelvis at the lumbar base. Then, the adapter posts are threaded into the adapter plate. A pelvic rear adapter is secured to the back of the pelvis at the instrumentation cavity. The femur adapter must be replaced with the 5th female adapter. To do this, remove the socket head screw at the outboard end of the adapter and sliding the adapter out of the bearing block.

7.3.2 95th % Large Male

The 95th Large Male ATD requires a separate femur adapter from the 50th and 5th percentile ATD's. To do this, remove the socket head screw at the outboard end of the adapter and sliding the adapter out of the bearing block.

7.4 Calibration Switch Location

Refer to A/D and channel gain calibrations in the SETUP section of the Hip ROM Test Fixture Controller Software Operations portion of this manual.

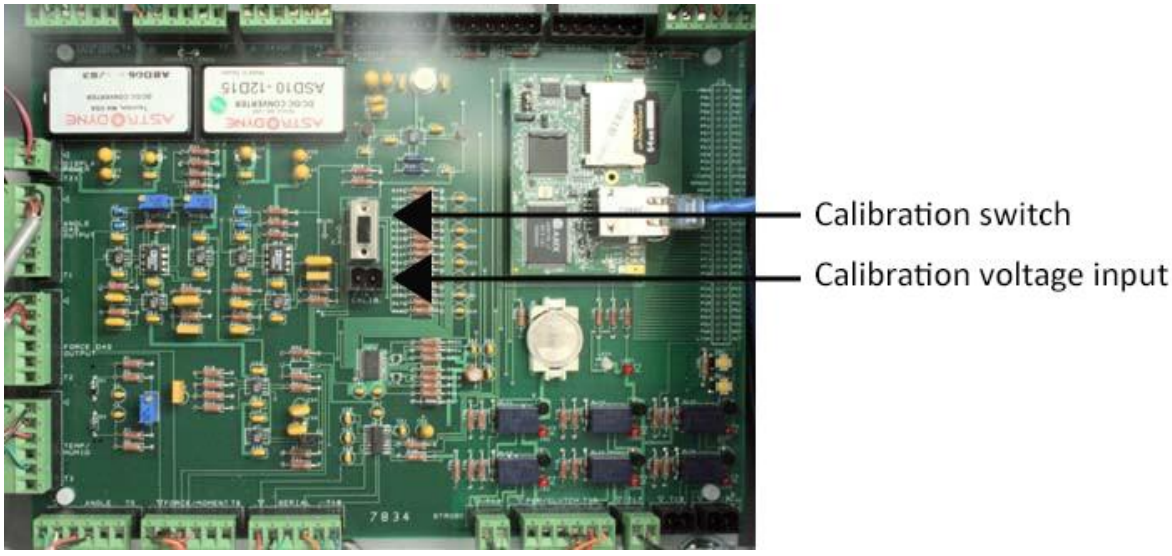
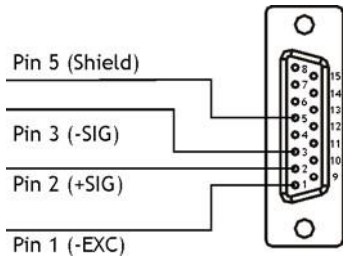
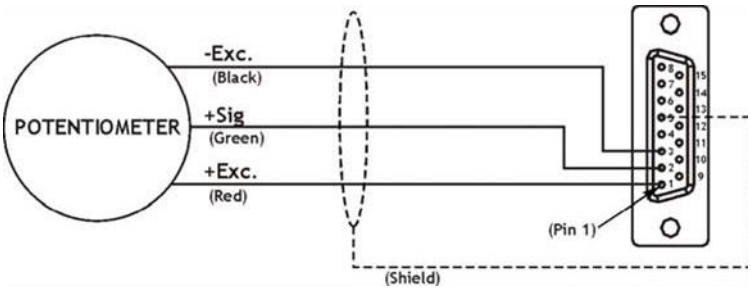
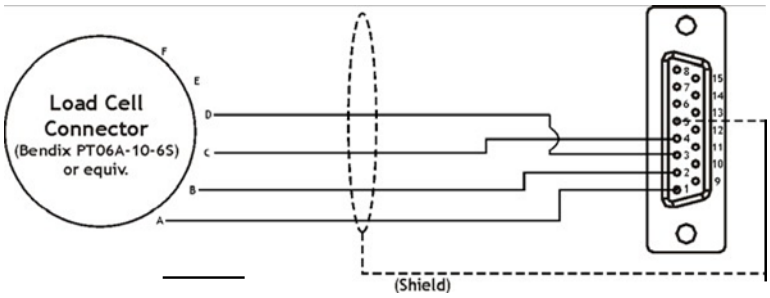
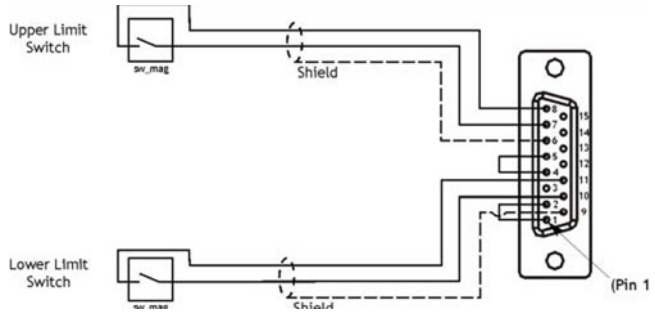
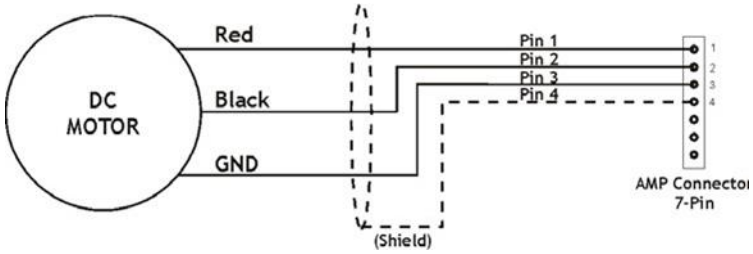


Figure 7.1 Calibration Switch Location

7.5 Connector Wiring

Table 7.1 Connector Wiring

Connector Wiring	Description
	Output to DAS – Moment, Angle and Angle Zero outputs
	Potentiometer (Angle Sensor)
	Load Cell (Moment)
	Limit Swihes

Connector Wiring	Description
	Drive Motor

Section 8. Legal Disclaimer and Notices

8.1 Disclaimer

The information in this manual is furnished for informational use only, and is subject to change without notice. Humanetics Innovative Solutions Inc. assumes no responsibility for liability on errors or inaccuracies that may appear in this manual.

8.2 Proprietary Statement

8.3 Notice of Lead Content in Product

The product referred to in this manual may contain lead. A list of components that may contain lead is being maintained on the Humanetics website by ATD (test dummy) type and subcomponents. The list includes items that may currently or in the past have contained or a lead-based alloy. Please refer to www.humaneticsatd.com/Lead_Disclosure for information regarding possible lead content in this product.

8.4 About Humanetics

Humanetics Innovative Solutions Inc. is a global company whose strategy is to harness the best of today's technologies for the creation of high-quality products which play an important role in improving safety, comfort, and protection of people and their environment. Humanetics is the world's leading supplier in the design and manufacture of sophisticated crash test dummies, associated technical support, and laboratory services and load cell crash wall systems. Furthermore, Humanetics develops and supplies finite element software-based dummy models for computerized crash test simulations, and specializes in static and dynamic strain measurements.

For additional information on Humanetics and its products and services, please refer to
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For information on Safety Technology Holdings, please refer to http://www.stholdingsinc.com/our-companies

Section 9. User Manual Update Log

Revision Level	Revision Date	Revision Author	Revision Description
A	Jul. 2018	MGT	Release