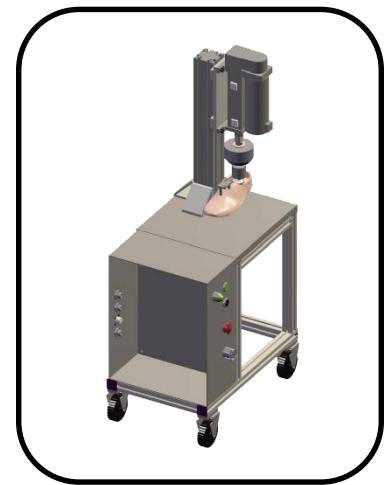


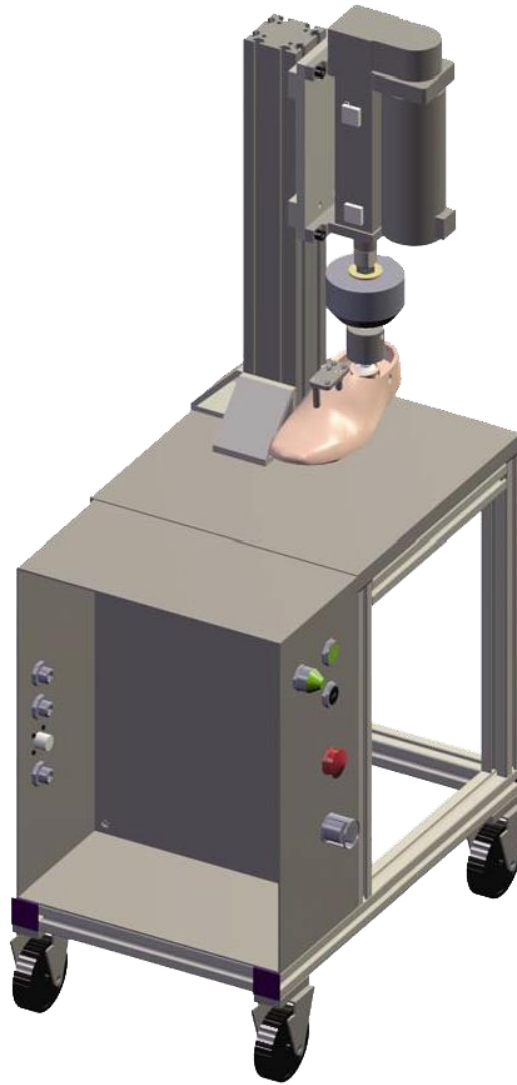
# Operations Manual



## Foot Compression Test Fixture 320-0000



Foot Compression Test Fixture Operations Manual 320-9900 [Rev. B]  
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# Table of Contents

<b>INTRODUCTION.....</b>	<b>4</b>
User Manual Description .....	4
Test Fixture Background .....	4
Description of Test .....	4
Test Fixture Description.....	6
<b>USER MANUAL.....</b>	<b>7</b>
Safety Precautions .....	7
Installation Requirements .....	8
Installation.....	8
Instrumentation .....	9
Data Acquisition.....	9
Test Procedure .....	9
<b>Software Overview.....</b>	<b>11</b>
Foot Compression Main Window .....	11
Test Results .....	13
Display Graph Data .....	14
Reprocess Existing Data .....	15
Test Setup .....	16
Test Limit.....	17
<b>Calibration .....</b>	<b>18</b>
Load Cell.....	18
<b>Legal Disclaimer and Notices.....</b>	<b>19</b>
Disclaimer .....	19
Proprietary Statement.....	19
Notice of Lead Content in Product .....	19
About Humanetics.....	19
<b>User Manual Update Log.....</b>	<b>20</b>

# INTRODUCTION

## User Manual Description

This manual describes the use, maintenance and calibration of the Foot Compression Test Fixture part number 320-0000 or 320-0000-E. The fixture is used to perform the foot compression test on the Hybrid III 5th, 50th and 95th dummy feet.

## Test Fixture Background

The Humanetics Foot Compression Test Fixture allows the user to perform the tests specified in the following SAE user manuals:

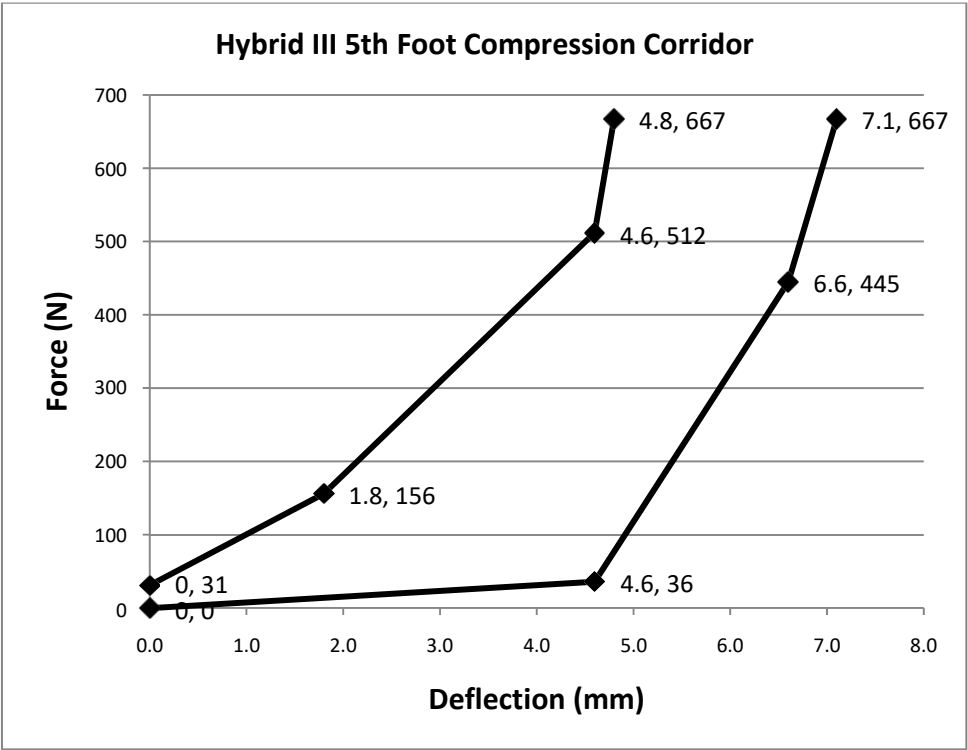
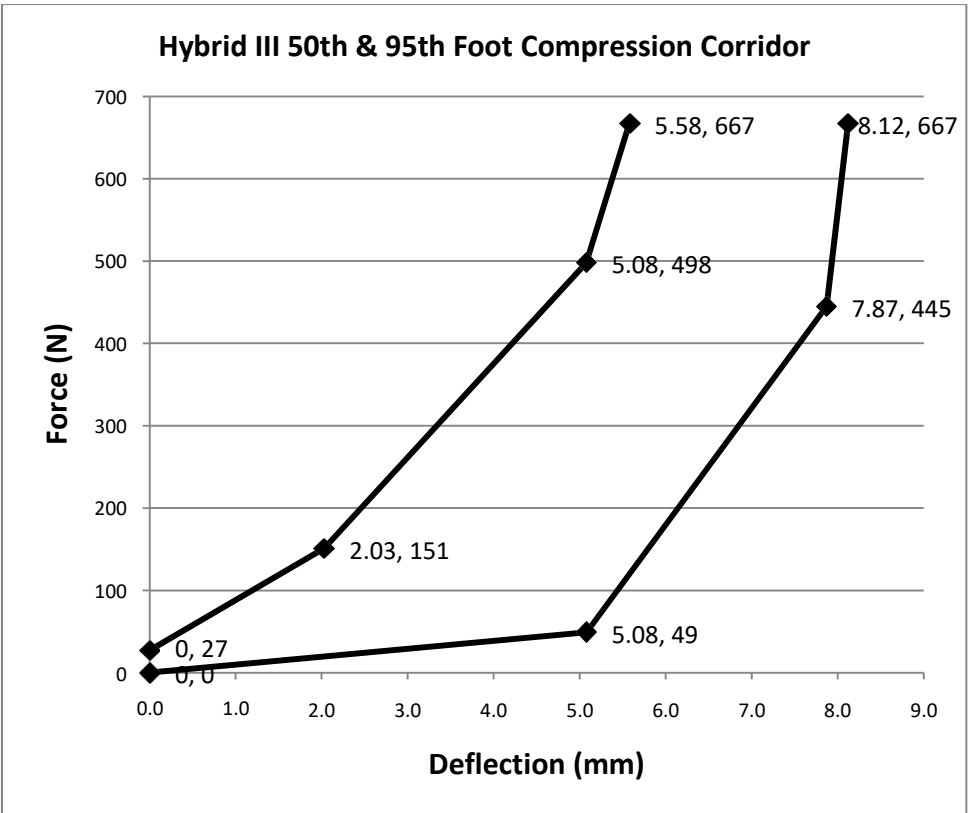
Dummy Type	SAE Manual	Manual Date
Hybrid III 50 <sup>th</sup>	Engineering Aid 23	June 1998
Hybrid III 5 <sup>th</sup>	Engineering Aid 25	July 1999
Hybrid III 95 <sup>th</sup>	Engineering Aid 26	October 2003

The test is specified as an Inspection Test for each of the dummy types and is supplemental to the calibration tests to insure that the component meets its design intent. The foot assembly and heel pad for the dummy are tested in this fixture.

## Description of Test

The foot compression test is performed on the foot assembly and heel pad of the Hybrid III 5<sup>th</sup>, 50<sup>th</sup> and 95<sup>th</sup> dummy. The foot assembly is positioned in a compression fixture attached through a modified ankle bracket. The foot is positioned with the heel just contacting the plate below it. The compression on the foot starts and continues until the deflection reaches 8.9 mm (0.35 in) for the Hybrid III 50<sup>th</sup> and 95<sup>th</sup> dummy or the load reaches 0.9 kN (200 lbf) for the Hybrid III 5<sup>th</sup> dummy. The foot is loaded at a rate of 14 to 16 mm/min (0.55 to 0.63 in/min).

During the test, downward force is recorded and compared to the displacement of the fixture. For a passing test result, the force versus deflection curve must lie within the corridor specified below for each dummy type.



## Test Fixture Description

The foot compression test fixture consists of a frame with a platform on which is a support column with a linear motor drive. The end of the linear drive contains a load cell and an adaptor to which the appropriate ankle assembly can be attached. Mounted to the frame is also an electrical box that contains the controls of the fixture, the PLC controller and required power supplies to support the operation of the fixture. There are wheels mounted to the fixture in order to position it in any location within the lab environment.

The fixture operation is controlled by the pre-programmed PLC controller located in the electrical box. The program within the PLC contains the information as to the motion of the fixture, the correct rate and distance that the motor must run during the test, the UP and DOWN function for positioning the foot and a trigger signal in order to start the data acquisition system during the test. The fixture also contains an Emergency Stop button that will stop all functions in the event of an issue during the test.

The test fixture contains three cables that exit the electrical box. The first is the power cable that supplies AC power to the fixture. The second is the signal cable for the load cell used to measure the force during the test. The third is the trigger signal (a 5 VDC pulse) that is used to identify the start of the test and for data acquisition to start.

The fixture contains four operation buttons and an ON/OFF switch for controlling its operation.

1. **START Button**– The green lighted push-button is used to start the downward motion of the linear motor at the beginning of the test. Once this button is pushed the motor will drive the actuator down until the programmed distance has been obtained. It will stop and reverse direction moving up to the limit switch where it will stop after the test is complete. This button will be illuminated once the power is turned ON and will blink while the motor is in motion during the test.
2. **UP Button** – This button is used to manually move the actuator in the up direction for positioning the foot before the test.
3. **DOWN Button** – This button is used to manually move the actuator in the down direction for positioning the foot before the test.
4. **EMERGENCY STOP Button** – This button is used to immediately stop the operation of the fixture at any time. Engaging this button will cut the power internal to the electrical box and prevent any further motion. Upon re-start, the UP/DOWN buttons should be used to manually correct any issues.
5. **ON/OFF Switch** – This switch is used to turn the power on/off to the fixture. It is recommended to keep it in the OFF position unless in operation.

The test fixture is available in two versions for operation at different power requirements. The 320-0000 is the standard fixture and will operate at 110-120 VAC, 60Hz. The 320-0000-E is wired to operate at 220-240 VAC, 50 Hz. The operation of the fixture is the same at both power settings.

The test fixture external dimensions are 54 in. high x 26 in. wide x 16 in. long. (1372 mm X 660 mm X 406 mm) and the approximate weight is 50 lbs (22.7 kg).

## USER MANUAL

### Safety Precautions

- **Warning:** Only a trained, experienced operator should conduct the tests and operate the test fixture.
- **Warning:** Before turning on the test fixture, verify that the power being supplied to the fixture is within its rated specifications. Operating the fixture with the incorrect power source will result in damage to the fixture.
- **Warning:** Before moving the test fixture or conducting any maintenance on the mechanical assembly, the drive motor, the limit switches, cabling or the motor control box, push in the red emergency stop button on the top of the motor control box and disconnect the power cord from the power source. Disconnect the two signal cables from the laboratory cable system as these carry instrumentation power from the data acquisition system. Failure to do so may result in injury.
- Before placing the Foot Assembly onto the fixture the following items must be verified:
  - All assembly mounting screws are tight.
  - All the cables are free from becoming entangled in the mechanism.
  - The linear drive shaft is all the way up at the top of its travel
- When conducting a test, make sure that there is nothing, human or mechanical, other than the Foot Assembly being tested blocking the motion of the linear drive or load cell. This could cause erroneous test readings and damage the test fixture.
- Do not touch the mechanism or the Foot Assembly during the test sequence. This could cause injury or erroneous test readings.
- **Emergency Stop** - If at any time you think that a test is not running correctly, immediately push the Emergency Stop Button (the large red palm button) on the front of the motor control box. This will shut off the machine. The fixture will not operate if the Emergency Stop is engaged. Make sure this button has been pulled out if the fixture does not operate.

- Do not disassemble the test fixture in any way; this is not necessary to perform the test for which the machine is intended. The position of the components is critical to the performance and safety of the test fixture and misalignment will lead to erroneous test results.
- **Caution:** Modification of the limit switches or the mounting of the linear drive may damage the fixture.
- **Caution:** The test fixture is designed for testing only Hybrid III 50<sup>th</sup>, 95<sup>th</sup> and 5<sup>th</sup> adult dummy feet. Do NOT use any other dummy to prevent damage to the dummy or the fixture.
- **Caution:** To insure accurate test results the user must select the correct ATD Type within the software to match the Hybrid III dummy.

## Installation Requirements

The fixture requires adequate, level floor space to accommodate the size of the fixture. Also required are 110-120 VAC, 60 Hz power for the 320-0000 or 220-240 VAC, 50 Hz for the 320- 0000-E and a climate controlled room. Temperature must be maintained from 66°F to 78°F and 10% to 70 % Relative Humidity to run the test within the required parameters. The Foot Assemblies to be tested must be in this environment for at least 4 hours before testing.

## Installation

The Foot Compression Test Fixture is designed to contain minimal installation requirements facilitating ease of setup and operation.

1. Remove any packaging material from the fixture.
2. Place the fixture in its desired location of operation with the test lab.
3. **Note:** For proper operation, the fixture must be installed on a level surface. Verify that the platform on the fixture is level within +/-0.5 degrees in both horizontal directions.
4. Connect the load cell signal cable to the connector on the load cell.
5. Connect the trigger signal cable to the Trigger connector located on the electrical box.
6. Connect the opposite end of the two signal cables to the data acquisition system used for testing.
7. Verify the Main Power Switch is in the OFF position.
8. Plug the power cord into an appropriate power supply.



## Instrumentation

Collection of data from two parameters is required when running the foot compression test: compression force and the test trigger. The transducers are described in the Transducer section of this manual.

Compression force is measured with an Interface Model 1200 Precision Series Universal Load Cell 1000 Newton capacity load cell (P/N 1210AF-1K-B). This is a 350 ohm Wheatstone bridge unit, recommended excitation 10 VDC.

The test trigger is simply a 5 VDC pulse supplied by the PLC controller within the test fixture to activate the data acquisition system at the start of the test and initiate the data collection. The trigger channel is a two conductor cable wired for +Signal and –Signal. There is no excitation required for the channel.

## Data Acquisition

The transducers require a data acquisition system with two signal conditioners supplying 5 to 10 VDC excitation to the load cell. They must accept full bridge transducers and voltage source units.

## Test Procedure

The following procedures are provided for mounting the Foot Assembly on the test fixture and performing a test.

1. Turn the fixture ON/OFF switch to the ON position.
2. Pressing the UP button, manually move the motor to the upper-most position to aid in assembling the foot onto the fixture.
3. Verify the ankle shell assembly mounted below the load cell is the correct adaptor for the foot being tested. If it needs to be changed, simply remove the screw (SHSS 3/8 x1”) holding the assembly and install the correct one. The ankle shell assembly part numbers are listed below:

Dummy Type	Ankle Shell Assembly P/N
Hybrid III 50 <sup>th</sup> & 95 <sup>th</sup>	320-1000
Hybrid III 5 <sup>th</sup>	320-3000

4. Prior to testing the foot assembly, inspect the heel pad to make sure it is not damaged and assembled properly in the foot. If the heel pad is damaged, replace it before testing.

5. Attach the Standoffs to the foot bone and assemble the Standoff Top Plate to the top of the Standoffs with the screws (FHSC 10-24x1/2”).
6. Assemble the Foot Assembly to the Ankle Shell Assembly on the fixture and insert the screw (SHSS 1/4x3/4” for Hybrid III 50<sup>th</sup> & 95<sup>th</sup>, SHSS 1/4x5/8” for Hybrid III 5<sup>th</sup>), tightening it to secure the foot.
7. While raising the toe of the foot to align it in a level position (a level can be placed on the Standoff Top Plate to verify the position), press the DOWN button on the fixture to lower the foot assembly until it just makes contact with the platform. Use the UP button to raise the foot if necessary. There should not be any pre-loading on the foot in this position.
8. Verify the position of the foot is level to within  $\pm 1^\circ$  both transversely and longitudinally relative to the test fixture.
9. Verify all instrumentation cables are connected to the data acquisition system.
10. The foot assembly is now ready to be tested.
11. Set up the test information as described in the Software Overview section and start the data collection process.
12. Start the fixture motion and test by pressing the START button on the fixture. This will send a trigger signal to the data acquisition system and cause the linear motor to move downward, compressing the heel of the foot.
13. At this point, data collection is fully automated as the linear motor will compress the heel the required amount, stop, and reverse direction until it reaches its stop point identified by the limit switch. It is recommended to monitor the motion of the fixture to make sure there are no issues during the test.
14. Upon completion of the test, the software will process the data and display the results of the test. The Test Results window will display both the test specifications and the test results. There are menu selections that provide the user with various options to graph and view the test results.
15. The user should wait 30 minutes to conduct the next test on the same Foot Assembly.
16. Once testing is complete, remove the Foot Assembly from the fixture by following the reverse order of the installation procedure outlined above in steps 5-6.

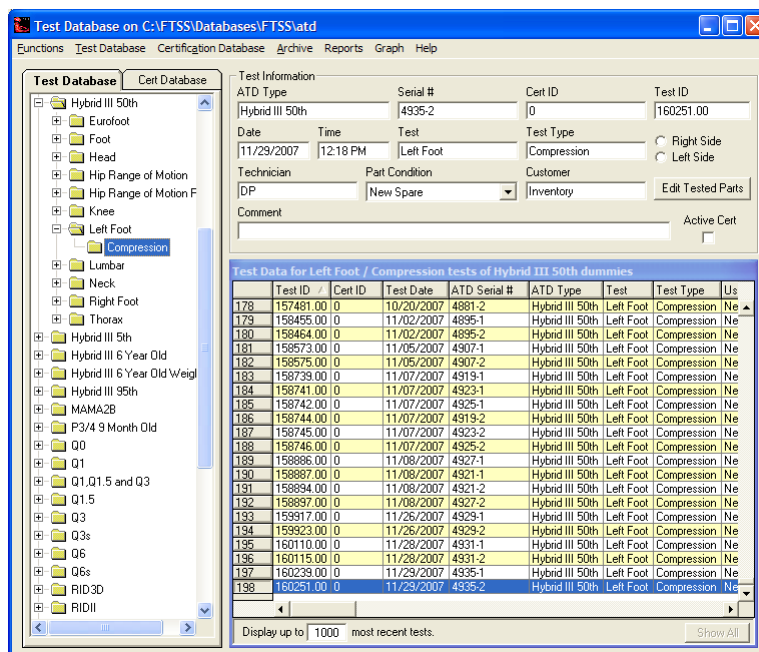
## Software Overview

The Foot Compression Test software is a subset of the Test Database portion of our ATD Management Software package and may be operated in a standalone or networked environment. This software consists of a database which contains tables for test setup, sensor data and test results. This database may be located on the local machine (or fixture computer) or on a network. With the use of Windows as an operating system, the software (and test fixture) provides the user with all the benefits included with a Windows environment, such as printer selection and network capabilities.

The software provides windows for fixture operation, test setup parameters, sensor data, graphing and reporting as well as reprocessing existing tests.

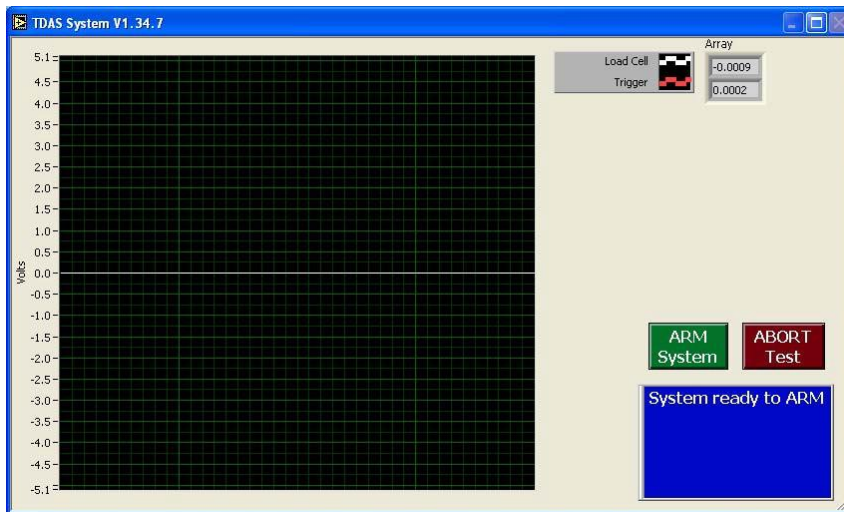
### Foot Compression Main Window

1. Start the software from within Windows by clicking on the Tests button on the Humanetics ATD Management toolbar. This will open the Test Database window.



2. This window requires the user to select the dummy type (Hybrid III 5<sup>th</sup>, 50<sup>th</sup> or 95<sup>th</sup>), test type (Left or Right Foot) and test type (Compression) from the tree menu on the left side of the window. Failure to select the proper ATD type could result in a test failure. This window also allows the user to enter information about the component under test.

3. The Test ID, Date and Time fields are automatically updated by the software when a test is initiated. The user can enter data into all other fields.
4. Select the New Test function from the Test Database drop down menu selection.
5. A window will open to allow the user to enter the temperature and humidity values for the test and click OK. If a temperature/humidity data logger is included in your system, these fields will be updated by the software automatically. If no data is entered, the test results will display failures for those values.
6. A new window will open that will display the real-time voltage data for each channel of the test. The user can verify operation of each sensor and the proper voltage levels for each channel.



7. From this point, the user has two options available within the software display:
  - a. ARM System – Clicking the “ARM System” button will set up the data acquisition system and come up with a user interface window for acquiring the initial values from the instrumentation
  - b. ABORT Test – Clicking the “ABORT Test” button will exit out of the current test and return to the Test Database window
8. At this point, the dummy must be positioned per step 10 of the Test Procedure.
9. The user can continue the test by clicking on the ARM System button.
10. The software will wait until the trigger has been received from the test fixture to indicate that it should start collecting data.

11. After setting up the test information as described in the Software Overview section and starting the data collection process, start the fixture motion and test by pressing the START button on the fixture. This will send a trigger signal to the data acquisition system and cause the linear motor to move downward, compressing the heel of the foot.
12. The software will process the data and display the results of the test within the Test Results screen.

## Test Results

Once a test is complete, data will be processed then displayed in the Test Results window. From within this window, the user has several options to Save, View and Print the test data.

Note: The user must select Save Test from the Test Database drop down menu for the data to be permanently saved to the database.

The Reports drop down menu item provides options for sending the test report and graph data directly to the Windows default printer. The software uses the Default printer setup within the Printer settings on the computer for printing tests and graphs. The user must change the Default printer settings if a different printer is to be used.

The screenshot shows the 'Test Database on C:\FTSS\Databases\FTSS\atd' window. The interface includes a 'Test Database' tree on the left, a 'Test Information' form, and a results table.

**Test Information:**

ATD Type	Serial #	Cert ID	Test ID
Hybrid III 50th	4835-2	0	160251.01
Date	Time	Test	Test Type
12/20/2007	03:13 PM	Left Foot	Compression
Technician	Part Condition	Customer	<input type="radio"/> Right Side <input type="radio"/> Left Side
DP	New Spare	Inventory	<input type="button" value="Edit Tested Parts"/>
Comment			<input type="checkbox"/> Active Cert

**Results Table:**

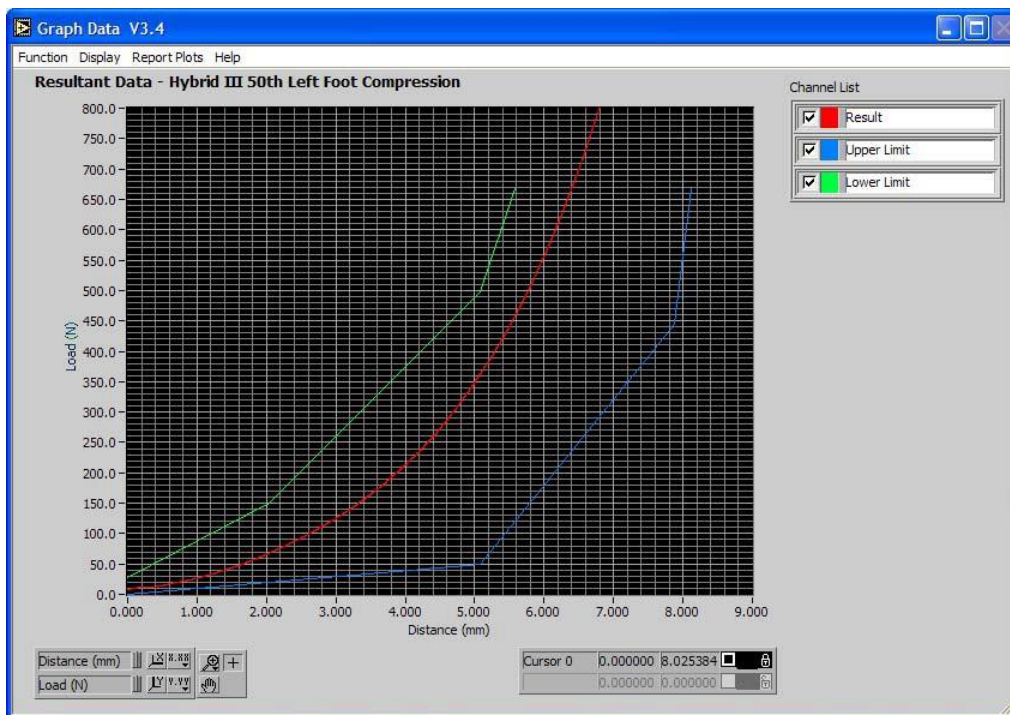
	Description	TestPoint	Unit	LowerLimit	Value	UpperLimit	Units	Results
1	Lower Limit 1	27	N	0.00	1.01	0.00	mm	Pass
2	Lower Limit 2	151	N	2.03	3.34	0.00	mm	Pass
3	Lower Limit 3	498	N	5.08	5.76	0.00	mm	Pass
4	Lower Limit 4	667	N	5.58	6.39	0.00	mm	Pass
5	Upper Limit 1	0	N	0.00	-55	0.00	mm	Pass
6	Upper Limit 2	49	N	0.00	1.63	5.08	mm	Pass
7	Upper Limit 3	445	N	0.00	5.52	7.87	mm	Pass
8	Upper Limit 4	667	N	0.00	6.39	8.12	mm	Pass
9	Temperature	0		18.90	21.50	25.60	degC	Pass
10	Humidity	0		10.00	21	70.00	%	Pass

## Display Graph Data

Display Graph Data provides the user with the ability to view the data in Raw (DAC counts), Voltage, Scaled (engineering units), Filtered (engineering units) or Result format as well as to print out the graphs.

To view data:

- From within the Test Results screen, click on the Graph menu item and select the Graph Test Data drop down menu item. The Graph Data screen will be displayed along with the Resultant Data for the specific test.
- To display the other formats of test data, select the Display menu item and select the appropriate data type to display.
- Clicking on the check box next to the channel name within the Channel List will select or deselect the channel to be displayed on the graph.
- The user may also zoom in/out, pan or rescale the graph by accessing the buttons at the bottom of the window.
- Selecting the Function drop down menu item provides the user options for printing out the displayed graph.



## Reprocess Existing Data

Previous test data can be reprocessed and displayed through the software. Printing the test results and graphing the data are also accessible after reprocessing the data. The procedure for reprocessing the test data is as follows:

1. From the Test Database window, select the dummy type (Hybrid III 5<sup>th</sup>, 50<sup>th</sup> or 95<sup>th</sup>), test type (Left or Right Foot) and the test (Compression) from the tree menu on the left side of the window to display the available tests.
2. Highlight the test to be reprocessed from the list in the table on the right side of the window by clicking on the row number to the left of the Test\_ID.
3. Select the Test Database drop down menu item and click on the Reprocess Test function to reprocess the data from the test highlighted.
4. The results will be displayed in the Test Results window where the user can print the results as well as access the graph data as previously detailed.

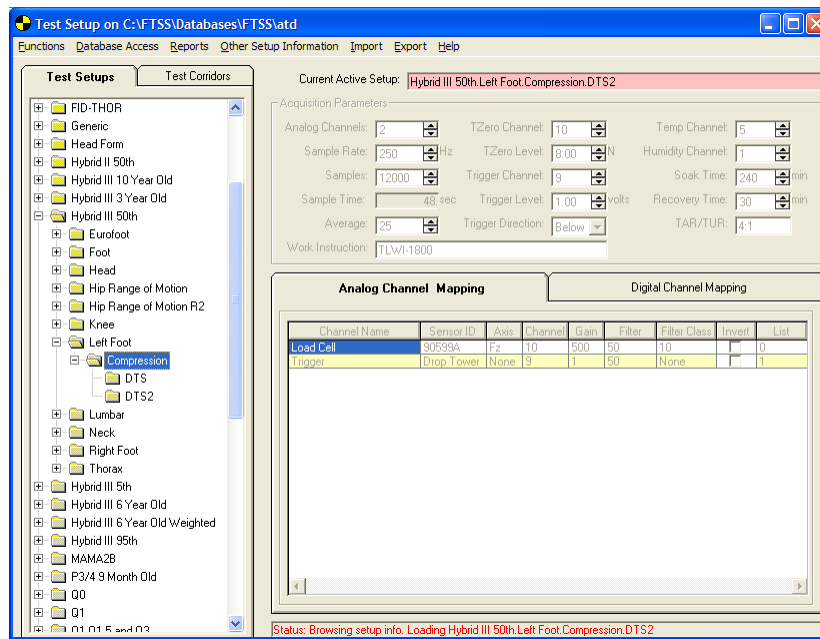
The screenshot shows the 'Test Database on C:\FTSS\Databases\FTSS\atd' window. The left pane shows a tree view with 'Test D' expanded to 'Left Foot' > 'Compression'. The right pane shows 'Test Information' for a selected test (Test ID: 160251.00) and a table of test data.

Test ID	Cert ID	Test Date	ATD Serial #	ATD Type	Test	Test Type	Us	
178	157481.00	0	10/20/2007	4881-2	Hybrid III 50th	Left Foot	Compression	Ne
179	158455.00	0	11/02/2007	4895-1	Hybrid III 50th	Left Foot	Compression	Ne
180	158464.00	0	11/02/2007	4895-2	Hybrid III 50th	Left Foot	Compression	Ne
181	158573.00	0	11/05/2007	4907-1	Hybrid III 50th	Left Foot	Compression	Ne
182	158575.00	0	11/05/2007	4907-2	Hybrid III 50th	Left Foot	Compression	Ne
183	158739.00	0	11/07/2007	4919-1	Hybrid III 50th	Left Foot	Compression	Ne
184	158741.00	0	11/07/2007	4923-1	Hybrid III 50th	Left Foot	Compression	Ne
185	158742.00	0	11/07/2007	4925-1	Hybrid III 50th	Left Foot	Compression	Ne
186	158744.00	0	11/07/2007	4919-2	Hybrid III 50th	Left Foot	Compression	Ne
187	158745.00	0	11/07/2007	4923-2	Hybrid III 50th	Left Foot	Compression	Ne
188	158746.00	0	11/07/2007	4925-2	Hybrid III 50th	Left Foot	Compression	Ne
189	158886.00	0	11/08/2007	4927-1	Hybrid III 50th	Left Foot	Compression	Ne
190	158887.00	0	11/08/2007	4921-1	Hybrid III 50th	Left Foot	Compression	Ne
191	158894.00	0	11/08/2007	4921-2	Hybrid III 50th	Left Foot	Compression	Ne
192	158897.00	0	11/08/2007	4927-2	Hybrid III 50th	Left Foot	Compression	Ne
193	159917.00	0	11/26/2007	4929-1	Hybrid III 50th	Left Foot	Compression	Ne
194	159923.00	0	11/26/2007	4929-2	Hybrid III 50th	Left Foot	Compression	Ne
195	160110.00	0	11/28/2007	4931-1	Hybrid III 50th	Left Foot	Compression	Ne
196	160115.00	0	11/28/2007	4931-2	Hybrid III 50th	Left Foot	Compression	Ne
197	160239.00	0	11/29/2007	4935-1	Hybrid III 50th	Left Foot	Compression	Ne
198	160251.00	0	11/29/2007	4935-2	Hybrid III 50th	Left Foot	Compression	Ne

## Test Setup

For the software to properly acquire test data, and then process the results correctly, it is necessary for all sensor and acquisition parameters to be set up properly. The Edit Test Setup selection of the Test Database window provides the user with an interface to setup and edit all the elements required for data acquisition and data processing.

1. From the Test Database window, select the dummy type (Hybrid III), test type (Left or Right Foot) and the test (Compression) from the tree menu on the left side of the window.
2. Click on the Functions drop down menu and select the Edit Test Setup menu item. This will open the Test Setup window for editing the test parameters.



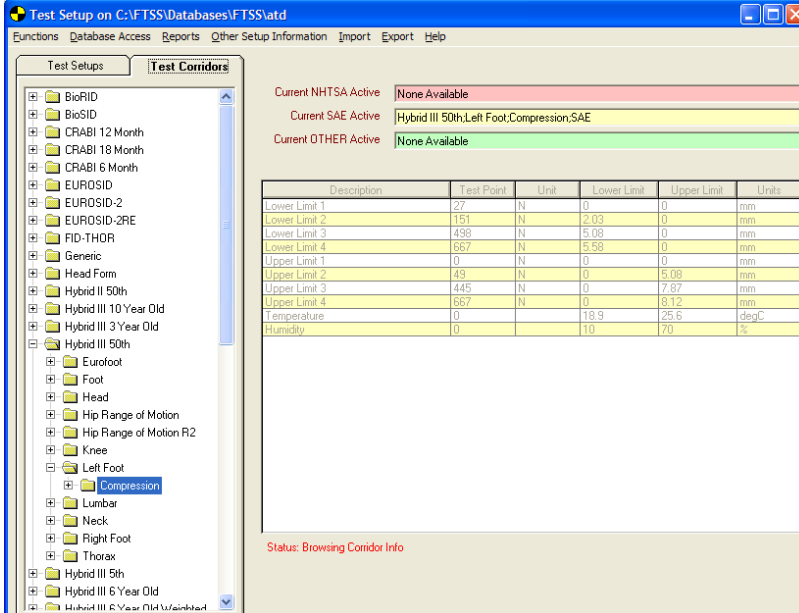
3. In order to make any changes to the Test Setup, click on the Functions drop down menu item and select the Edit menu item.
4. Once the changes have been made, they must be saved by selecting the Functions drop down menu item and selecting the Save menu item.



## Test Limit

The user may display test limits from the Test Database window. It is suggested NOT to alter the Test Limits as to maintain the correct processing and required results.

1. From the Test Database window, select the dummy type (Hybrid III), test type (Left or Right Foot) and the test (Compression) from the tree menu on the left side of the window.
2. Click on the Functions drop down menu and select the Edit Test Setup menu item. This will open the Test Setup window for editing the test parameters.
3. Select the Test Corridors tab above the tree menu to access the available limits for the test selected.



Description	Test Point	Unit	Lower Limit	Upper Limit	Units
Lower Limit 1	27	N	0	0	mm
Lower Limit 2	151	N	2.03	0	mm
Lower Limit 3	498	N	5.08	0	mm
Lower Limit 4	667	N	5.58	0	mm
Upper Limit 1	0	N	0	0	mm
Upper Limit 2	49	N	0	5.08	mm
Upper Limit 3	445	N	0	7.87	mm
Upper Limit 4	667	N	0	8.12	mm
Temperature	0		18.9	25.6	degC
Humidity	0		10	70	%

Status: Browsing Corridor Info

## Calibration

The calibration of the Foot Compression Test Fixture requires calibration of the load cell used on the fixture.

### Load Cell

The load cell should be removed and calibrated by an accredited laboratory over the force ranges listed in the original calibration sheet provided with the unit.

1. Remove the Ankle Shell Assembly from the Ankle Adaptor by removing the screw (SHSS 3/8 x1") holding them together.
2. Loosen the nut (5/8-18 locknut) under the load cell.
3. Unscrew the Ankle Adaptor from the bottom of the load cell.
4. Loosen the nut (5/8-18 locknut) on top of the load cell.
5. Unscrew the load cell from the Load Cell Adaptor mounted on the end of the linear motor drive.
6. Calibrate the load cell following standard practice over the range  $\pm 1000$  N using the excitation voltage supplied by the data acquisition system.
7. Reassemble the load cell in the reverse order.

# Legal Disclaimer and Notices

## Disclaimer

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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](http://www.humaneticsatd.com/Lead_Disclosure) for information regarding possible lead content in this product.

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For additional information on Humanetics and its products and services, please refer to [www.humaneticsatd.com](http://www.humaneticsatd.com) or contact:

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## User Manual Update Log

Revision Level	Revision Date	Revision Author	Revision Description
A	Jun. 2010		Pg. 3, under Description of Test, mm/min was mm/in, in/min. was in/mm
B	Aug. 2018	MGT	Humanetics was FTSS; Update address