Computer Sports Medicine, Inc., (CSMi)

HUMAC® NORM™
HUMAC2015 APPLICATION PROGRAM
User's Guide

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The CSMi HUMAC NORM™ (also referred to as “NORM” in this document) and TMC (also referred to as “Trunk Extension/Flexion Modular Component” and “TEF Modular Component” in this document) Systems are designed to be operated with software that is installed at the time of shipment. Any additional software not authorized by CSMi, that is added to the factory installed program, is done at the user’s risk and may cause service problems not covered by the customer’s warranty.

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Trademark Note:

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SECTION 1.HUMAC APPLICATION

The chapter focuses on using the HUMAC Application program. Instructions for installing the software are provided as an easy reference for any future software updates.

The HUMAC Application is compatible with Microsoft® Windows7, Windows8, and Windows 10. The HUMAC utilizes the Windows Multiple Document Interface (MDI) interface and standard Windows controls. Familiarizing yourself with Windows will enhance your understanding of the HUMAC's operation.

Main HUMAC Screen

The Main HUMAC Screen contains a number of components:

Figure 1-1 Main HUMAC Form

The **Title Bar** located at the top of the screen contains the Application Name (HUMAC for Windows), the current patient (Potash, Robert L) and the current screen (Patient Selection).

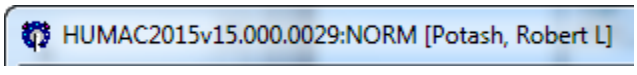


Figure 1-2 Title Bar

Just below the title bar is the **Menu Bar**. You can access all of the HUMAC functions from the menu bar. Each menu item has an underlined character. Holding the **Alt** key while pressing the underlined character selects the menu item. For example **Alt-F** selects the file menu.

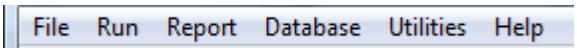


Figure 1-3 Menu Bar

The **Button Bar** contains shortcuts to the most commonly used HUMAC functions. When the HUMAC program begins, only the Patient, Home Exercise, Speed, and Help options are available. Selecting a patient enables the Test, Exercise, and Report options.

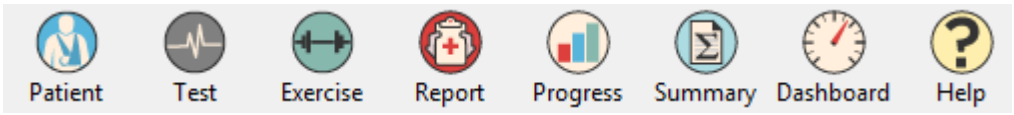


Figure 1-4 Button Bar

To the right of the button bar is a real-time display of the Dynamometer Status. This includes the current ROM limits, the input adapter position, the dynamometer settings, and the real-time torque, position, and speed.

Figure 1-5 Real-Time Display

The bottom of the screen contains the **Status Bar** which displays the current test pattern and system units. The system units are displayed for the Torque, Position, and Velocity measures.

Figure 1-6 Status Bar

Starting the NORM

1. From the Windows desktop, double-click the **HUMAC** icon to start the HUMAC program.
2. The **HUMAC Power-On Test** dialog box is displayed.

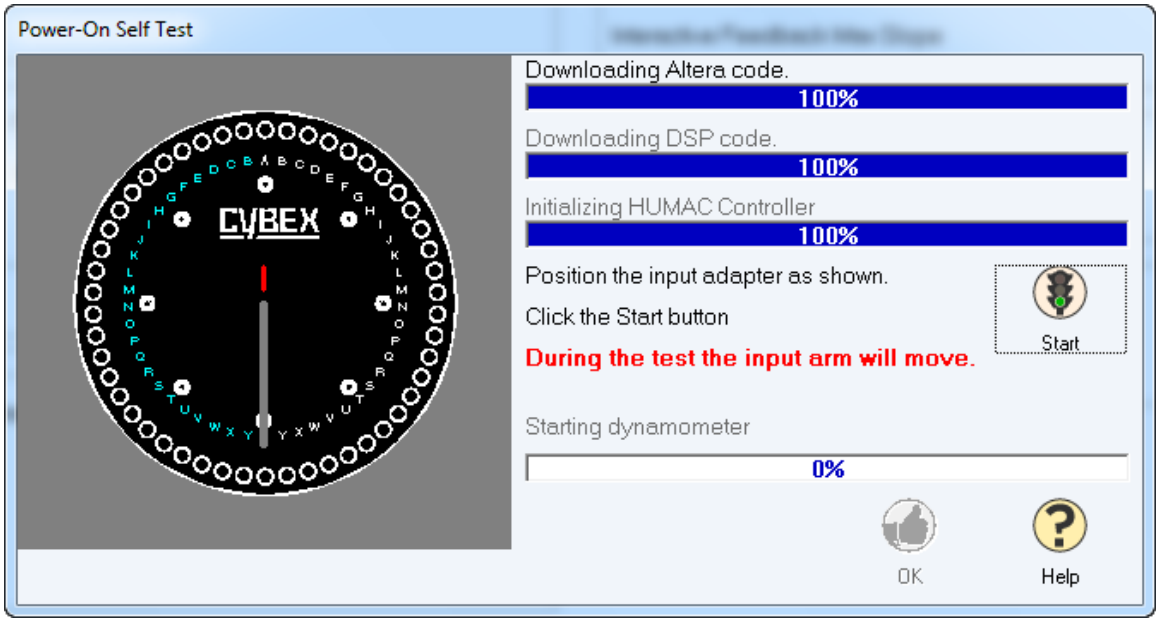


Figure 1-7 Power-On Self-Test

3. The HUMAC will Download the code and initialize the controller. After the initialization is completed, the **Start** button will be enabled. When the **Start** button is enabled you should position the adapter at 6:00 (pointed straight down).

   IMPORTANT: *The input adapter must be positioned straight down before you click the* ***Start*** *button.*

4. After you click the **Start** button, HUMAC runs the dynamometer power-on-test.

   IMPORTANT: *During the Power-On Test the input adapter will move slightly. It is very important that you not touch or be near the input arm during the Power-On Test procedure.*

5. After the Power-On Test completes the **OK** button will be enabled. Click **OK** to continue.

Selecting a Patient

The **Patient Selection** screen allows you to select a patient for testing, exercise, and report generation.

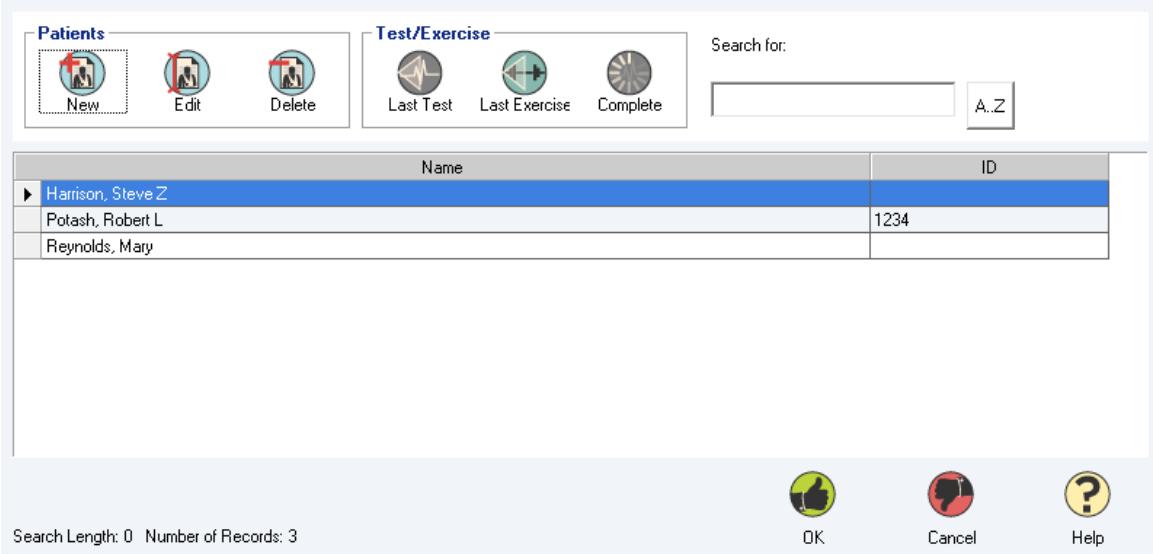


Figure 1-8 Patient Selection Screen

Actions

Action	Description
OK	Select the highlighted patient. You can also double-click a patient's name to select them.
Cancel	Cancel the patient selection and return to the main HUMAC screen.
Search	As you begin typing the patient's last name, the HUMAC automatically displays patients matching the search criteria.
New	Add a new patient to the database.
Edit	Edit the highlighted patient's background information (Name, Height, Weight, etc.).
Delete	Delete the highlighted patient from the HUMAC Database. ***IMPORTANT:*** *When you delete a patient from the HUMAC Database, all of their test and exercise data is deleted from the system. There is no way to recover deleted data.*
Last Test	Repeat the last test run on the patient. The HUMAC recalls the most recent test run on the patient and begins a new test session using the same pattern and protocol.
Last Exercise	Repeat the last exercise run on the patient. The HUMAC recalls the most recent exercise run on the patient and begins a new exercise session using the same pattern and protocol.
Complete	Complete the last test or exercise run on the patient. The HUMAC recalls the patient's previous test and goes directly to the test status screen. This is typically used if you are unable to complete the test, e.g. the patient stopped or there was a computer problem.

Adding a New Patient

1. Click the **Patient** button to access the **Patient Selection** screen.
2. Click **New**.

Selecting an Existing Patient

1. Click the **Patient** button to access the **Patient Selection** screen.
2. Begin typing the Patient's last name in the **Search** box.
3. Click the Patient's Name in the **Patient List** area.
4. Click **OK**.

Editing an Existing Patient's Information

1. Click the **Patient** button to access the **Patient Selection** screen.
2. Begin typing the Patient's last name in the **Search** box.
3. Click the Patient's Name in the **Patient List** area.
4. Click the **Patient's Name**.
5. Click **Edit**.

Note:

- *After a patient has been tested, use the **Edit Background** command to edit the information stored with the test.*
- *The **Patient Selection** screen lists the Patient Name and ID. By default the list is sorted by patient name. To sort by ID, click on the ID column heading.*

Entering Patient Information

When you recall a stored patient or enter a new patient, the HUMAC displays the **Patient Background Information** screen.

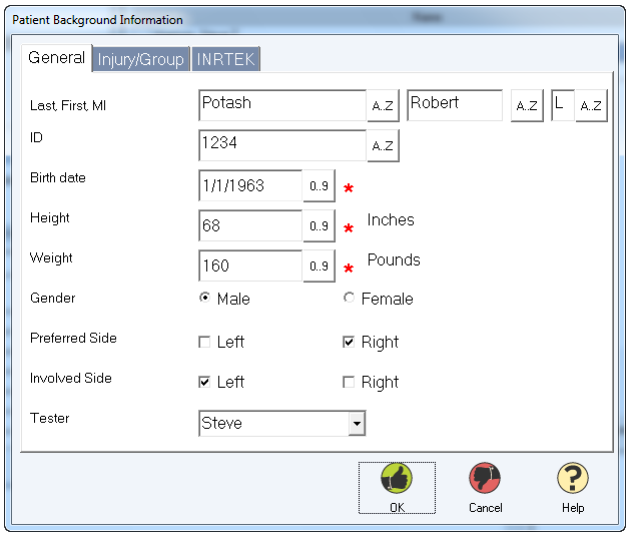


Figure 1-9 Patient Background Information

Actions

Action	Description
OK	Save your changes to the patient record.
Cancel	Cancel your changes to the patient record.

Entering Data

- Click the Keypad buttons A..Z or 0..9 to pop-up a keypad for data entry with a touch-screen monitor.
- You can select neither side, the Right side, the Left side or both the Right and Left sides for the patient's **Preferred** side and **Involved** side.
- The Diagnosis, Surgery, Doctor, Tester, Group1, and Group2 values are entered from a list of choices called picklists. To select from the picklist, you can begin typing and the HUMAC will find the closest match or you can click the pull-down arrow to display the list of choices. To edit the choices, click the pull-down arrow and select **<<Edit list>>** from the end of the list.

Note

- Only one copy of the patient's Name, ID, Birth Date, and Sex are stored in the HUMAC database. Any changes to these fields will automatically appear on every test and exercise record for the patient.
- The Height, Weight, Preferred Side, Involved Side, Diagnosis, Injury Date, Surgery, Surgery Date, Doctor, Tester, Group1, and Group2 values are stored individually with each test and exercise session run. This allows changes to these fields to accurately reflect the patient's condition at

the time of the test or exercise session. Use the **Edit Background** (Section 0) command to change the values for a test which has already been run.

Pattern Selection

The HUMAC contains the dynamometer setup and patient positioning information for the test and exercise patterns.

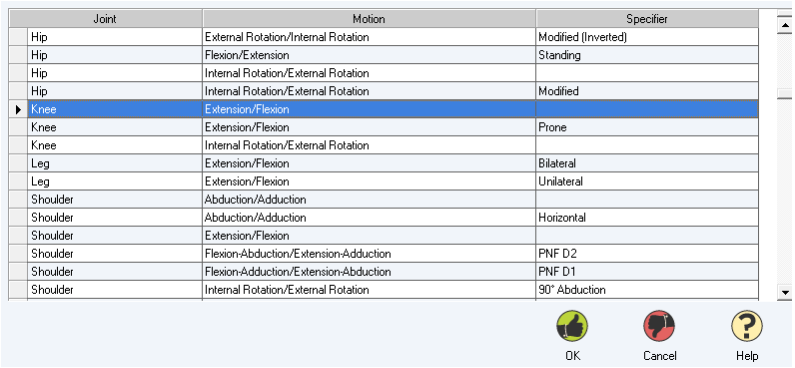


Figure 1-10 Pattern Selection

Actions

Value	Description
OK	Select the highlighted pattern. You can also double-click a pattern to select it.
Cancel	Cancel the pattern selection and return to the main HUMAC screen.

Protocol Selection

Protocols are collections of one or more sets which describe the dynamometer operating mode, termination, rest period and other parameters. A protocol can contain up to 25 sets.

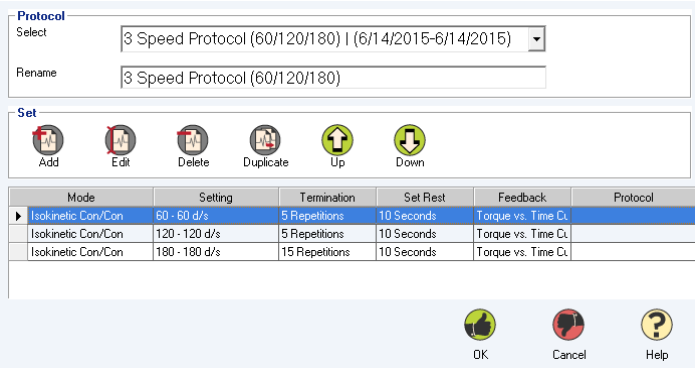


Figure 1-11 Protocol Selection

Actions

Action	Description
Select	The pull-down control displays a list of the protocols the patient has been tested with. The patient's most recent protocol at the top of the list. Following the patient's individual protocols, the HUMAC displays the system protocols.
Rename	A text description which is displayed in the Protocol control after the protocol is saved.
OK	Continue with the displayed protocol.
Cancel	Cancel the test/exercise session and return to the main HUMAC menu.
Add	Add a new set to the protocol.
Edit	Edit the selected set.
Delete	Delete the selected set from the protocol.
Insert	Insert a copy of the selected set into the protocol.
Up	Move the selected set up one row in the protocol.
Down	Move the selected set down one row in the protocol.

Sets

A set specifies the parameters (dynamometer operating mode, termination parameter, and number of repetitions) for one row in a protocol. The available parameters (described below) are based on the selected Mode (Isokinetic, Isometric, Isotonic, and CPM).

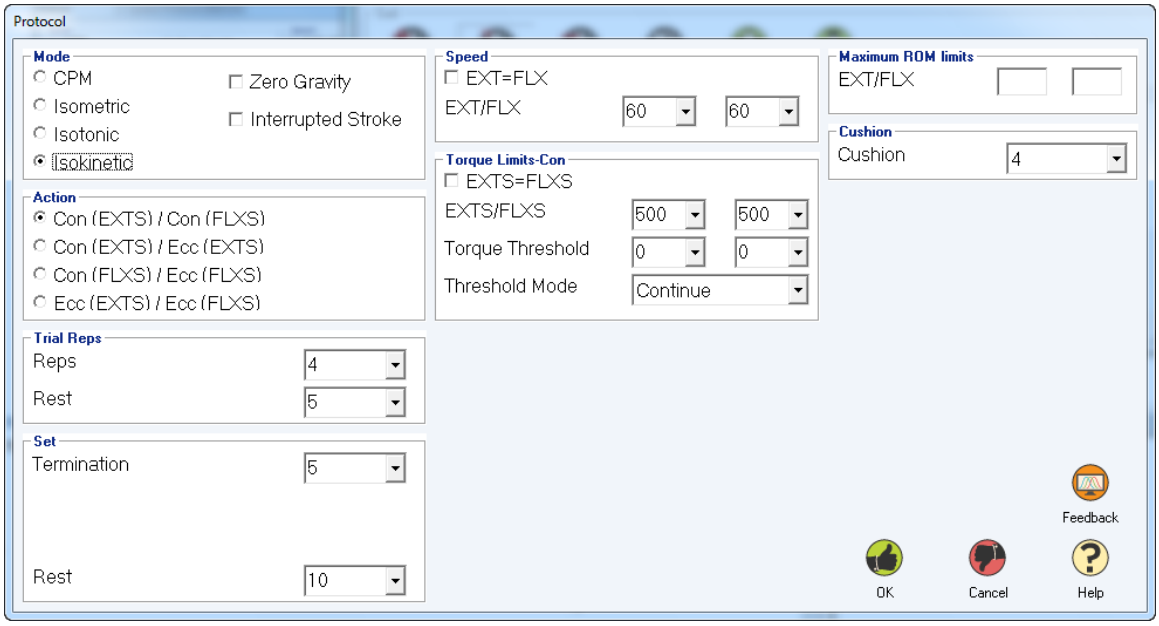


Figure 1-12 Isokinetic Set Editor

Mode

The dynamometer operating mode: Isokinetic, Isometric, Isotonic, or CPM.

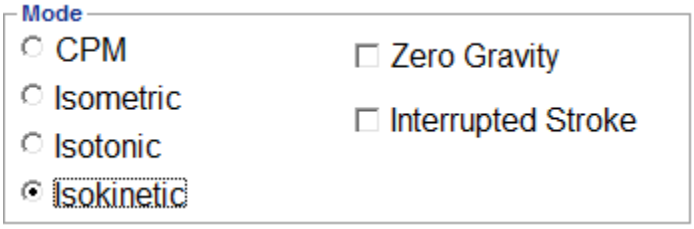


Figure 1-13 Mode Selection

Option	Description
Isokinetic	Constant speed
Isometric	Constant position
Isotonic	Constant Force
CPM	Continual Passive Motion
Zero Gravity	In Zero-Gravity mode the dynamometer provides active compensation for the limb and input adapter weight so the limb feels weightless. **Isokinetic Con/Con Mode:** Helpful when working with weak patients and heavy limbs, e.g. Shoulder Ab/Ad.

Option	Description
	CPM Mode: Useful when using the **Reverse Direction on Overtorque** option with a low torque value to provide passive stretching.
Interrupted Stroke	Interrupted Stroke mode allows the therapists to individually test and select single Extension and Flexion motions. In Interrupted Stroke mode, the patient is asked to do one Extension or one Flexion. At the conclusion of each "stroke" the therapist can review the data and decide if the data should be included in the final report.

Action

The dynamometer action.

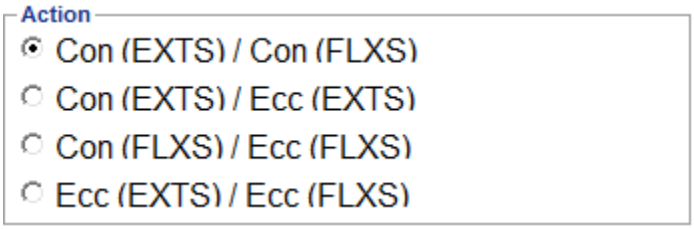


Figure 1-14 Action Selection

Option	Description
Con/Con	Concentric/Concentric. The patient begins in full Flexion. The repetition begins with a concentric extensor action followed by a concentric flexor action. Available in Isokinetic Mode.
Con/Ecc	Concentric/Eccentric. The patient begins in full Flexion. The repetition begins with a concentric extensor action followed by an eccentric extensor action. Available in Isokinetic, Isometric and Isotonic Modes. Con/Ecc would be used to test the Knee Extensor muscles.
Ecc/Con	Eccentric/Concentric. The patient begins in full Extension. The repetition begins with a concentric flexor action followed by an eccentric flexor action. Available in Isokinetic, Isometric and Isotonic Modes. Ecc/Con would be used to test the Knee Flexor muscles.
Ecc/Ecc	Eccentric/Eccentric. The patient begins in full Extension. The repetition begins with an eccentric extensor action followed by an eccentric flexor action. Available in Isokinetic Mode.

Trial Reps

The number of repetitions to be performed before the start of the test or exercise.

Figure 1-15 Trial Reps Selection

Option	Description
Reps	The number of repetitions to be performed. Trial Reps are available in Isokinetic, Isometric and Isotonic modes. Trial Reps are not available in CPM mode. Selecting Unlimited causes the HUMAC to remain at the Trial Reps Feedback Display screen until the therapist clicks the **Cancel** button.
Rest	The rest time in seconds at the end of the trial reps. At the conclusion of the Trial Rest the Test or Exercise is begun.

Set Termination

The HUMAC allows you to specify the termination (repetitions, time) to end a set.

Figure 1-16 Set Termination Selection

Option	Description
Termination	For Isokinetic, Isometric, and Isotonic mode, the termination is specified as number of repetitions to be performed. For CPM mode, the termination can be specified as the number of repetitions to be performed or the length of time in seconds or minutes.
Rest	The rest time in seconds at the end of the set.

Speed

The Dynamometer Speed setting for Isokinetic and CPM modes.

Figure 1-17 Speed Selection

Option	Description
EXT=FLX	Selecting the EXT=FLX checkbox causes the HUMAC to automatically copy changes in the EXT speed to the FLX speed. This is convenient if you want the speeds to be equal.
EXT/FLX	The speed in degrees per second for rotary patterns and inches per second for linear patterns. The HUMAC allows you to specify different extension and flexion speeds.

Torque

The Dynamometer Torque setting for Isotonic mode.

Figure 1-18 Torque Selection

Option	Description
EXT=FLX	Selecting the EXT=FLX checkbox causes the HUMAC to automatically copy changes in the EXT torque to the FLX torque. This is convenient if you want the torques to be equal.
EXT/FLX	The Torque setting in foot-pounds or Newton-meters depending on the HUMAC Preferences. The HUMAC allows you to specify different extension and flexion torques, which allows you to provide higher Eccentric loads “negatives”.

Angle

The Dynamometer Angle setting for Isometric mode.

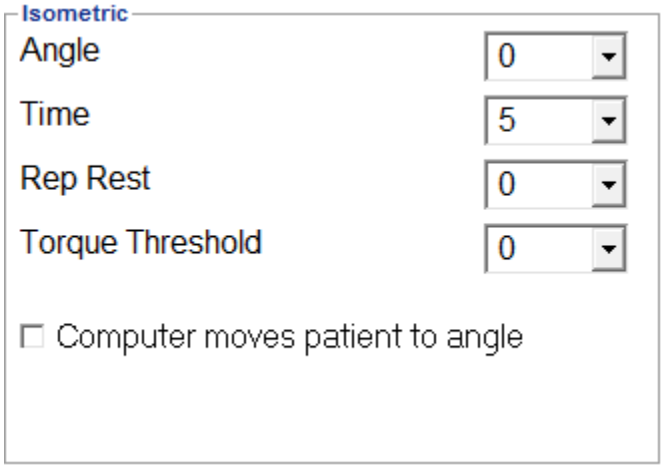


Figure 1-19 Angle Selection

Option	Description
Angle	The limb angle (in degrees for rotary motion or inches for linear motion) for the isometric contraction.
Time	The time (in seconds) for the isometric contraction.
Rep Rest	The rest (in seconds) between each isometric contraction (repetition) in the set.
Torque Threshold	The torque required for the timer to being counting the isometric contraction. Once the Torque Threshold is reach, the timer continues even if the torque drops below the threshold. Torque Threshold helps assure the patient is generating a contraction before the timer begins.
Computer moves patient to angle	Computer moves patient to angle determines how the isometric angle is reached at the start of a set. **Checked:** The HUMAC moves the patient limb (using a slow-speed CPM) to the Isometric Angle. When the angle is reached, the HUMAC switches to Isometric mode. This is sometimes referred to as "powered isometrics".

Option	Description
	Cleared: The HUMAC enters Setup mode (Isokinetic Con/Con) and waits for the patient to move their limb to the Isometric Angle. When the patient reaches the Angle, the HUMAC enters Isometric mode.

Torque Limits - Concentric

The Dynamometer Concentric Torque Limits allow you to specify a Threshold to initiate motion and a Limit for the maximum torque. The Concentric Torque Limits are available in Isokinetic and CPM modes. ***Note:*** *While the patient is exceeding the torque limit, the real-time dynamometer settings are displayed in red.*

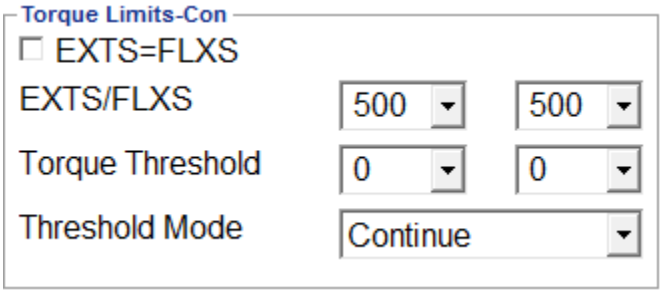


Figure 1-20 Concentric Torque Limit Selection

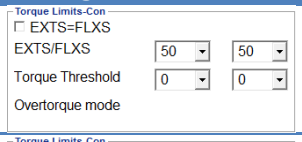
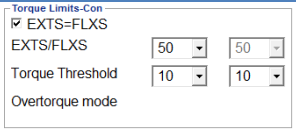
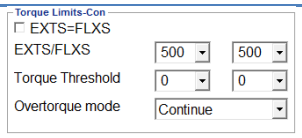
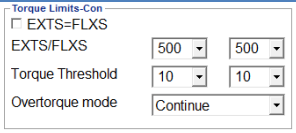
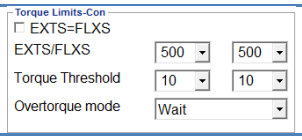
Option	Description
EXTS=FLXS	Selecting the EXT=FLX checkbox causes the HUMAC to automatically copy changes in the EXT torque to the FLX torque. This is convenient if you want the torques to be equal.
EXTS/FLXS	If the patient exceeds the concentric torque limit the HUMAC automatically switches to isotonic mode at the torque limit. Isotonic mode allows the speed of the dynamometer to increase in order to keep the torque below the concentric limit. During this time the patient will be able to push the input arm in the direction of motion faster than the speed setting. When the torque drops below the limit, the HUMAC automatically switches back to Isokinetic/CPM mode. ***Note:*** 1. *Patients sometimes report it felt like the dynamometer "slipped" as the speed increased. If so, they may be exceeding the concentric torque limit.* 2. *It is possible for the patient to exceed the concentric torque limit at a ROM stop. Because ROM stops must be enforced the patient may exceed the concentric torque limit as the limb is being decelerated while approaching a ROM stop.*
Torque Threshold	The torque required to initiate motion of the dynamometer. See Threshold Mode for the response when the patient reaches the Threshold. ***Note:*** *When a non-zero torque threshold is selected, the patient must move through the complete Range of Motion. They cannot change direction until the end point is reached.*
Threshold Mode	**Continue:** When the patient reaches the Torque Threshold the dynamometer enters the selected mode begins moving until the end of range is reached, regardless of if the patient torque falls below the Threshold. At that point the dynamometer stops and waits until the patient again reaches the Torque Threshold in the opposite direction to begin the reciprocal motion.

Option	Description
	Wait: When the patient reaches the Torque Threshold the dynamometer enters the selected mode begins moving. If the patient torque falls below the Threshold, the dynamometer stops and waits until they again exceed the Threshold. When the end of range is reached, the dynamometer waits until the patient again reaches the Torque Threshold in the opposite direction to begin the reciprocal motion.

Note: Selecting Wait for the Torque Threshold in CPM mode or Isokinetic mode would be exactly the same from the patient's perspective. Thus, to simplify the settings, in CPM mode, the Torque Threshold operates in **Continue** mode. In Isokinetic Mode, the user can select between **Continue** and **Wait** modes.

Robotic Modes

The Torque Threshold allows you to provide Robotic Modes. You can think of the course of rehabilitation as follows:

Mode	Setting	Description
CPM, No Torque Threshold		1. HUMAC beings the CPM motion automatically.
CPM, Torque Threshold		1. The patient must generate the Torque Threshold (in this case 10 ft-lbs) to initiate each CPM motion. 2. Once the motion is initiated, the motion continues until the End of Range is reached.
Isokinetic, No Torque Threshold		1. The HUMAC beings the isokinetic motion as soon as any concentric torque is generated. 2. The patient can change direction any point in the Range of Motion.
Isokinetic, Torque Threshold, Continue		1. The patient must generate the Torque Threshold to initiate the Isokinetic motion. 2. Once the motion is initiated the patient no longer needs to maintain the Threshold to continue the motion. 3. The patient must go through the full range of motion before they can change direction.
Isokinetic, Torque Threshold, Wait		1. The patient must generate the Torque Threshold to initiate the Isokinetic motion.

Mode	Setting	Description
		2. The patient must maintain the Torque Threshold to continue the motion. 3. If they fall below the Threshold the input adapter will stop. 4. Once they generate the Threshold again, the adapter will resume moving. 5. The patient must go through the full range of motion before they can change direction.

Torque Limits – Eccentric

The Dynamometer Eccentric Torque Limits allow you to specify a Threshold to initiate motion and a Limit for the maximum torque. The Eccentric Torque Limits are available in Isokinetic mode. ***Note:*** *While the patient is exceeding the torque limit, the real-time dynamometer settings are displayed in red.*

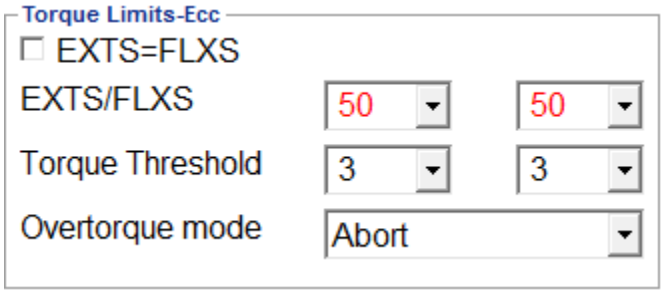


Figure 1-21 Eccentric Torque Limit Selection

Option	Description
EXTS=FLXS	Selecting the EXT=FLX checkbox causes the HUMAC to automatically copy changes in the EXT torque to the FLX torque. This is convenient if you want the torques to be equal.
EXTS/FLXS	If the patient exceeds the Eccentric limit the HUMAC automatically responses with the selected Overtorque mode.
Torque Threshold	The torque required for the dynamometer to initiate and maintain the Eccentric motion. If the patient falls below the Torque Threshold the input adapter stop until the Torque Threshold is reached. ***Note:*** *This option is available in Isokinetic Mode only.*
Overtorque Mode	**Isokinetic and CPM Mode Options** • **Abort:** The HUMAC switches to setup mode and reports an eccentric over-torque error. This option is available in Isokinetic and CPM Mode. • **Isometric**: The HUMAC switches to isometric mode and the input adapter remains in-place. When the torque is reduced to below the torque limit, the system resumes Isokinetic mode. **CPM Mode Only Options**

Option	Description
	• **Isotonic**: The HUMAC switches to isotonic mode and the patient is allowed to "overpower" the input adapter. • **Reverse Direction**: The HUMAC initiates the end of ROM sequence. The input adapter stops, the pause is counted down and the input adapter moves in the reverse direction. A low Eccentric Torque Limit value, combined with Reverse Direction, and Expand ROM can be used to provide passive stretching.

Pause – CPM Mode

The pause in seconds at the end of each motion.

Figure 1-22 Pause Selection

Option	Description
EXT=FLX	Selecting the EXT=FLX checkbox causes the HUMAC to automatically copy changes in the EXT Pause to the FLX Pause. This is convenient if you want the Pauses to be equal.
EXT/FLX	The Pause setting in seconds. The HUMAC allows you to specify different extension and flexion pauses.

Maximum ROM Limits

The patient ROM limits are established during the patient setup and typically are used for all sets in the patient protocol. The HUMAC allows you to over-ride the patient ROM limits on a set-by-set basis. For example, the patient Knee Ex/Fl range may be from 90 deg of flexion to 4 degrees of extension. During the first set in a protocol you want the patient to perform as short-arc CPM from 90 deg of flexion to 45 deg of flexion. In this case you would set the Maximum ROM limits in the Set to 90 and 45.

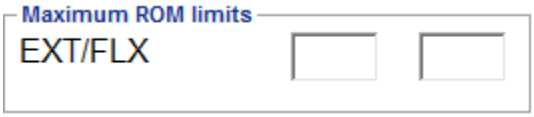


Figure 1-23 Maximum ROM Limits Setting

Note: *During each set, the HUMAC will never increase the patient ROM limits beyond the patient ROM limits. The Maximum ROM limits specify the most the ROM can be, not the actual ROM. Consider the following example of a Knee Ex/Fl set.*

Patient ROM (Ex/Fl)	Maximum ROM (Ex/Fl)	*Final Setting (Ex/Fl)*
90 deg to 4 deg	Blank	*90 deg to 4 deg*
90 deg to 4 deg	85 deg to blank	*85 deg to 4 deg*
90 deg to 4 deg	blank to 45 deg	*90 deg to 45 deg*

Patient ROM (Ex/Fl)	Maximum ROM (Ex/Fl)	*Final Setting (Ex/Fl)*
90 deg to 4 deg	85 deg to 45 deg	*85 deg to 45 deg*
90 deg to 4 deg	100 deg to 45 deg	*90 deg to 45 deg*
90 deg to 4 deg	*100 deg to 0 deg*	*90 deg to 4 deg*

Cushion

As the patient approaches the ROM limits, the HUMAC must decelerate the dynamometer. The smallest cushion value (0) corresponds to the slowest deceleration (softest stop). The largest cushion value (5) corresponds to the fastest deceleration (hardest stop).

Figure 1-24 Cushion Setting

Ramping – CPM Mode

The CPM Ramping feature allows you to gradually increase the CPM speed during a set.

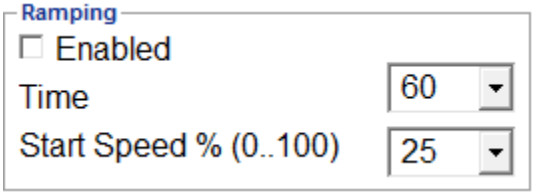


Figure 1-25 CPM Ramping Setting

Option	Description
Enabled	When selected CPM Ramping is enabled.
Time	The time in seconds to complete the Ramping.
Start Speed %	The percent of the target speed to begin the Ramping.

In this example, we want the patient to perform a high-speed CPM exercise at 180 deg/sec. However, we don't want the first repetition to begin at that speed; instead we want the CPM speed to ramp-up to 180 deg/sec during the first few repetitions as though we were "turning-up" the CPM the speed. Assume Ramping is enabled, the Time is set to 60 seconds and the Start Speed is 25% of the target. When the patient begins CPM mode, the dynamometer will operate as-though the CPM speed is set to 45 deg/sec (180 * 25%) and is being increased to 180 deg/sec during the next 60 seconds.

Note:

1. *The speed increase **Time** does not run during the Pause time.*
2. *The HUMAC will still accelerate and decelerate the patient smoothly at the ROM stops.*

Feedback

The HUMAC provides a number of real-time feedback displays. The feedback options are based on the dynamometer mode and action. To select the feedback type:

1. From the Protocol Editor, select the **Set** to edit and click the **Edit** button.
2. From the Set Editor from, click the **Feedback** button.

Feedback: Curves/Bars

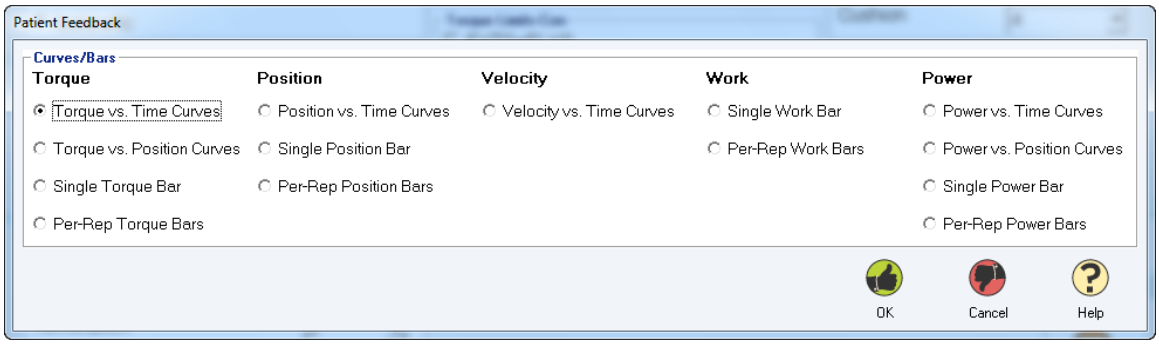


Figure 1-26 Feedback Display: Curves/Bars

The Curve/Bar feedback displays available in each Mode are shown below.

Display	Isokinetic	Isometric	Isotonic	CPM
Torque vs. Time Curves	✓	✓		✓
Torque vs. Position Curves	✓			✓
Single Torque Bar	✓	✓		✓
Per-Repetition Torque Bars	✓	✓		✓
Position vs. Time Curves	✓		✓	
Single Position Bar	✓		✓	
Per-Rep Position Bars	✓		✓	
Velocity vs. Time Curves	✓		✓	
Velocity vs. Position Curves			✓	
Single Velocity Bar			✓	
Per-Rep Velocity Bars			✓	
Single Work Bar	✓		✓	✓
Per-Repetition Work Bars	✓		✓	✓
Power vs. Time Curves	✓		✓	
Power vs. Position Curves	✓		✓	
Single Power Bar	✓		✓	
Per-Repetition Power Bars	✓		✓	

Samples of each type of plot are shown below. Concentric motions are displayed as positive values and Eccentric motions as negative values.

Feedback: Torque vs. Time

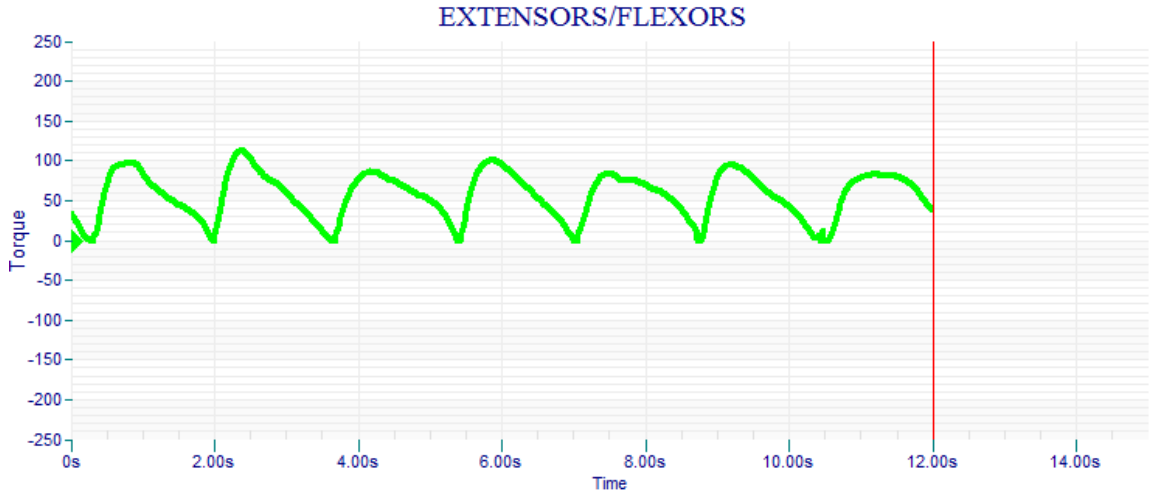


Figure 1-27 Torque vs. Time Feedback

Feedback: Torque vs. Position

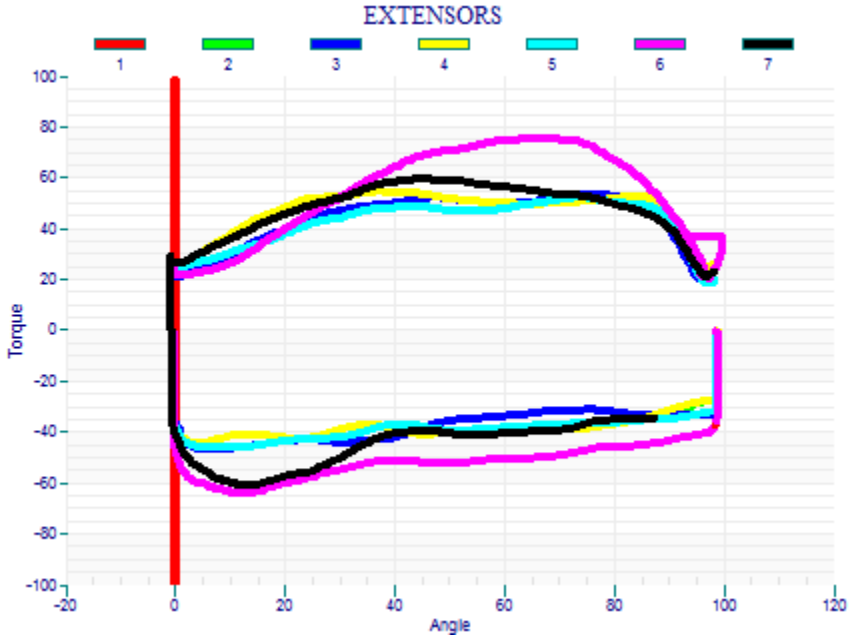


Figure 1-28 Torque vs. Position Feedback

Feedback: Single Bar

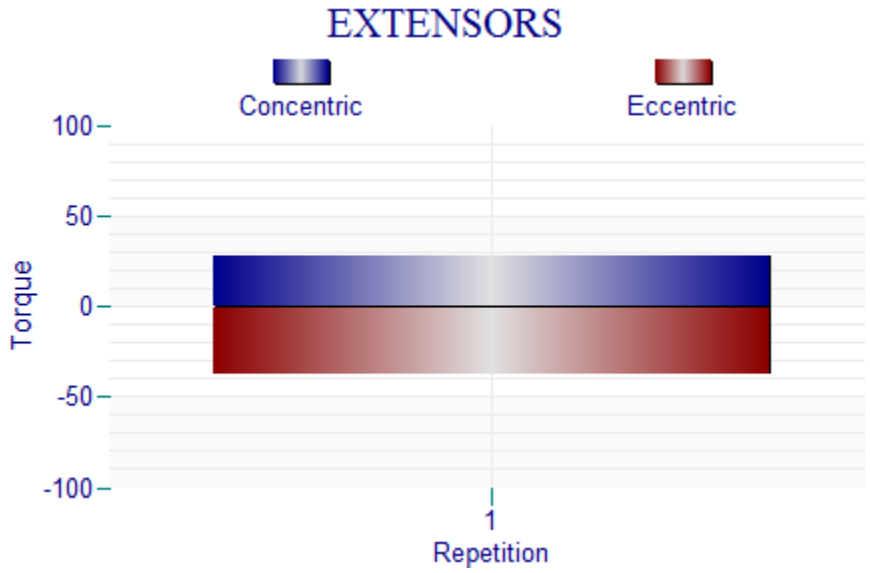


Figure 1-29 Single Torque Bars

Feedback: Per-Repetition Bars

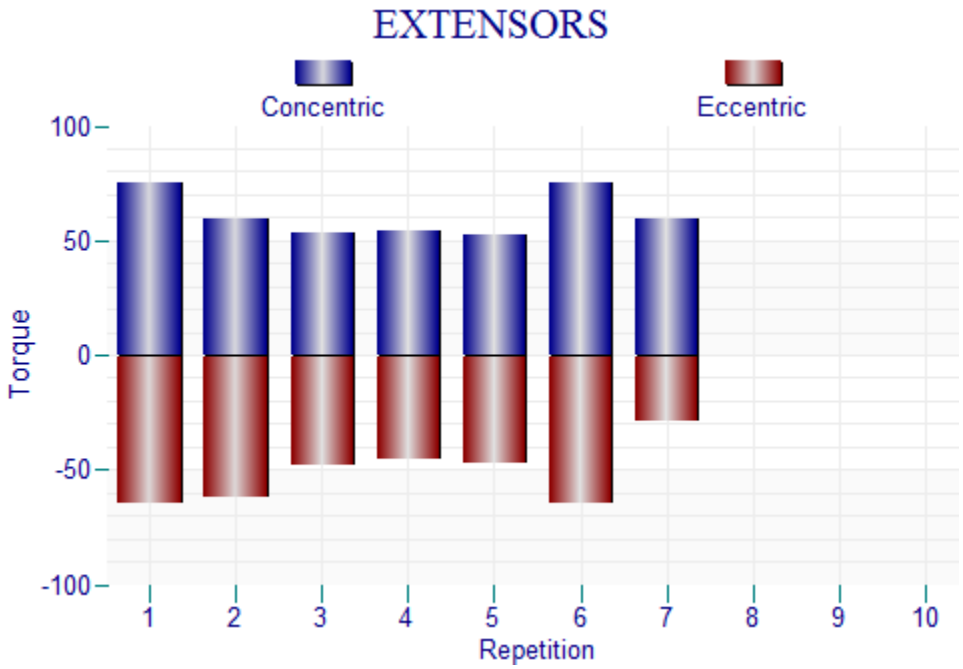


Figure 1-30 Per-Rep Torque Bars

Feedback: Real-Time Range of Motion

The HUMAC displays a Range of Motion bar along the right side of the screen to indicate the patient's current position as a percent of their range of motion.

Figure 1-31 Real-Time Range of Motion Display

Feedback: Robotic Concentric Direction

When you are in Isokinetic Concentric Torque Threshold robotic mode, the patient must to throught he full range of motion before changing direction. The HUMAC displays an Up (Initical Motion)/Down (Reciprocal Motion) arrow to indicate the direction they should be moving and when they can change direction.

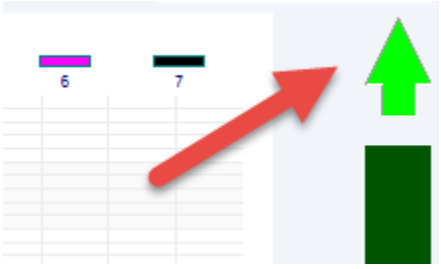


Figure 1-32 Robotic Mode Direction

Feedback: Changing Displays

You can change the feedback display directly from the real-time feedback screen. To change the display, click the desired button. The options include:

Isokinetic, Isometric, CPM Mode

1. Torque vs. Time
2. Torque vs. Position
3. Single Torque Bar
4. Per-Repetition Torque Bars
5. Single Work Bar
6. Per-Repetition Work Bars

Isokinetic, Isometric, CPM Mode

1. Power vs. Time
2. Power vs. Position
3. Single Power Bar
4. Per-Repetition Power Bars
5. Single Work Bar
6. Per-Repetition Work Bars

Note: *When changing displays, the HUMAC erases the previous display and begins drawing the new display with the current real-timed data. All data from the start of the test is saved.*

Figure 1-33 Changing Real-Time Feedback Displays

Feedback: Dynamic Tests

The HUMAC offers a number of dynamic test displays, including Roadways, Interactive Lines, Response Time and Proprioception. The Dynamic tests are available in both Isotonic (where the patient must act hive a specific position) and Isometric (where the patient must achieve a specific torque) modes. The Dynamic Tests are fully described later in this manual.

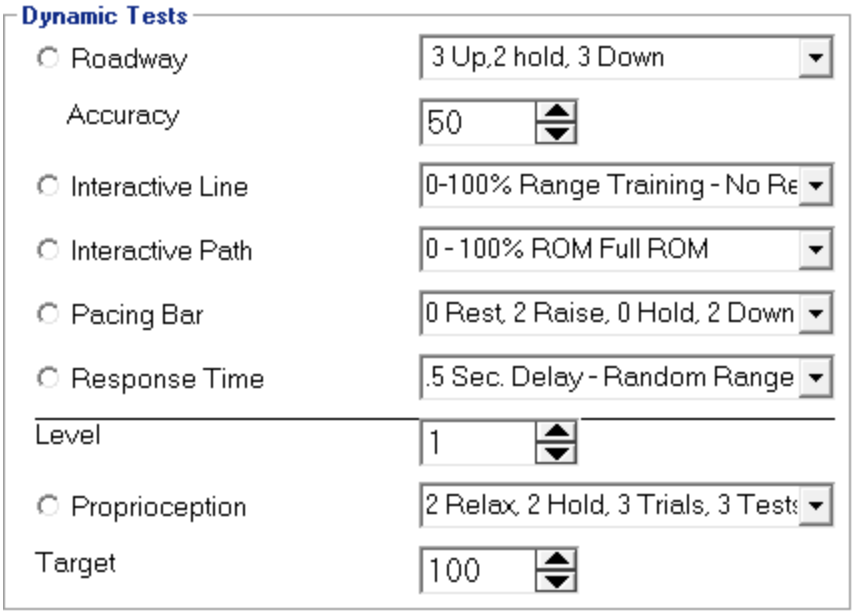


Figure 1-34 Feedback Displays: Dynamic Test

Feedback: Games

The HUMAC offers Pong and Breakout game displays. The Games are available in both Isotonic (where the patient must act hive a specific position) and Isometric (where the patient must achieve a specific torque) modes. The Games are fully described later in this manual.

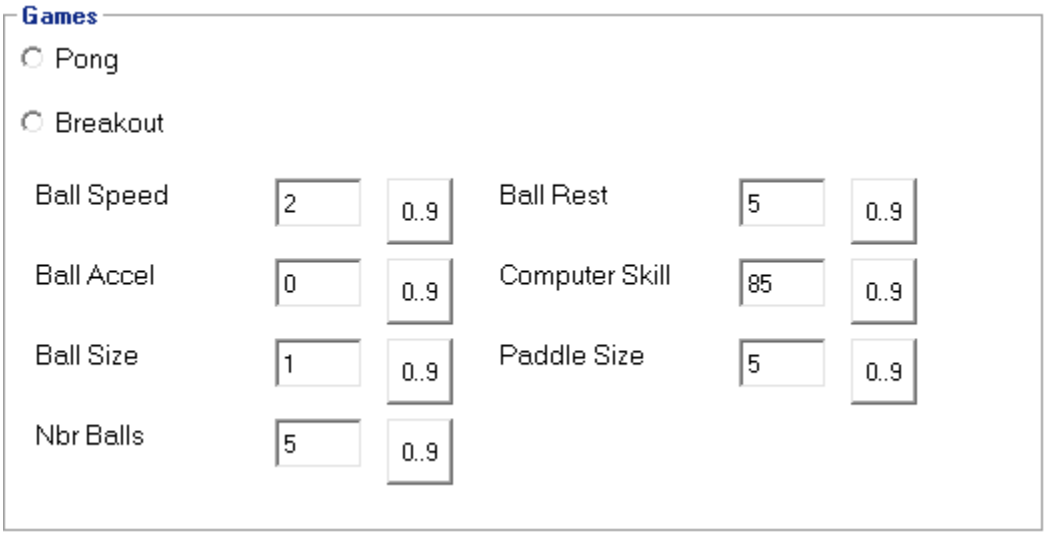


Figure 1-35 Feedback Displays: Games

Feedback: Isometric Targets

The HUMAC includes a special Isometric targets feedback mode which allows the user to perform sub-maximal Isometric testing. In this mode the HUMAC will have the patient perform a maximal isometric contraction and then set feedback targets to the percent of the MVC.

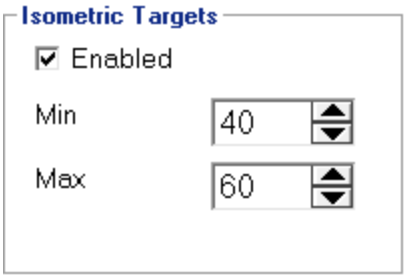


Figure 1-36 Feedback Displays: Isometric Targets

Test Status

The Test Status form displays the protocol and the status of each set (Tested, Not Tested, Error).

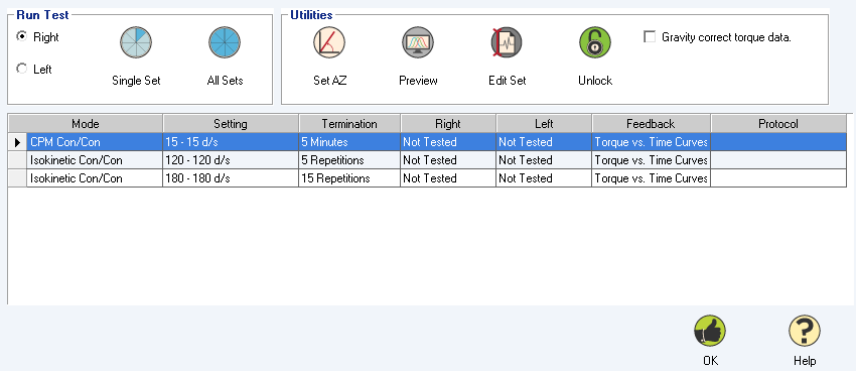


Figure 1-37 Test Status

Status

Action	Description
Not Tested	The set as not been run yet.
Tested	The set was completed successfully.
Error	An error occurred while running the set, for example, the patient did not go through a full range of motion or the clinician aborted the set.

Actions

Action	Description
OK	Leave the Test Status screen and move to the Report screen. Once you leave the Test Status screen you cannot run additional sets from the protocol.
Side	Select the Side which will be tested.
Single Set	Run the currently highlighted set.
All Sets	Run all sets in the protocol starting with the selected set. Note: When you select All Sets the HUMAC deletes all data from any sets which are run. For example, if you completed all sets in a 3 set protocol, select the second set and click All Sets, the HUMAC will leave the data from the first set in-place and replace the data in the second and third set with the new data as the sets are re-run.
Set AZ	Re-set the patient's Anatomical Zero. If you re-set the AZ you should re-run the sets.
Preview	Display the short torque vs. position report. This allows you to quickly check the results of a set before switching sides or leaving the Test Status screen.
Edit Set	Display the protocol editor allowing changes to the selected set. ***Note:*** *When a set is edited, any data which was run on the selected set will be lost.*
Unlock	The HUMAC remains in Isometric mode at the conclusion of an isometric set to provide support to the patient limb. The Unlock button returns the system to Isokinetic mode.
Gravity Correct	When selected the HUMAC weighs the limb so gravity correctly can be applied. Note: The checkbox only applies to the current protocol. Use the Preferences to set the default gravity correction option for all patients.

Action	Description
Display Targets	When selected the HUMAC display user- adjustable targets on the real-time feedback display.
Freeze Display	When selected, the HUMAC stops the timer if the patient's torque production is not within the Targets. ***Note:*** *This option is only available in Isometric mode.*

Note: *If the patient stops in the middle of a set you may choose to re-run the set. When you re-run a set the HUMAC overwrites the previous data with the new data.*

Patient Setup

The Patient Setup form displays a picture of the patient setup for the selected test pattern along, a list of the required adapters, and fields for you to record the dynamometer settings. To assure repeatable set-up between patient tests you should record your dynamometer settings. The first time a patient is tested for a given pattern, the dynamometer settings will be blank. The next time you test or exercise the patient on the same pattern, the HUMAC will display the previous dynamometer settings.

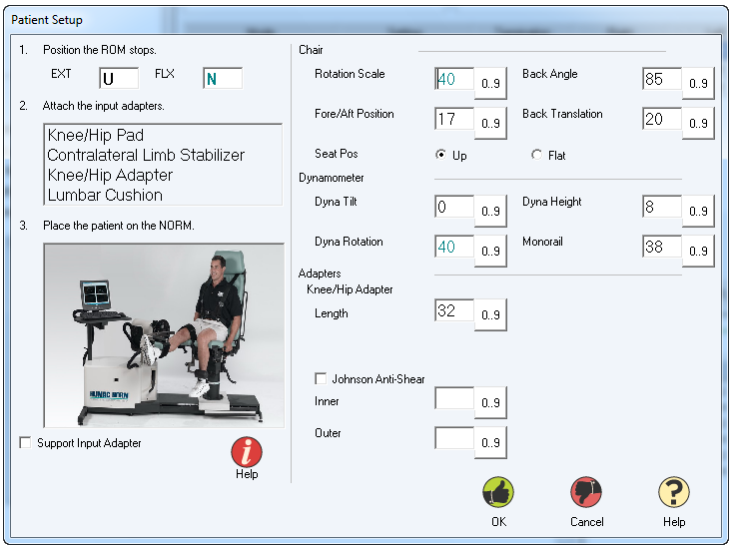


Figure 1-38 Patient Setup

IMPORTANT *Before placing the patient on the NORM, set mechanical stops to the locations shown in the* ***ROM Stops*** *box. Before the software stops are established the controller has no information on how to limit the range of motion in the event of a system failure. Placing the hardware stops at the initial locations provides an extra layer of safety until the software stops are established.*

Actions

Action	Description
Support Input Adapter	Sets the dynamometer to a 3 ft-lbs torque threshold which holds the input adapter in-place. This is convenient when setting-up the patient and setting Anatomical Zero.
Help (Under picture)	Open the Help System to a description of how to setup the selected pattern.
Help (Right Corner)	Open the Help System to a description of how to use this screen.
Adapter Name	Double-click the Adapter Name to see a picture and description of the adapter.
OK	Continue with the test/exercise protocol.
Cancel	Cancel the test/exercise session and return to the status screen.

Anatomical Zero

The Anatomical Zero allows the HUMAC to convert position data from the dynamometer to the patient's anatomical position.

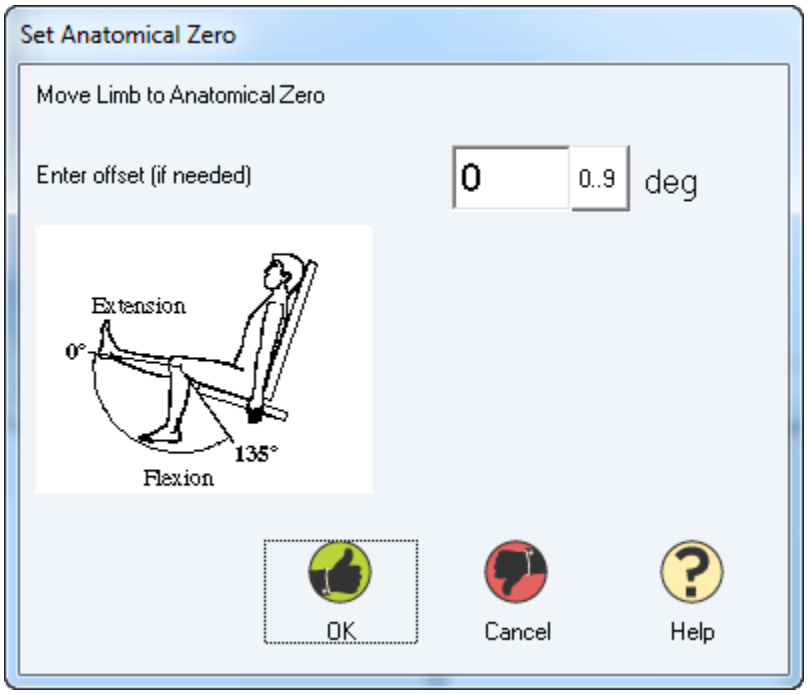


Figure 1-39 Anatomical Zero

Actions

Action	Description
OK	Set the Anatomical Zero to the patient's current limb position.
Cancel	Cancel setting the Anatomical Zero. The AZ will need to be re-set before performing any test or exercise sessions.
Offset	If the patient cannot reach Anatomical Zero, enter the offset to the current limb position. For example, if the patient is at 30 degrees of extension, enter 30 as the offset and then click OK.

Range of Motion Limits

IMPORTANT *The HUMAC uses computer controlled (software) and mechanical stops to control the patient range of motion while on the NORM. It is the clinician's responsibility to ensure that the computer range of motion stops are always used on the NORM, and that the mechanical range limiting stops are securely set to the position indicated by the software.*

Range of Motion

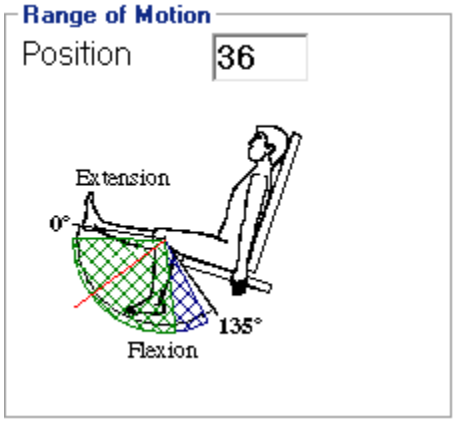


Figure 1-40 Range of Motion

The HUMAC displays the current limb position (red line and numeric value 36°), Software Stop limits (green area) and Expanded ROM limits (blue area).

Software Stops

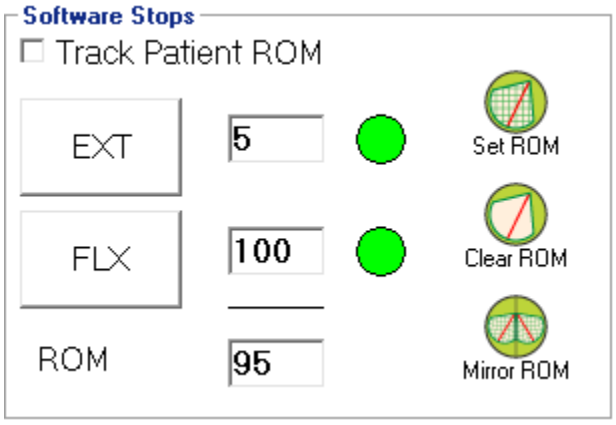


Figure 1-41 Software Stops

Actions

Action	Description
EXT	Set the Extension ROM limit to the current limb position. The EXT setting (11°) is displayed after the EXT button.
FLX	Set the Flexion ROM limit to the current limb position. The FLX setting (88°) is displayed after the FLX button.
Total ROM	The Total Range of Motion (77°) is displayed directly below the EXT and FLX values.

Action	Description
Track Patient ROM	Instead of using the EXT and FLX buttons to set the ROM you can have the HUMAC track the limb position and automatically set the EXT and FLX values. Check the Track Patient ROM option and move the limb through the desired ROM. The HUMAC will automatically update the ROM limits to match the greatest excursion of the patient's limb.
Set ROM	Enable the software stops to the current EXT and FLX values.
Clear ROM	Clear the software stops. This is typically used if you decide to change the stop locations after selecting Set ROM.
Mirror ROM	Copy the stop locations from the patient's other side to the current side. For example, if you have set the stops for the right side and now you are testing the left side, Mirror ROM will copy the EXT and FLX stops used on the right side to the left side. After the ROM locations are copied the Software Stop indicators will be red. The patient must move their limb to the stop locations to confirm they can reach the stops. Mirror ROM is only enabled if the stops have been set for the other side.

Note: *The Software Stops include a red/green circle indicating the patient has demonstrated they can reach the stop location. For example, if the patient is being re-tested, the HUMAC sets the stop locations to the value from their previous test. The circles will be red indicating the patient has not confirmed they can reach the stops. As the patient moves through the Range of Motion, the HUMAC monitors their position and turns the circle to green when the patient has reached the stop. The purpose of this is to always verify the patient can reach the software stops before enabling them. The HUMAC will not allow you to select Set ROM until both circles are green.*

Expand ROM

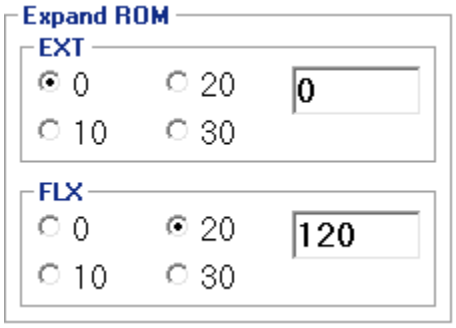


Figure 1-42 Expand ROM

The HUMAC allows you to increase the range of motion from the Neutral Menu while the patient is in CPM mode. In order to correctly set the hardware stops the HUMAC must know the maximum amount you intend to increase the ROM. For example to allow an extra 20 degrees of Flexion, click the 20 option in the Expand ROM, EXT area. The HUMAC will display the correct hardware stops to accommodate the extra 20 degrees of Flexion.

The CPM exercise will begin with the range displayed in the Software Stops. From the Patient Feedback display, use the Inc/Dec buttons to increase or decrease the range of motion.

Note: *The HUMAC limits the expanded ROM settings to the maximum ROM allowable for the selected pattern. For example, Knee Flexion is limited to 135°. If the patient's current FLX stop is at 120° and you set the FLX value to 30, the HUMAC will display 135 as the maximum expanded ROM.*

Mechanical Stops

Figure 1-43 Mechanical Stops

When a software stop location is set, the HUMAC updates the required mechanical stop location. ***IMPORTANT:*** *The mechanical stops must be securely set to the required location.*

Gravity Correction

The HUMAC allows you to gravity correct your torque data.

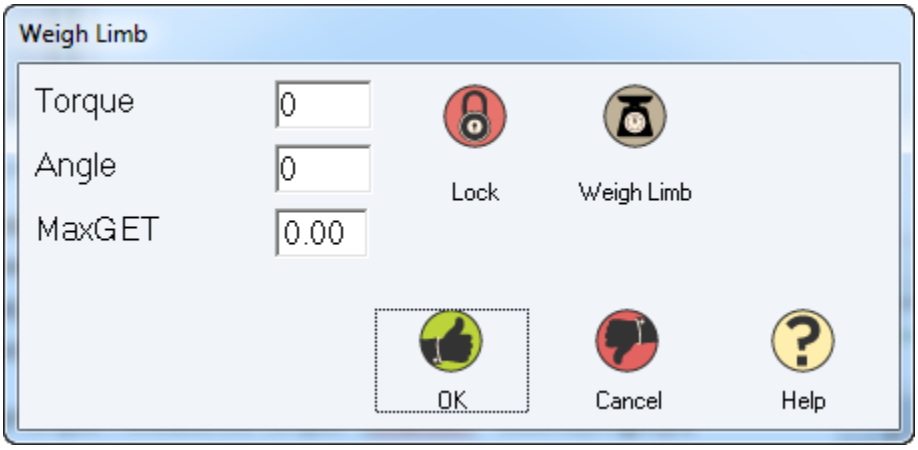


Figure 1-44 Weigh Limb

During testing and exercise the patient's limb may be assisted or resisted by gravity. When you enable gravity correction, the HUMAC asks you to weigh the patient's limb. From this the HUMAC computes the MaxGET (Maximum Gravity Effected Torque). The MaxGET, limb position, and direction of motion are used to adjust the torque values for the effects of gravity using the following equation.

- Limb is assisted by gravity. Reported Torque = Measured Torque - (MaxGET * Cosine(Angle))
- Limb is resisted by gravity. Reported Torque = Measured Torque + (MaxGET * Cosine(Angle))

The Angle is the position of the limb relative to vertical not the limb's anatomical position. The Angle is 0 when the limb is horizontal and 90 when the limb is vertical. The Reported Torque values are used to compute the Peak Torque, Work, and Power values.

Weighing the Limb

1. Move the limb to desired angle. For the most accurate weight, the limb should be positioned as near horizontal (greatest MaxGET) as possible.
2. Click the **Lock** button to switch the dynamometer to isometric mode.
3. Instruct the patient to relax the limb and click the **Weigh Limb** button.
4. The HUMAC will display the measured **Torque**, **Angle**, and **MaxGET**.

Note

- If you feel the patient was not relaxed during the limb weighing, you can repeat the procedure using the UnLock button to re-position the limb and the Weigh Limb button to repeat the weighing.
- During testing and exercise the real-time feedback display is not gravity corrected.
- When using gravity correction you will notice a discontinuity in the torque data when the patient changes direction during a gravity-affected motion. During a change of direction the

CSMI is below the isokinetic test speed, so the torque transducer shows 0 output. However when gravity correction is enabled, the HUMAC adds the position-adjusted limb weight during extension and subtracts the position adjusted limb weight during flexion. At the point the patient reverses direction, the HUMAC switches from adding to subtracting the torque correction and you see a discontinuity. You do not see this during the change from flexion to extension because the limb is near vertical where the effect of gravity is 0.

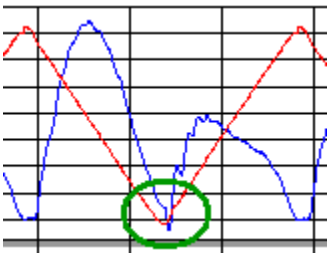


Figure 1-45 Gravity Corrected Torque

Feedback Display – Curves, Bars

The HUMAC displays real-time feedback to the patient during testing and exercise sessions. The HUMAC feedback display contains a number of sections.

Computed Data

At the top-left side are the Extensor and Flexor Peak Torque and Work Concentric/Eccentric values.

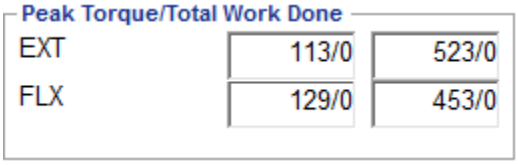


Figure 1-46 Feedback Display: Computed Data

The data is displayed as:

Extensors	Con Peak Trq (113)/Ecc Peak Trq (0)	Con Work (523)/Ecc Work (0)
Flexors	Con Peak Trq (129)/Ecc Peak Trq (0)	Con Work (453)/Ecc Work(0)

Set/Rep Counter

At the top-right side are the current Repetition and Set for the protocol. In this example the patient is on set 1 of a 3 set protocol. Set 1 contains 5 repetitions and the patient is currently on repetition number 2.

Figure 1-47 Feedback Display: Set/Rep Counter

Real-Time Feedback Display

The real-time Torque vs. Position display is shown below. Multiple colors are used to indicate each repetition with a legend at the top of the display. The vertical red bar indicates the patient's Anatomical Zero.

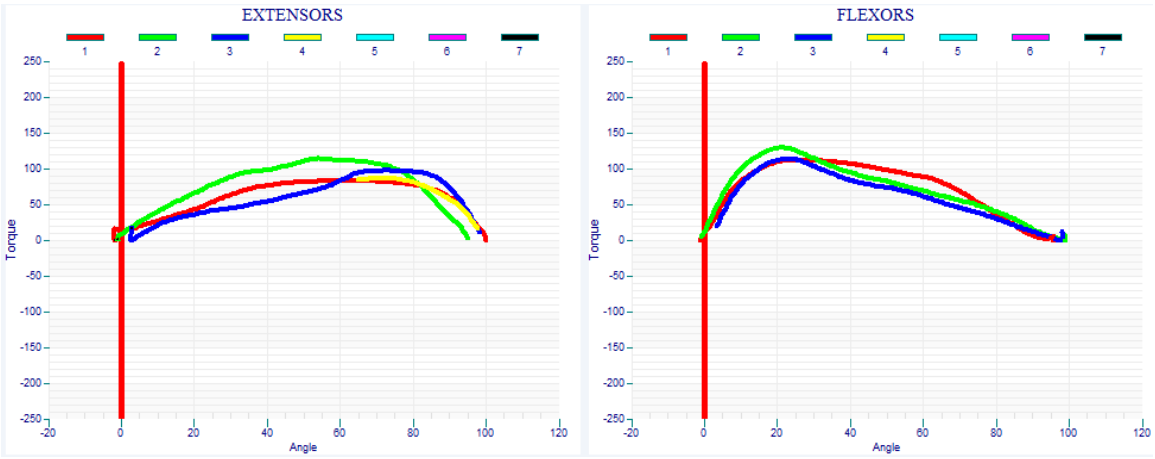


Figure 1-48 Feedback Display: Curves

Important: *The patient should not begin their motion until the feedback display is fully displayed.*

Isometric Targets

In Isometric Mode from the Dashboard you can select to display targets to the patient. The HUMAC displays the High/Low targets as horizontal lines on the real-time displays.

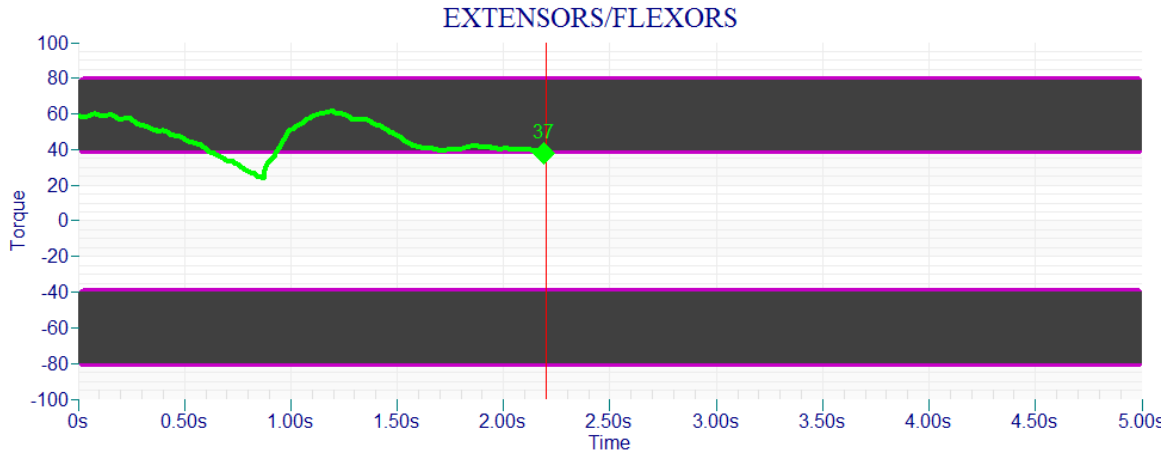


Figure 1-49 Isometric Feedback Targets

The targets can be changed by dragging them up and down using the left mouse button. When changing the targets, the HUMAC displays the target value (80 ft-lbs in this example).

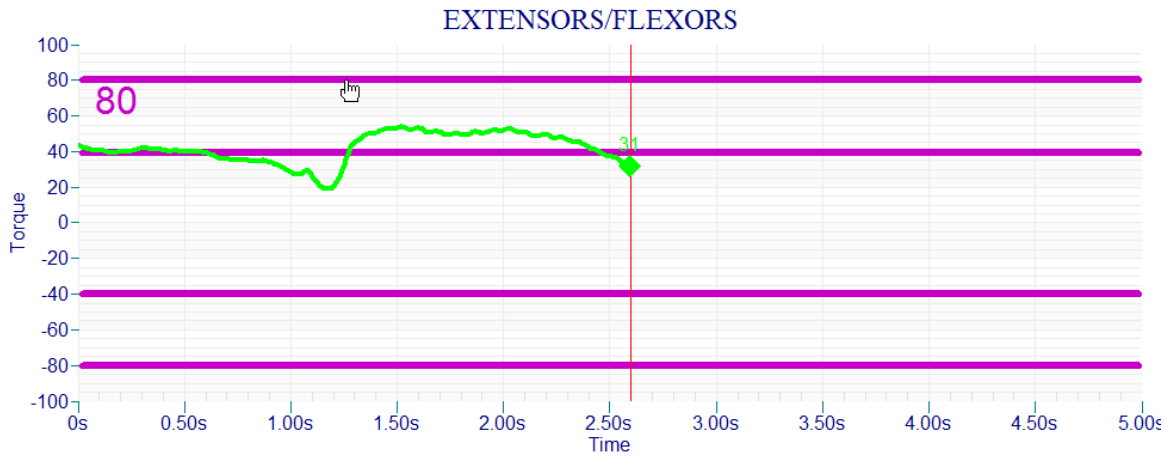


Figure 1-50 Dragging the Target to a New Value

In Isometric Torque vs. Time mode, the HUMAC displays a diamond cursor with the current toque value. From the Dashboard, you can select **Freeze display if outside target**. When selected the cursor turns red and the timer stops if the patient torque is not within the target area.

Figure 1-51 Isometric In Target

Figure 1-52 Isometric Out of Target

Dynamometer Settings

At the bottom of the feedback display are the dynamometer settings which can be adjusted.

Note:

1. *Changes made from the feedback display are not copied back to the original settings.*
2. *The Dynamometer Settings can only be changed when working from the Dashboard. Changing the settings during testing or exercise would result in inconsistent test results.*

Set ROM Limits (All Modes)

The Set ROM Limits area is used to change the ROM limits during Exercise and Testing.

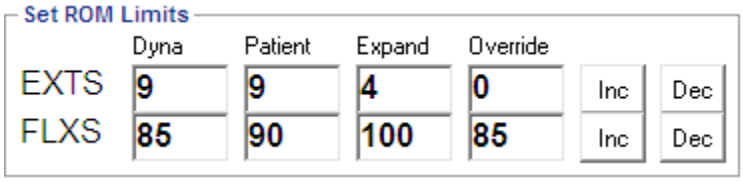


Figure 1-53 Feedback Display: ROM Limit Settings

Settings

Settings	Description
Dyna	The current software ROM limits set on the dynamometer. In this case, the input adapter will move from 85 degrees of flexion to 9 degrees of extension.
Patient	The ROM the patient was able to reach when the software stops were set. **Error! Reference source not found.**
Expand	The Expand ROM values set by the therapist. Figure 1-42.
Override	The ROM override limits set by the therapist in the protocol. Figure 1-23

Actions

Action	Description
Inc	Increase the ROM limit. Note: The Inc button expands the ROM limits so the patient moves though a larger ROM. For the EXT stop the displayed value would decrease, e.g. to –3 or –4. For the FLX stop, the value would increase, e.g. 87 or 88. ***Note:*** *When increasing the ROM, the limits are checked in the following order: Override, Expand, Patient. If an Override value exists, the ROM is limited to that value. If no Override is specified but an Expand exists, the ROM is limited to that value. If no Override or Expand is specified, the ROM is limited to the Patient value.*
Dec	Decrease the ROM limit. Note: The Dec button reduces the ROM limits so the patient moves though a smaller ROM. For the EXT stop the displayed value would increase, e.g. to –1 or 0. For the FLX stop, the value would decrease, e.g. 85 or 84.

Speed (Isokinetic, CPM)

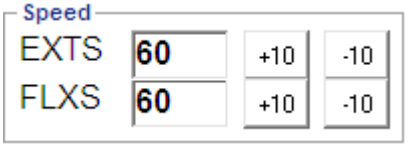


Figure 1-54 Feedback Display: Speed Settings

Actions

Action	Description
+10 (+1)	Increase the speed by 10 deg/sec for rotary patterns. (1 inch/sec for linear patterns.)
-10 (-1)	Decrease the speed by 10 deg/sec for rotary patterns. (1 inch/sec for linear patterns.)

Torque (Isotonic)

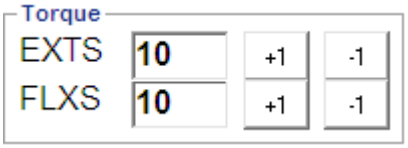


Figure 1-55 Feedback Display: Torque Settings

Actions

Action	Description
+1	Increase the torque 1 ft-lbs for rotary patterns. (1 lb for linear patterns.)
-1	Decrease the torque 1 ft-lbs for rotary patterns. (1 lb for linear patterns.)

Pause (CPM)

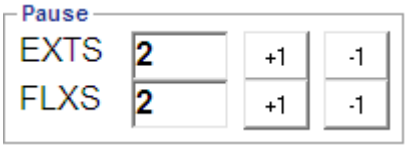


Figure 1-56 Feedback Display: Pause Settings

Actions

Action	Description
+1	Increase the pause by 1 sec.
-1	Decrease the pause by 1 sec.

Angle (Isometric, Isotonic)

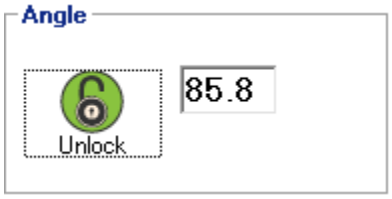


Figure 1-57 Feedback Display: Angle Settings

Actions

Action	Description
Lock	Switch the dynamometer to Isometric mode.
Unlock	Switch the dynamometer to Isokinetic mode to re-position the limb. The current position is displayed next to the Lock icon.

Note: *In Isotonic mode, you can use the Lock/Unlock button to re-position the input adapter at either end of the ROM. This allows you to work the Agonist muscle group, click the Unlock button, position the adapter at the other end of the patient's ROM, click the Lock button and work the Antagonist group.*

Feedback Display: Curves/Bars

You can change the feedback display directly from the real-time feedback screen. To change the display:

1. Select an option from the **Feedback Display** list.

Note: *When changing displays, the HUMAC erases the previous display and begins drawing the new display with the current real-timed data. All data from the start of the test is saved.*

Figure 1-58 Feedback Display: Select Curves/Bars

SECTION 2.SPECIAL TEST MODES

Interrupted Stroke

Interrupted Stroke mode allows the therapists to individually test and select single Extension and Flexion motions. In Interrupted Stroke mode, the patient is asked to do one Extension or one Flexion. At the conclusion of each "stroke" the therapist can review the data and decide if the data should be included in the final report. To perform an Interrupted stroke test:

1. From the **Protocol Editor**, select **Isokinetic** mode, **Interrupted Stroke**.

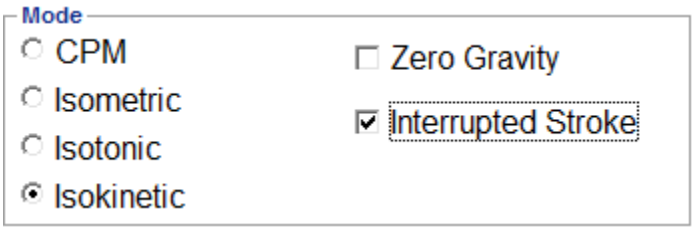


Figure 2-1 Interrupted Stroke Protocol

2. Set the **Repetitions** for the number of valid repetitions you want to select, e.g. 3 if you want to select 3 repetitions. The HUMAC allows the patient to perform up to 10 repetitions.
3. During the test, the HUMAC displays the following screen:

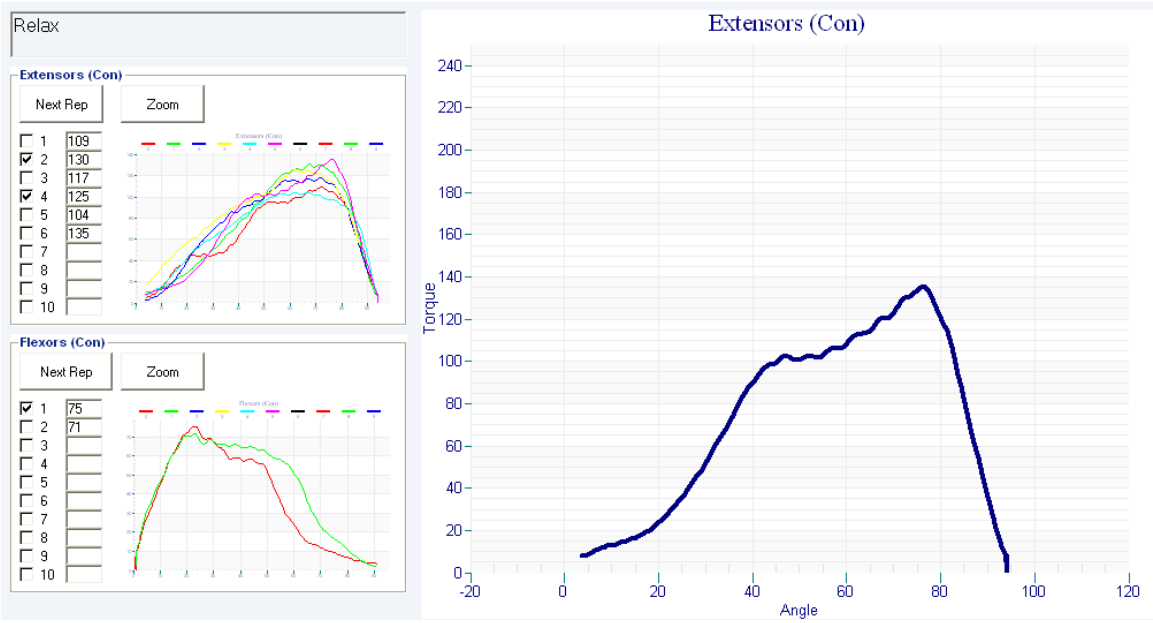


Figure 2-2 Interrupted Stroke Feedback Display

Items	Description
Instructions	Instructions to the patient, e.g. "Relax", "Move to Full Flexion".
Next Rep	Perform another repetition for the indicated motion.
Zoom	Zoom-in the repetitions performed. (Figure 2-3)

Items	Description
1, 2, 3	Select the repetitions you want to accept.
Large Display	Patient feedback.

4. To perform an Extension, in the **Entensors (Con)** area, click the **Next Rep** button. The HUMAC will instruct the patient to move to Full Flextion.
5. Have the patient perform a single Extension. The HUMAC will graph the real-time feedback in the large **Extensors (Con)** area.
6. When the repetition is completed, the HUMAC will copy the data to the smaller **Extensors (Con)** area and display the peak torque next to the Repetition number.
7. To select the repetition for inclusion in the report, check the box next to the repetition number.
8. Click the **Zoom** button to expand the view of the repetitions. Figure 2-3.

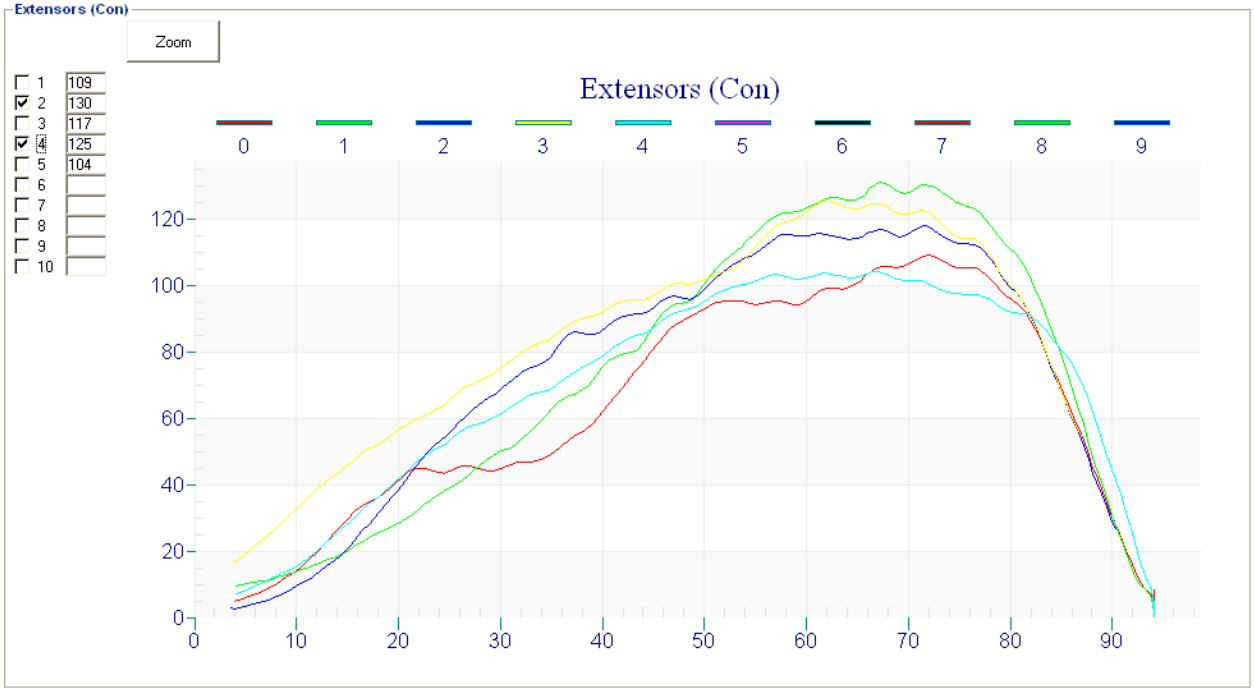


Figure 2-3 Interrupted Stroke, Zoom Display

9. From the expanded display, click the **Zoom** button to return to the main display.
10. When all repetitions have been selected, click the **Exit** button to end the set.

Sub-Maximal Isometric Testing

The Sub-Maximal Isometric Testing allows you to have the patient perform a Maximal Voluntary Contraction (MVC) and then provide feedback targets at a percentage of the MVC. This is often used by researchers who want to study the EMG activity level during sub-maximal contractions. To perform a Sub-Maximal Isometric Contraction test.

Note: *You cannot mix Con/Ecc and Ecc/Con sets with this feature.*

1. From the **Feedback** screen, in the **Isometric Targets** area, select **Enabled** and set the **Min** and **Max** values. In this example, the targets will be set to 40% and 60% of the patient's MVC.

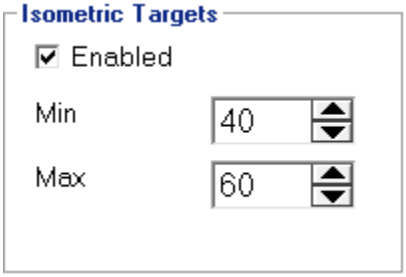


Figure 2-4 Isometric Targets

2. You can set different Isometric Targets for each set, for example:

Set	Min	Max
1	0	20
2	20	40
3	40	60
4	60	80
5	80	100

3. Before the first set, the HUMAC will have the patient perform a Maximum Voluntary Contraction. This will be used when scaling the targets.

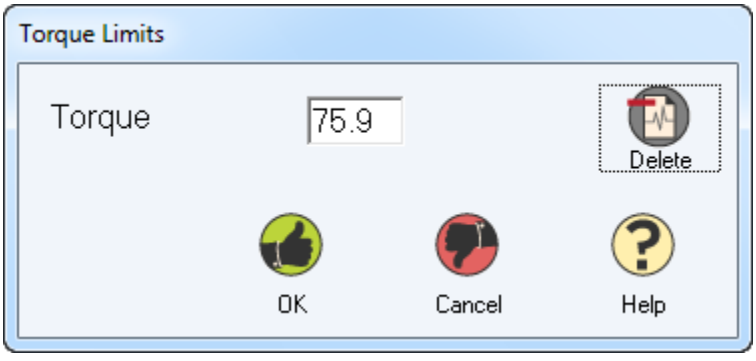
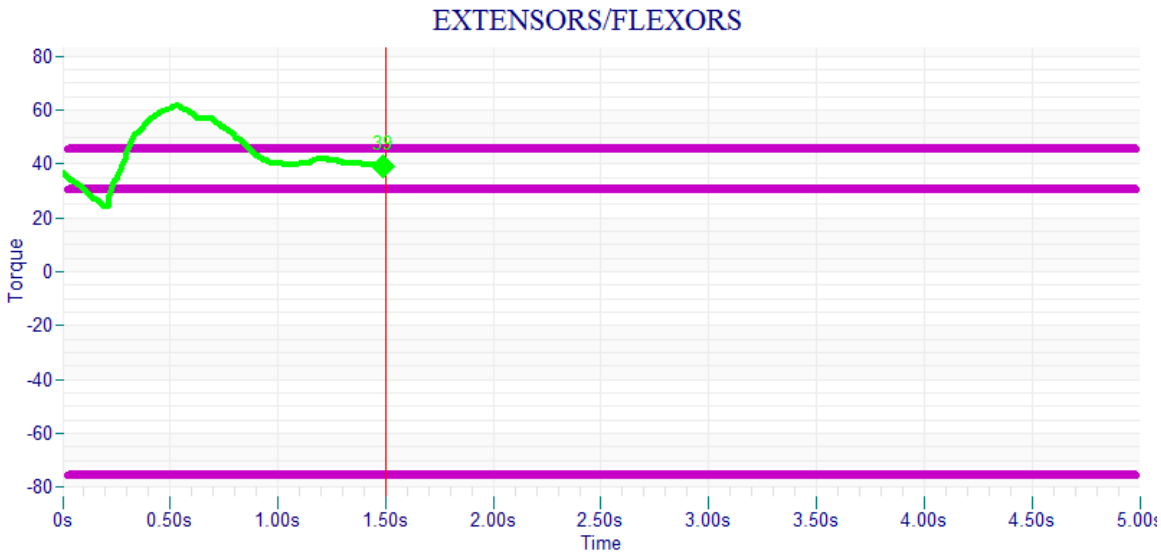


Figure 2-5 Read Torque Limits

4. During the feedback, the HUMAC will display the targets in this case 30.28 (75.5 *0.4) and 45.42 (75.7 * .6).


EXTENSORS/FLEXORS
80
60
40
20
0
-20
-40
-60
-80
Torque
30
0s
0.50s
1.00s
1.50s
2.00s
2.50s
3.00s
3.50s
4.00s
4.50s
5.00s
Time

Feedback Display – Roadway

The Roadway Display allows the user to create custom paths for the patient to trace.

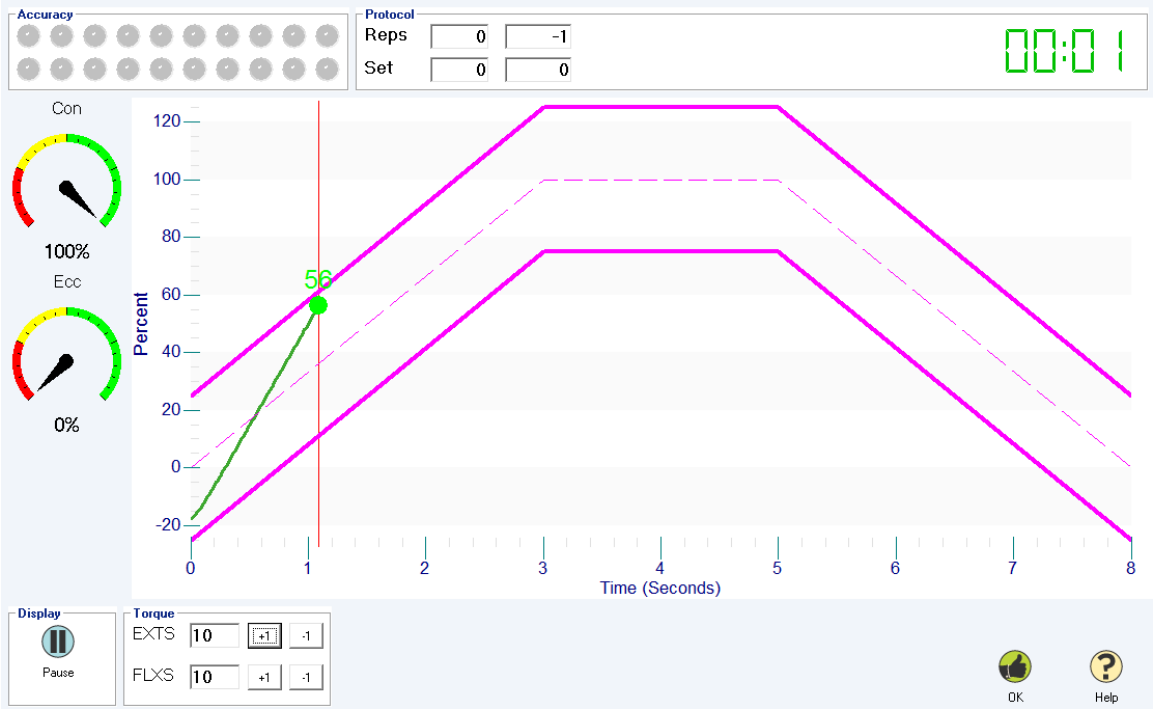


Figure 2-6 Feedback Display – Roadway

The goal is for the patient to keep the round cursor between the roadway boundaries. (on-target).

In Isotonic mode, the ball position corresponds to the patient's limb position. The Y-Axis displays the percent of the patient's total ROM.

In Isometric mode, the ball position corresponds to the patient's torque production. The Y-Axis display the percent of the patient's Maximum Voluntary Contraction (MVC).

A green ball color indicates the patient is on-target, a red ball color indicates they are not on-target. The Score dials indicate the percent of time the patient was on-target during the Concentric and Eccentric phases of the exercise.

The display shows the target in Magenta, the current repetition in yellow and the previous 9 repetitions in gray.

The HUMAC Dashboard allows you to set an Accuracy Target for the patient. The Accuracy allows you to set a target (Percent they were within the Roadway Limits for the Concentric and Eccentric motions. The Accuracy display shows a green light for each repetition the patient achieved the Accuracy Target and a Red light for each repetition the patient did not achieve the Accuracy target.

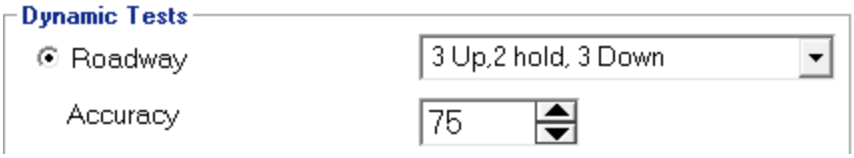


Figure 2-7 Roadway: Accuracy Setting

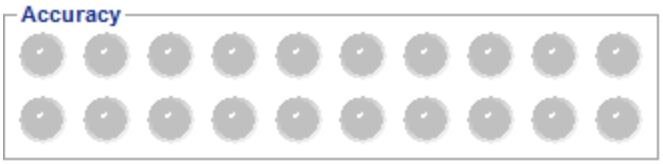


Figure 2-8 Roadway: Accuracy Display

Options

The following options can be set from the Feedback Options screen.

Items	Description
Protocol	The path for the patient to follow.
Level	The width (1: Easiest to 10: Hardest) of the roadway.

Actions

Items	Description
Start	Start the display moving at the first repetition.
Pause	Pause the display timer. The Patient effort will continue to be updated. ***Note:*** *Pressing Pause again will re-start the display from the current position. Clicking Start will re-start the display at the first repetition. Pause allows the therapist to pause the display and give the patient further instructions before continuing.*
Torque	The dynamometer torque settings in Isotonic mode.
OK	Exit the display.

Feedback Display – Pacing Bar

The Roadway Display allows the user to create custom paths for the patient to trace.

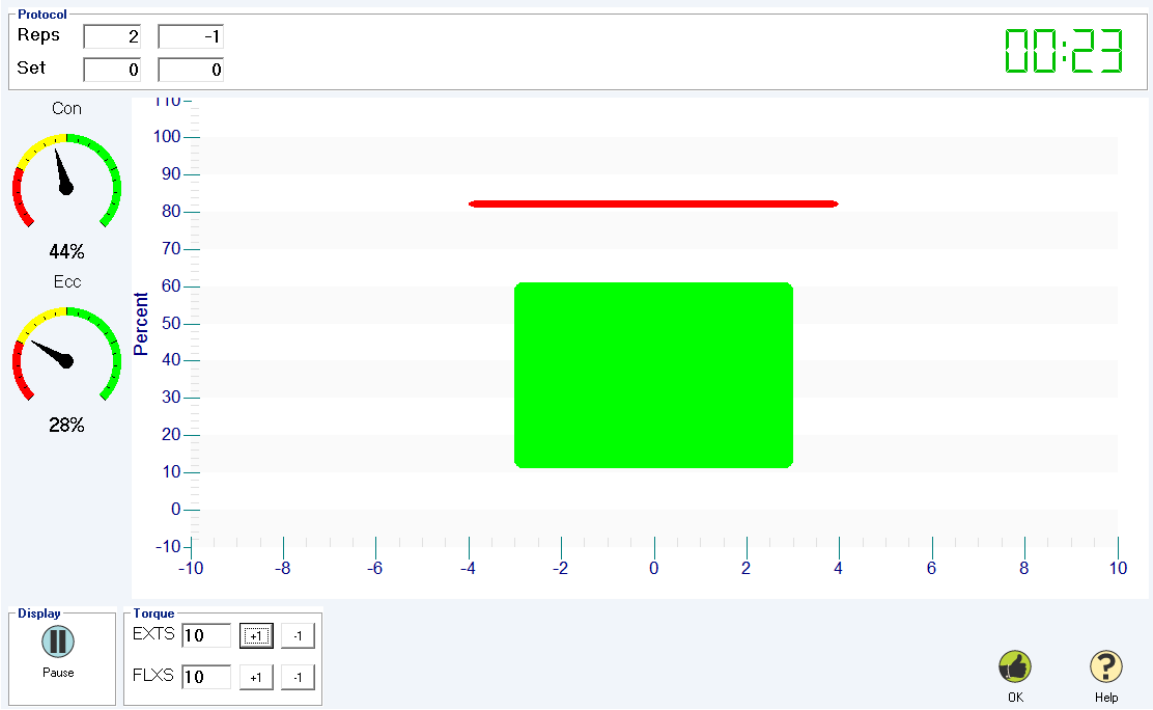


Figure 2-9 Feedback Display – Pacing Bar

The goal is for the patient to keep the blue cursor on the green/red target (on-target).

In Isotonic mode, the blue cursor corresponds to the patient's limb position. The Y-Axis displays the percent of the patient's total ROM.

In Isometric mode, the blue cursor corresponds to the patient's torque production. The Y-Axis display the percent of the patient's Maximum Voluntary Contraction (MVC).

A green target color indicates the patient is on-target, a target color indicates they are not on-target. The Score dials indicate the percent of time the patient was on-target during the Concentric and Eccentric phases of the exercise.

Note: *The target turns yellow one second before it begins moving.*

Options

The following options can be set from the Feedback Options screen.

Items	Description
Protocol	The pace for the target to move.
Level	The height (1: Easiest to 10: Hardest) of the target.

Actions

Items	Description
Start	Start the display moving at the first repetition.
Pause	Pause the display timer. The Patient effort will continue to be updated. ***Note:*** *Pressing Pause again will re-start the display from the current position. Clicking Start will re-start the display at the first repetition. Pause allows the therapist to pause the display and give the patient further instructions before continuing.*
Torque	The dynamometer torque settings in Isotonic mode.
OK	Exit the display.

Feedback Display – Response Time Test

The Response Time Test allows the user to create moving targets for the patient to respond to.

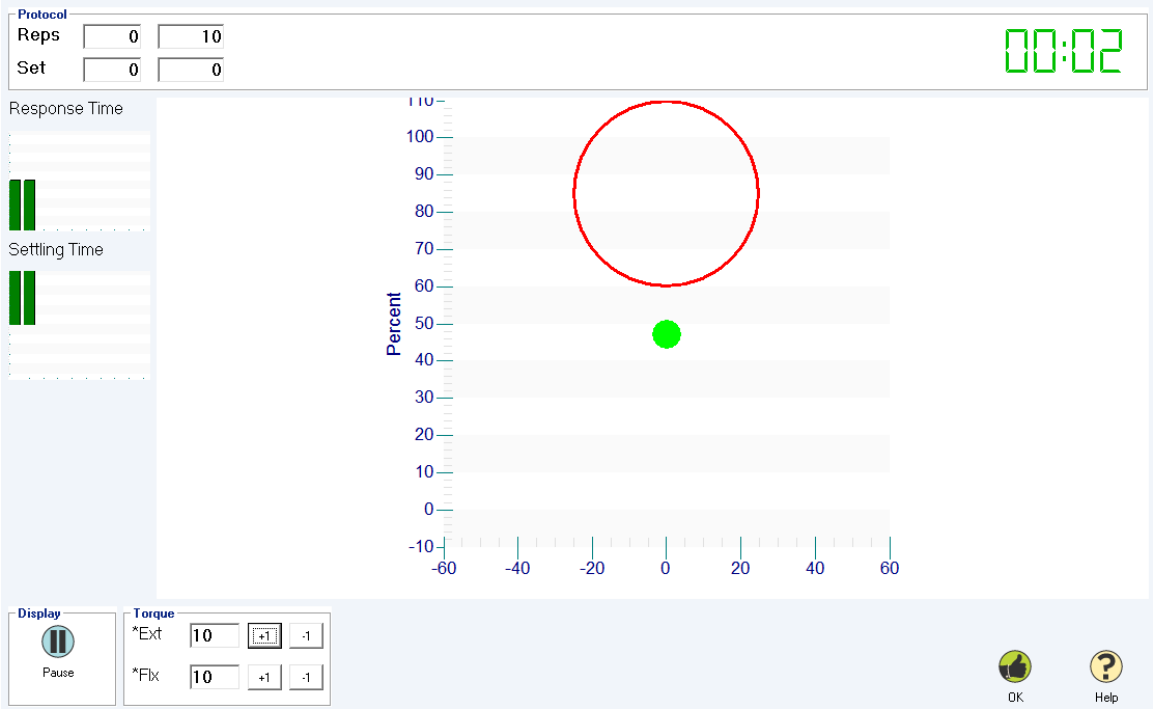


Figure 2-10 Feedback Display – Response Time

The goal is for the patient to move the dot inside the circle.

In Isotonic mode, the dot position corresponds to the patient's limb position. The Y-Axis displays the percent of the patient's total ROM.

In Isometric mode, the dot position corresponds to the patient's torque production. The Y-Axis display the percent of the patient's Maximum Voluntary Contraction (MVC).

A green ball color indicates the patient is on-target, a red ball color indicates they are not on-target.

A green target color indicates the patient has successfully moved into the target for the settle time.

A red target indicates the patient should move into the target. If they are in the target and it is still red, then they have not reached the Settle Time yet.

The Response Time and Settle Time plots show how quickly the patient responded after the target was moved and how long it to them to reach the target after which they maintained the target position for the Settle Time.

Options

The following options can be set from the Feedback Options screen.

Items	Description
Protocol	The path for the patient to follow.
Level	The diameter (1: Easiest to 10: Hardest) of the target circle.

Actions

Items	Description
Start	Start the display moving at the first repetition.
Pause	Pause the display timer. The Patient effort will continue to be updated. ***Note:*** *Pressing Pause again will re-start the display from the current position. Clicking Start will re-start the display at the first repetition. Pause allows the therapist to pause the display and give the patient further instructions before continuing.*
Torque	The dynamometer torque settings in Isotonic mode.
OK	Exit the display.

Feedback Display –Interactive Line

The Interactive Line Feedback Display allows the user to create custom paths for the patient to follow.

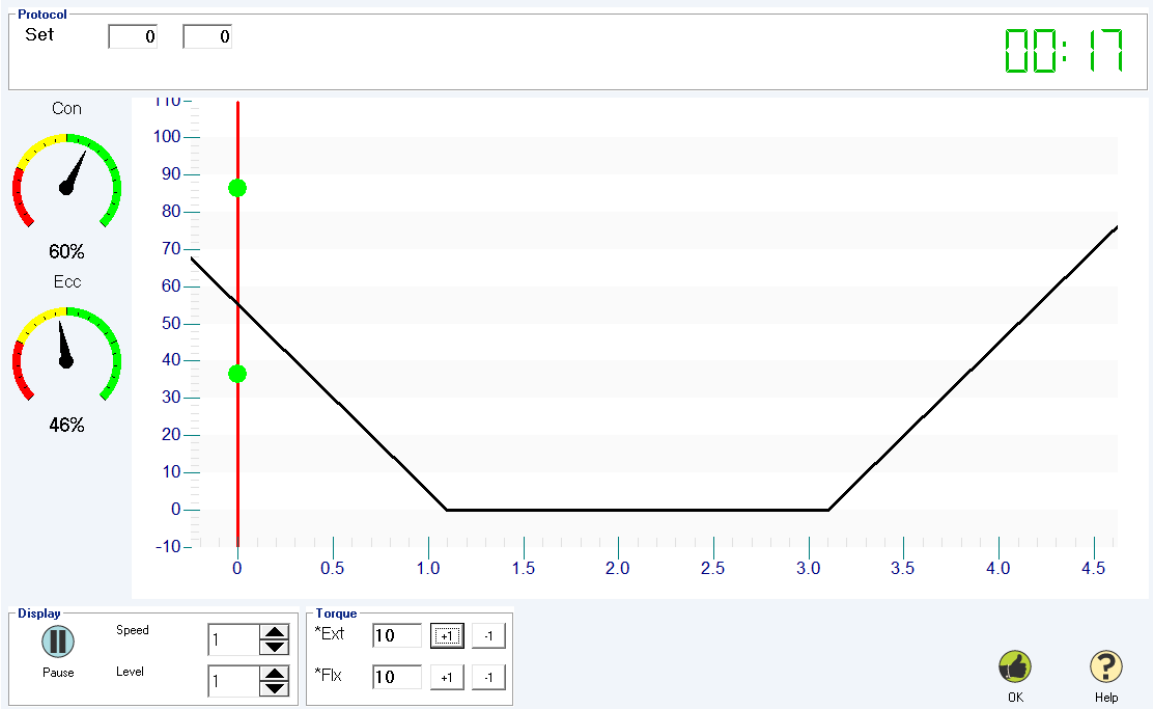


Figure 2-11 Feedback Display - Interactive Line

The goal is for the patient to keep the two balls around the line (on-target).

In Isotonic mode, the ball position corresponds to the patient's limb position. The X-Axis displays the percent of the patient's total ROM.

In Isometric mode, the ball position corresponds to the patient's torque production. The X-Axis display the percent of the patient's Maximum Voluntary Contraction (MVC).

A green ball color indicates the patient is on-target, a red ball color indicates they are not on-target. The Score dials indicate the percent of time the patient was on-target during the Concentric and Eccentric phases of the exercise.

The displayed time is shown in the MM:SS format.

Options

The following options can be set from the Feedback Options screen.

Options	Description
Protocol	The path for the patient to follow.
Level	The spacing (1: Easiest to 10: Hardest) of the balls.
Speed	The speed at which the display scrolls down the screen.

Actions

Actions	Description
Start	Start the display moving at the first repetition.
Pause	Pause the display timer. The Patient effort will continue to be updated. ***Note:*** *Pressing Pause again will re-start the display from the current position. Clicking Start will re-start the display at the first repetition. Pause allows the therapist to pause the display and give the patient further instructions before continuing.*
Level	The spacing (1: Easiest to 10: Hardest) of the balls.
Speed	The speed at which the display scrolls across the screen.
Torque	The dynamometer torque settings in Isotonic mode.
Help	Display the Help topic.
OK	Exit the display.

Feedback Display – Proprioception

The Proprioception Feedback Display allows the user to create custom proprioception challenges for the patient.

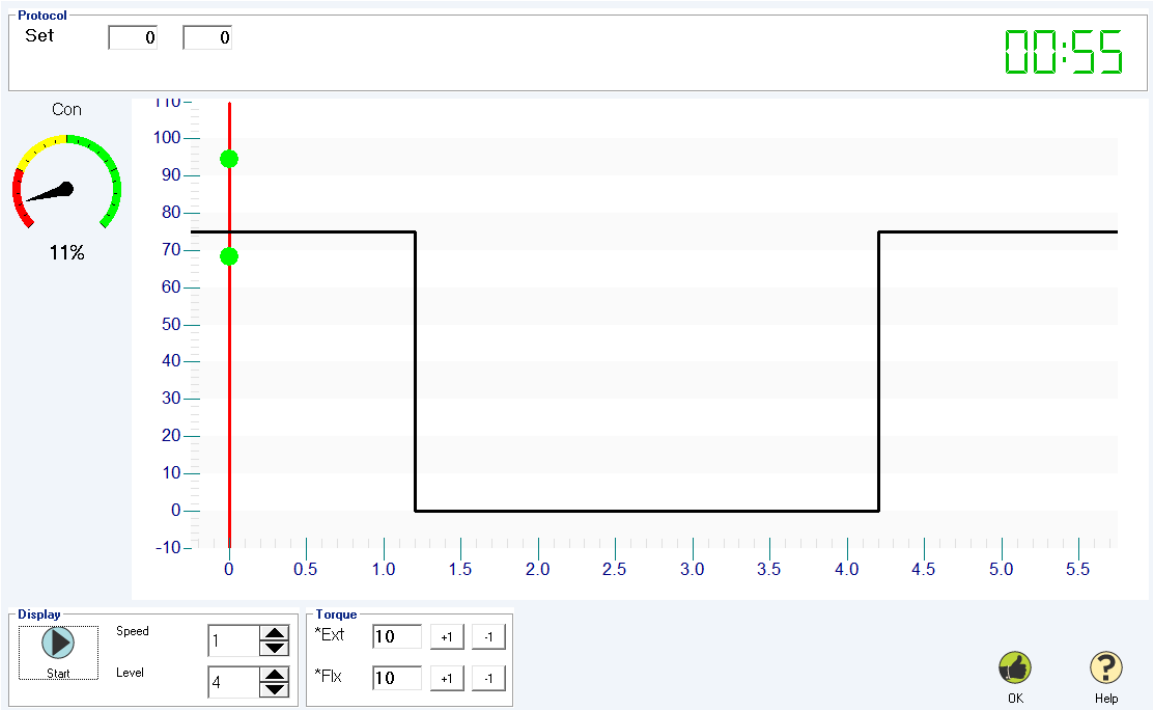


Figure 2-12 Feedback Display - Proprioception

The goal is for the patient to keep the two balls around the line (on-target).

In Isotonic mode, the ball position corresponds to the patient's limb position. The X-Axis displays the percent of the patient's total ROM.

In Isometric mode, the ball position corresponds to the patient's torque production. The X-Axis display the percent of the patient's Maximum Voluntary Contraction (MVC).

A green ball color indicates the patient is on-target, a red ball color indicates they are not on-target. The Score dials indicate the percent of time the patient was on-target during the Concentric and Eccentric phases of the exercise.

The displayed time is shown in the MM:SS format.

Note: *The above display has a Target of 75% of the patient's ROM.*

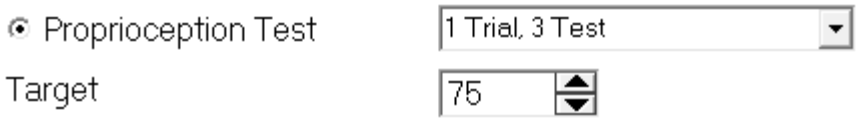


Figure 2-13 Proprioception Target

Options

The following options can be set from the Feedback Options screen.

Options	Description
Protocol	The path for the patient to follow.
Level	The spacing (1: Easiest to 10: Hardest) of the balls.
Speed	The speed at which the display scrolls down the screen.

Actions

Actions	Description
Start	Start the display moving at the first repetition.
Pause	Pause the display timer. The Patient effort will continue to be updated. ***Note:*** *Pressing Pause again will re-start the display from the current position. Clicking Start will re-start the display at the first repetition. Pause allows the therapist to pause the display and give the patient further instructions before continuing.*
Level	The spacing (1: Easiest to 10: Hardest) of the balls.
Speed	The speed at which the display scrolls down the screen.
Torque	The dynamometer torque settings in Isotonic mode.
OK	Exit the display.

Feedback Display – Interactive Scrolling Path

The Interactive Line Feedback Display allows the user to create custom paths for the patient to trace.

Figure 2-14 Feedback Display - Interactive Path

The goal is for the patient to keep the balls inside the blue path.

In Isotonic mode, the ball position corresponds to the patient's limb position. The X-Axis displays the percent of the patient's total ROM.

In Isometric mode, the ball position corresponds to the patient's torque production. The X-Axis display the percent of the patient's Maximum Voluntary Contraction (MVC).

A green ball color indicates the patient is on-target, a red ball color indicates they are not on-target. The Score dials indicate the percent of time the patient was on-target during the Concentric and Eccentric phases of the exercise.

The displayed time is shown in the MM:SS format.

Options

The following options can be set from the Feedback Options screen.

Options	Description
Protocol	The path for the patient to follow.
Speed	The speed at which the display scrolls down the screen.

Actions

Actions	Description
Start	Start the display moving at the first repetition.
Pause	Pause the display timer. The Patient effort will continue to be updated. ***Note:*** *Pressing Pause again will re-start the display from the current position. Clicking Start will re-start the display at the first repetition. Pause allows the therapist to pause the display and give the patient further instructions before continuing.*
Speed	The speed at which the display scrolls down the screen.
Torque	The dynamometer torque settings in Isotonic mode.
Help	Display the Help topic.
OK	Exit the display.

Feedback Display – Pong

The Pong Feedback Display allows the patient to play interactive challenges with the HUMAC.

Figure 2-15 Feedback Display - Interactive Pong

The goal is for the patient to keep hitting the balls causing the computer to miss. In Isotonic mode, the patients paddle position corresponds to the patient's limb position. In Isometric mode, the paddle position corresponds to the patient's torque production.

Options

The following options can be set from the Feedback Options screen.

Options	Description
Torque	In Isometric Mode the torque required to move the paddle fully across the screen.
Ball Speed	The initial speed of each ball as the game begins.
Ball Accel	The ball acceleration each time it strikes a paddle. Setting the Accel to 0 keeps the ball at a constant speed during the game.
Ball Size	The ball diameter.
Nbr Balls	The number of balls per game.
Ball Rest	The rest period in seconds before the next ball is launched.
Paddle Size	The patient's paddle height.
Computer Skill	The percent of the screen which the computer uses to track an approaching ball. At 100%, the computer paddle starts moving toward the ball immediately. At 50%, the computer paddle starts moving toward the ball when it is ½ of the way toward the computer's paddle.

Actions

Actions	Description
Start	Start the game.
OK	Exit the display.

Feedback Display – Breakout

The Breakout Feedback Display allows the patient to play interactive challenges with the HUMAC.

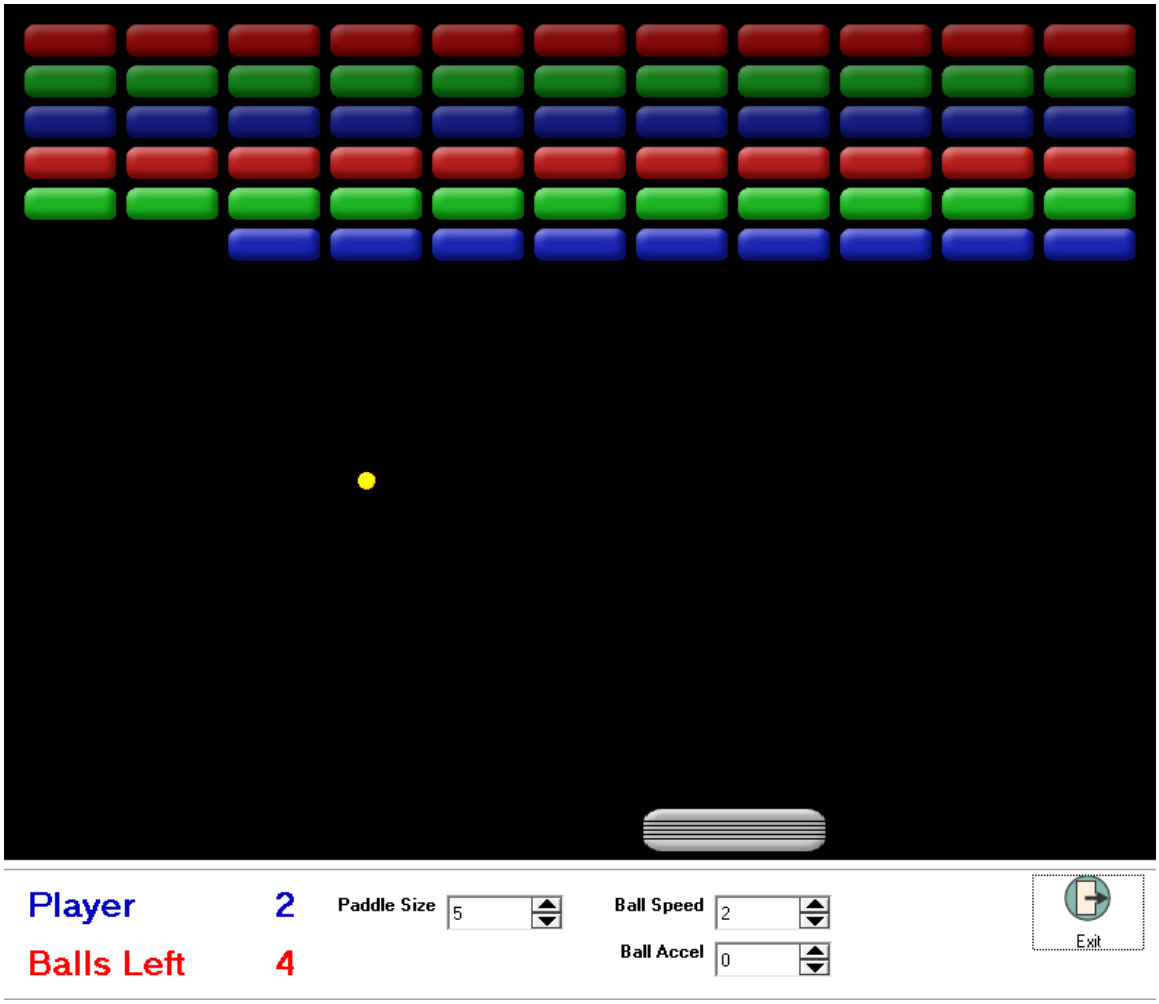


Figure 2-16 Feedback Display - Interactive Breakout

The goal is for the patient to keep hitting the balls breaking the blocks at the top of the display. In Isotonic mode, the patients paddle position corresponds to the patient's limb position. In Isometric mode, the paddle position corresponds to the patient's torque production.

Options

The following options can be set from the Feedback Options screen.

Options	Description
Torque	In Isometric Mode the torque required to move the paddle fully across the screen.
Ball Speed	The initial speed of each ball as the game begins.
Ball Accel	The ball acceleration each time it strikes a paddle. Setting the Accel to 0 keeps the ball at a constant speed during the game.
Ball Size	The ball diameter.
Nbr Balls	The number of balls per game.

Options	Description
Ball Rest	The rest period in seconds before the next ball is launched.
Paddle Size	The patient's paddle width.

Actions

Actions	Description
Start	Start the game.
OK	Exit the display.

Rest Period

At the conclusion of a test or exercise bout the HUMAC displays a count-down timer for the rest period. The timer switches to yellow when the time reaches five seconds.

Options

Options	Value	Description
Clock	Checked	Display as a round count-down clock.
Progress	Cleared	Display as a progress bar. (Allows user to see more of the feedback display screen).
Center	Checked	Automatically center the clock on the screen.
Center	Cleared	Allow the user to re-position the clock on the screen. The HUMAC remembers the clock position the next time it is displayed.
Resize	Any	You can re-size the clock screen by dragging the lower-right-hand corner. The HUMAC remembers the clock size the next time it is displayed.

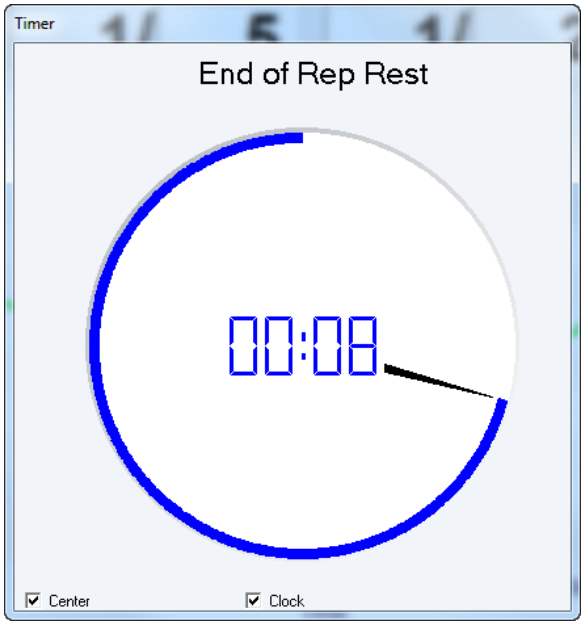


Figure 2-17 Count-Down Clock

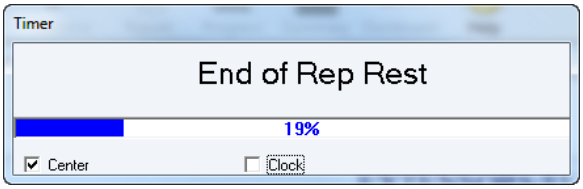


Figure 2-18 Count-Down Progress

SECTION 3.REPORTING

Single Test Report

The HUMAC provides a number of test and exercise reports.

Figure 3-1 Single Test Report Screen

Report Types

The HUMAC provides a number of test and exercise reports.

Report	Description
Short Torque vs. Time	Single Page report with Torque vs. Time plots and most commonly measured parameters.
Short Torque vs. Position	Single Page report with Torque vs. Position plots and most commonly measured parameters.
Long Torque vs. Time	Multi-Page report with Torque vs. Time plots and all measured parameters.
Long Torque vs. Position	Multi-Page report with Torque vs. Position plots and all measured parameters.
Graphic Summary	Multi-Page report with Bar Plot of Torque, Work and Power value and Fatigue Plots.
Curve Overlay	Single page report with Torque vs. Position plots and Torque values at user-selected angles.

Report	Description
Torque Repeatability	Single page report with Torque vs. Position curve overlay and comparison measured parameters for the initial and final set in a protocol.
Narrative Report	Select the side for the Multi-Session report.
Multi-Session Report	Multi-Page report with Torque and Work plots and Torque, Work, Power and ROM values across multiple test sessions. ***Note:*** *The Multi-session report can combine up to 15 sessions in a single report. Use the Windows Multi-selection options (Shift & Control) to select the sessions for the report.*
Reps Torque vs. Time	Multi-Page report with Torque vs. Time plots and Torque, Work, Power and ROM values for each repetition.
Reps Torque vs. Position	Multi-Page report with Torque vs. Position plots and all measured parameters.
Interactive Feedback	Multi-Page report with Position (Isotonic) or Torque (Isometric) vs. Target plots and all measured Interactive values.
Isometric	Multi-Page report with Torque vs. Time plots and all measured isometric parameters.
Proprioception	Multi-Page report with Position (Isotonic) or Torque (Isometric) vs. Target plots and all measured Proprioception values.
Response Time	Multi-Page report with Position (Isotonic) or Torque (Isometric) vs. Target plots and plots of Response Time and Settle Time values.
Coordination	Multi-Page report with Position (Isotonic) or Torque (Isometric) vs. Target plots and all measured Coordination values.
Endurance Capacity	Multi-Page report with Force vs. Position plots and all measured Endurance values.
Exercise	Single page report with Torque and Work values.

Actions

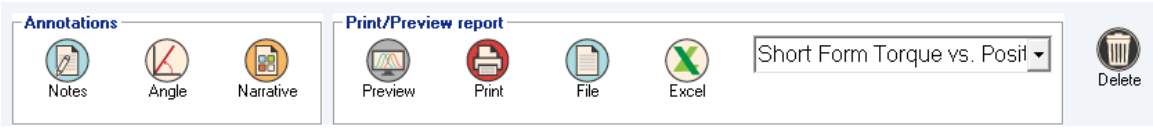


Figure 3-2 Single Report: Actions

Actions	Description
Notes	Enter text notes which are displayed on the Long Report.
Angle	Select angles for the Curve Overlay Report.
Narrative	Select Modalities and Goals to be included on the Narrative Report.
Preview	Preview the selected report on the screen.
Print	Send the selected report to the printer.
File	Save the selected report to a disk file.
Excel	Export the computed results to an Excel spreadsheet.
Type	Select the type of report to generate.
Delete	Delete the selected test from the database.

Options

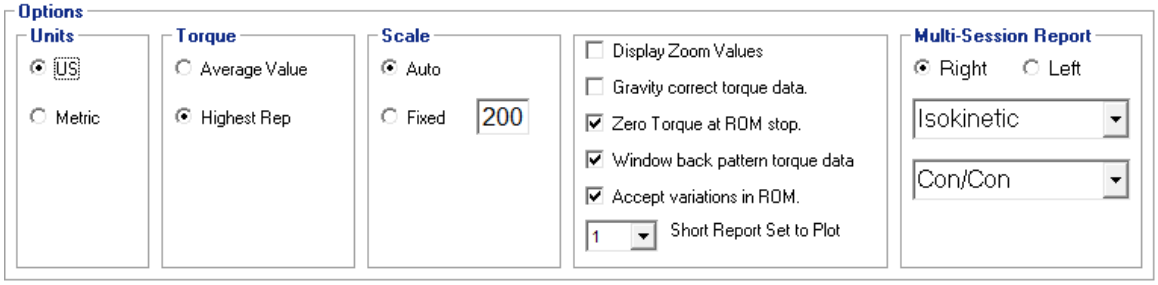


Figure 3-3 Report: Options

The **Options** section allows you to change how the data is processed and reported for the selected test. (See the PREFERENCES section for a complete description of the report options.)

Note: *Changes to the* ***options*** *only apply to the current report being generated and do not affect the* ***Preferences****. Use the* ***File, Preferences*** *command to set the default report options.*

Multi-Session Options

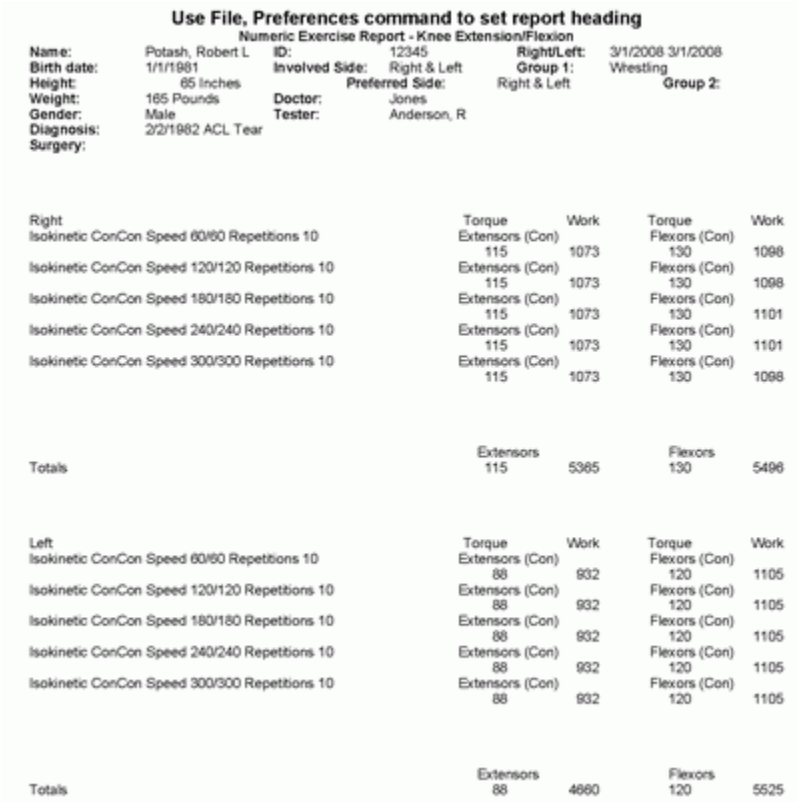
Options	Description
Right/Left	Report the data for the Right or Left side.
Mode	Report data for sets with the selected Mode.
Action	Report data for sets with the selected Action.

Exercise Report

The **Exercise Report** shows the numeric results and for exercise sessions.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **Exercise protocol**.
4. From the **Print/Preview** area, select **Exercise** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.



Use File, Preferences command to set report heading

Numeric Exercise Report - Knee Extension/Flexion

Name:	Potash, Robert L	**ID:**	12345	**Right/Left:**	3/1/2008 3/1/2008
Birth date:	1/1/1981	**Involved Side:**	Right & Left	**Group 1:**	Wrestling
Height:	65 Inches	**Preferred Side:**	Right & Left	**Group 2:**	
Weight:	165 Pounds	**Doctor:**	Jones		
Gender:	Male	**Tester:**	Anderson, R		
Diagnosis:	2/2/1982 ACL Tear				
Surgery:					

Right	Torque Extensors (Con)	Work	Torque Flexors (Con)	Work
Isokinetic ConCon Speed 60/60 Repetitions 10	115	1073	130	1098
Isokinetic ConCon Speed 120/120 Repetitions 10	115	1073	130	1098
Isokinetic ConCon Speed 180/180 Repetitions 10	115	1073	130	1101
Isokinetic ConCon Speed 240/240 Repetitions 10	115	1073	130	1101
Isokinetic ConCon Speed 300/300 Repetitions 10	115	1073	130	1098
	Extensors		Flexors	
Totals	115	5365	130	5496

Left	Torque Extensors (Con)	Work	Torque Flexors (Con)	Work
Isokinetic ConCon Speed 60/60 Repetitions 10	88	932	120	1105
Isokinetic ConCon Speed 120/120 Repetitions 10	88	932	120	1105
Isokinetic ConCon Speed 180/180 Repetitions 10	88	932	120	1105
Isokinetic ConCon Speed 240/240 Repetitions 10	88	932	120	1105
Isokinetic ConCon Speed 300/300 Repetitions 10	88	932	120	1105
	Extensors		Flexors	
Totals	88	4660	120	5525

Figure 3-4 Report: Exercise

Short Torque vs. Time Report

The **Short (Trq vs. Time) Report** provides a single page report showing the torque vs. time plots for the first set and the numeric results for the first three sets in the protocol.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Short (Trq vs. Time)** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

Note: *Use the* ***Long Torque vs. Time Report*** *for a full report of all measured parameters during every set.*

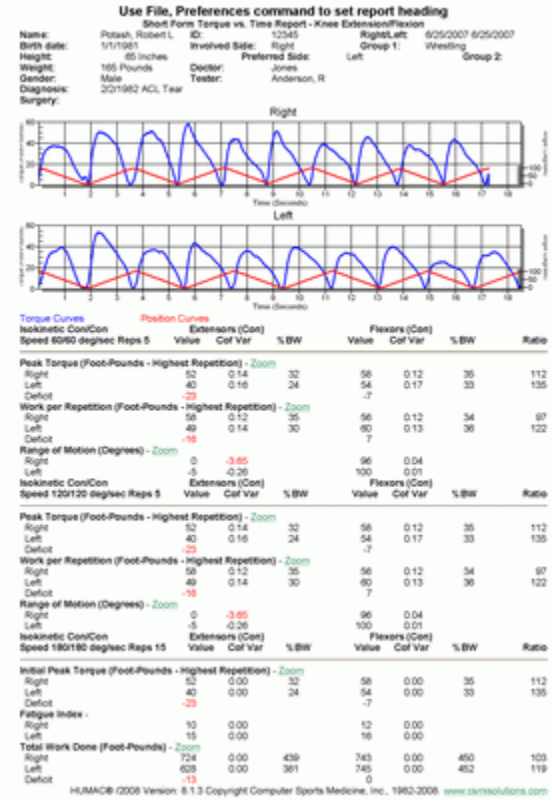


Figure 3-5 Report: Short Torque vs. Time

Short Torque vs. Position Report

The **Short (Trq vs. Pos) Report** provides a single page report showing the torque vs. position plots for the first set and the numeric results for the first three sets in the protocol.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview area**, select **Short (Trq vs. Pos)** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

Note: *Use the* ***Long Torque vs. Pos*** *Report for a full report of all measured parameters during every set.*

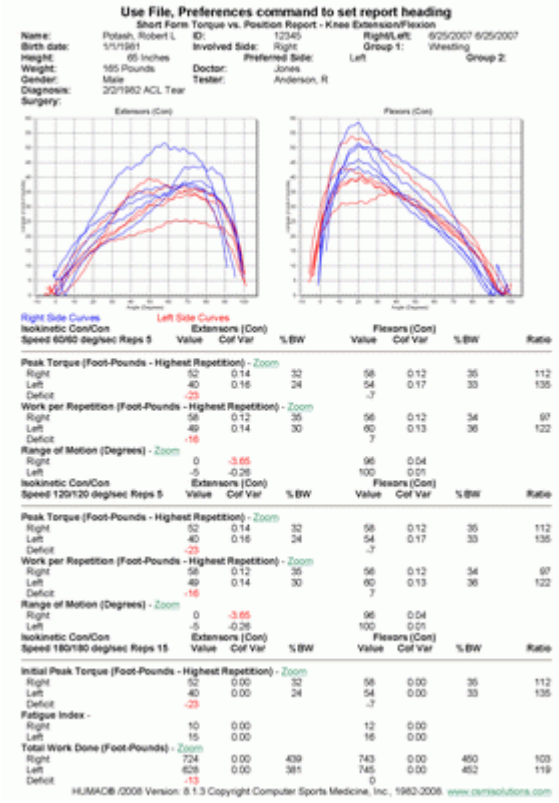


Figure 3-6 Report: Short Torque vs. Position

Long Torque vs. Time Report

The **Long (Trq vs. Time) Report** is a multi-page reports providing a torque vs. time plot and complete numeric results for each set in the protocol.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview area**, select **Long (Trq vs. Time)** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

Note: *Use the* ***Notes*** *button to add text notes which appear on the first page of the long report.*

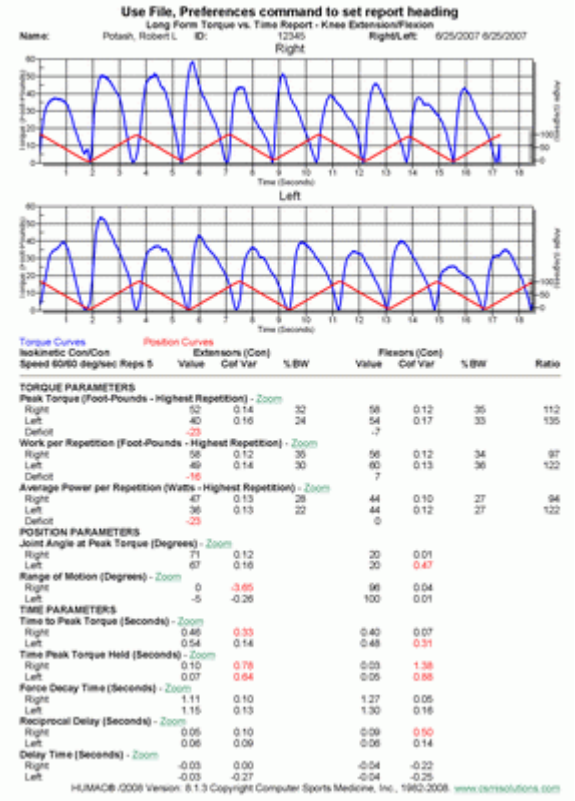


Figure 3-7 Report: Long Torque vs. Time

Long Torque vs. Position Report

The **Long (Trq vs. Pos) Report** is a multi-page reports providing a torque vs. position plot and complete numeric results for each set in the protocol.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview area**, select **Long (Trq vs. Pos)** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

Note: *Use the* ***Notes*** *button to add text notes which appear on the first page of the long report.*

Figure 3-8 Report: Long Torque vs. Position

Graphic Summary Report

The **Graphic Summary report** provides a single page report showing torque, work, and power bar plots for the first three sets in the protocol and fatigue plots for the final set in the protocol. The bar plot include the numeric values are displayed under the bars and the right/left side deficit at the top of the bars.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Graphic Summary** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

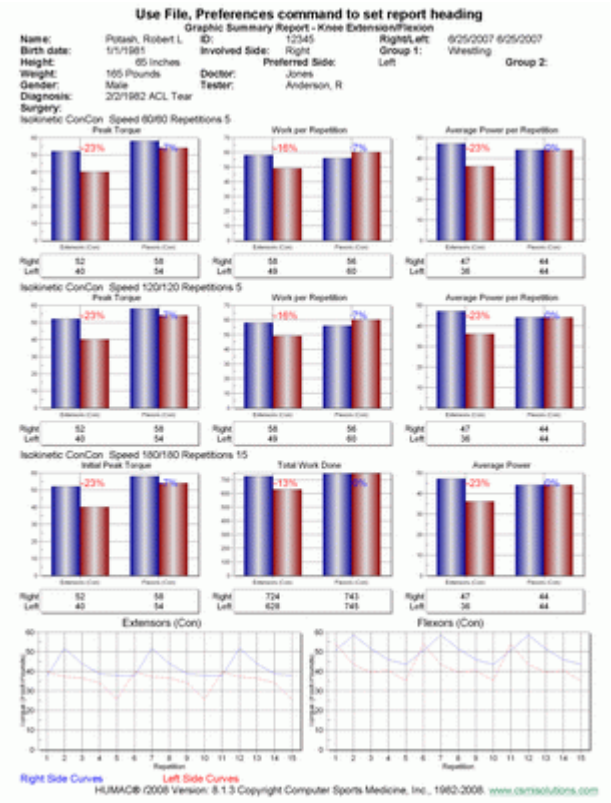


Figure 3-9 Report: Graphic Summary

Curve Overlay Report

The **Curve Overlay Report** overlays the right and left side torque vs. position data. You can select up to four angles for the HUMAC to report the torque data and right to left side deficit.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Curve Overlay** as the report type.
5. Click the **Angle** button to select the desired angles.
6. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

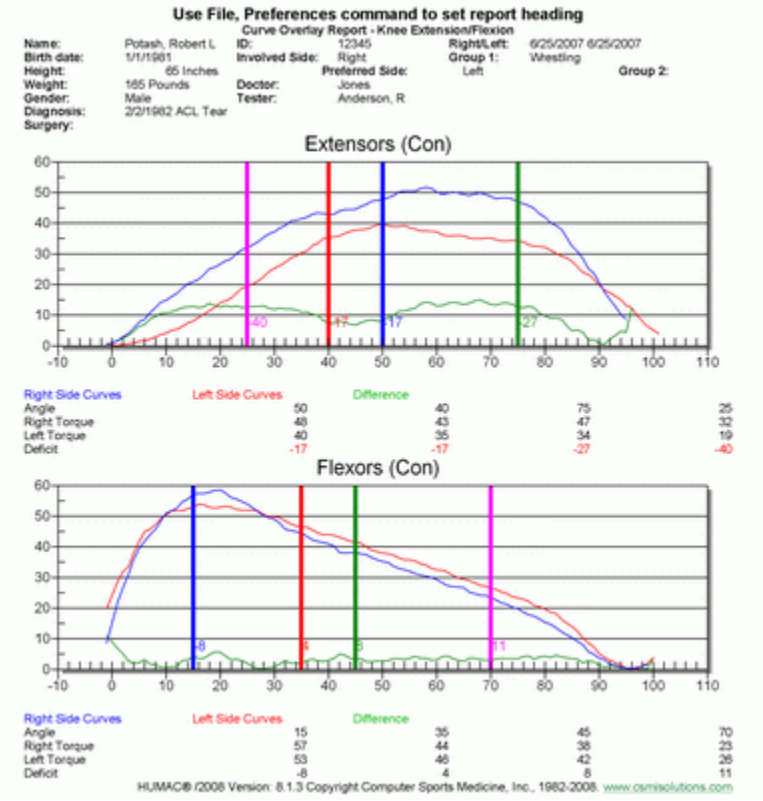


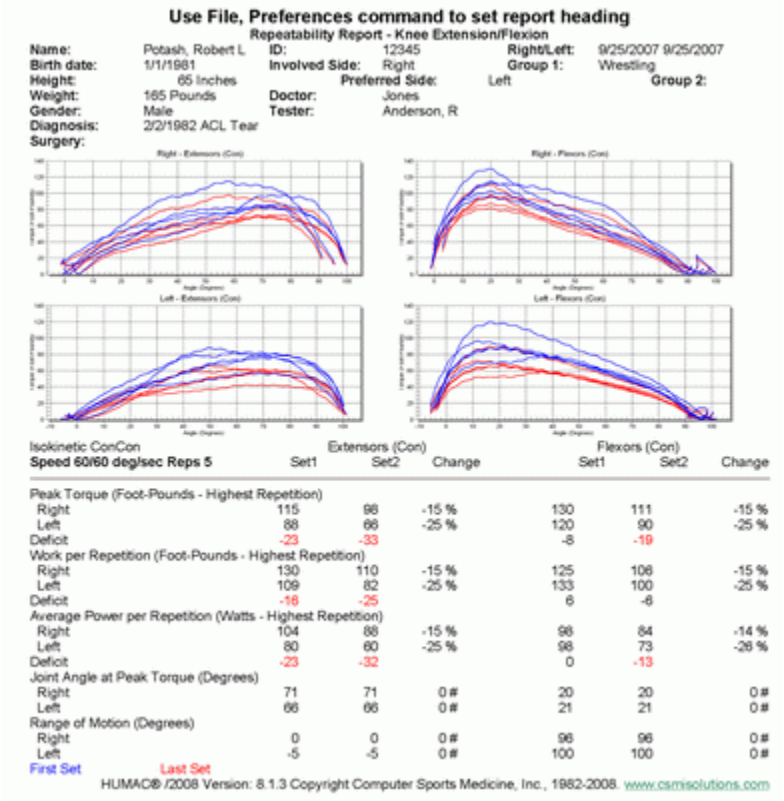
Figure 3-10 Report: Curve Overlay

Torque Repeatability Report

The **Torque Repeatability Report** compares the initial bout in an isokinetic test to the final bout. The report includes curve overlays of the data along with computed numeric values.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Repeatability** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.



Use File, Preferences command to set report heading

Repeatability Report - Knee Extension/Flexion

Name:	Potash, Robert L	**ID:**	12345	**Right/Left:**	9/25/2007 9/25/2007
Birth date:	1/1/1981	**Involved Side:**	Right	**Group 1:**	Wrestling
Height:	65 Inches	**Preferred Side:**	Left	**Group 2:**	
Weight:	165 Pounds	**Doctor:**	Jones		
Gender:	Male	**Tester:**	Anderson, R		
Diagnosis:	2/2/1982 ACL Tear				
Surgery:					

Right - Extensors (Con) | Right - Flexors (Con)

Left - Extensors (Con) | Left - Flexors (Con)

Isokinetic ConCon	Extensors (Con)			Flexors (Con)		
Speed 60/60 deg/sec Reps 5	Set1	Set2	Change	Set1	Set2	Change
Peak Torque (Foot-Pounds - Highest Repetition)						
Right	115	98	-15 %	130	111	-15 %
Left	88	66	-25 %	120	90	-25 %
Deficit	-23	-33		-8	-19	
Work per Repetition (Foot-Pounds - Highest Repetition)						
Right	130	110	-15 %	125	106	-15 %
Left	109	82	-25 %	133	100	-25 %
Deficit	-16	-25		6	-6	
Average Power per Repetition (Watts - Highest Repetition)						
Right	104	88	-15 %	98	84	-14 %
Left	80	60	-25 %	98	73	-26 %
Deficit	-23	-32		0	-13	
Joint Angle at Peak Torque (Degrees)						
Right	71	71	0 #	20	20	0 #
Left	66	66	0 #	21	21	0 #
Range of Motion (Degrees)						
Right	0	0	0 #	96	96	0 #
Left	-5	-5	0 #	100	100	0 #

First Set Last Set

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Figure 3-11 Report: Repeatability

Interactive Feedback - Scrolling Line Report

The **Interactive Feedback Report** provides a report showing the path and the patient position (for isotonic mode) or torque (for isometric mode) during the test.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Interactive Feedback** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

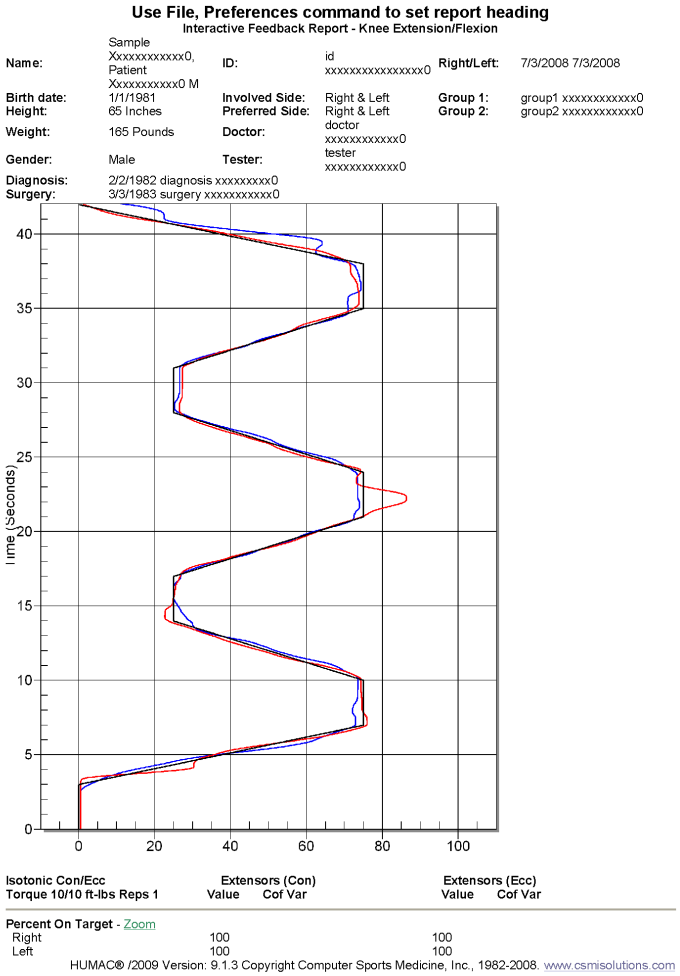


Figure 3-12 Report: Interactive Feedback – Scrolling Line

Interactive Feedback – Scrolling Path Report

The **Interactive Feedback Report** provides a report showing the path and the patient position (for isotonic mode) or torque (for isometric mode) during the test.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Interactive Feedback** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

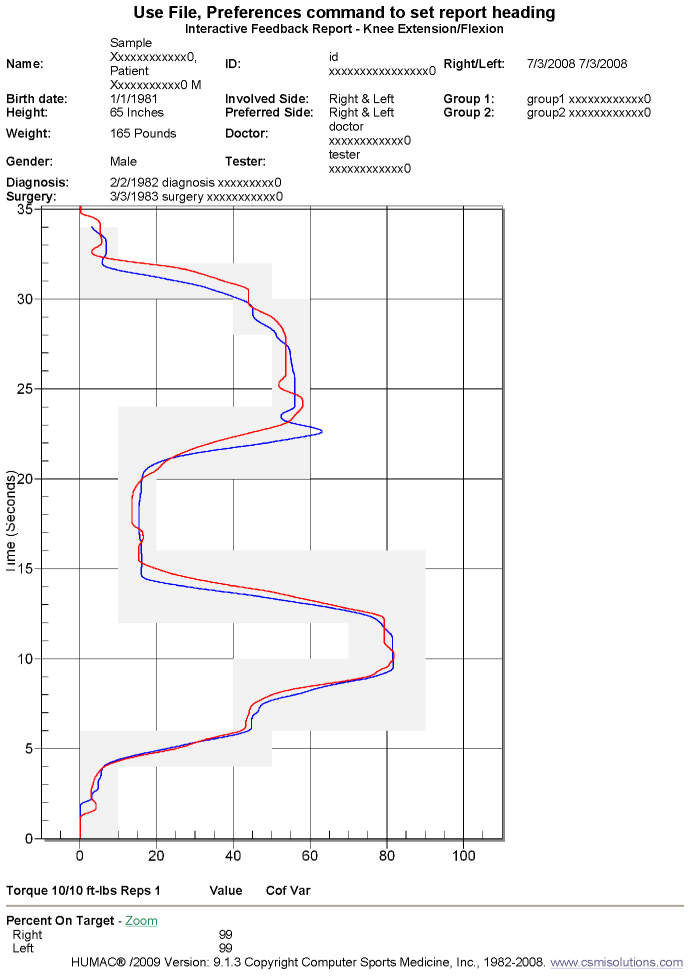


Figure 3-13 Report: Interactive Feedback Path

Interactive Feedback – Roadway & Pacing Bar Reports

The **Interactive Feedback Roadway Report** provides a report showing the target path and the patient position (for isotonic mode) or torque (for isometric mode) during the test. The Percent on Target, Coefficient of Variation and Maximum Deviation are reported.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Coordination Test** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

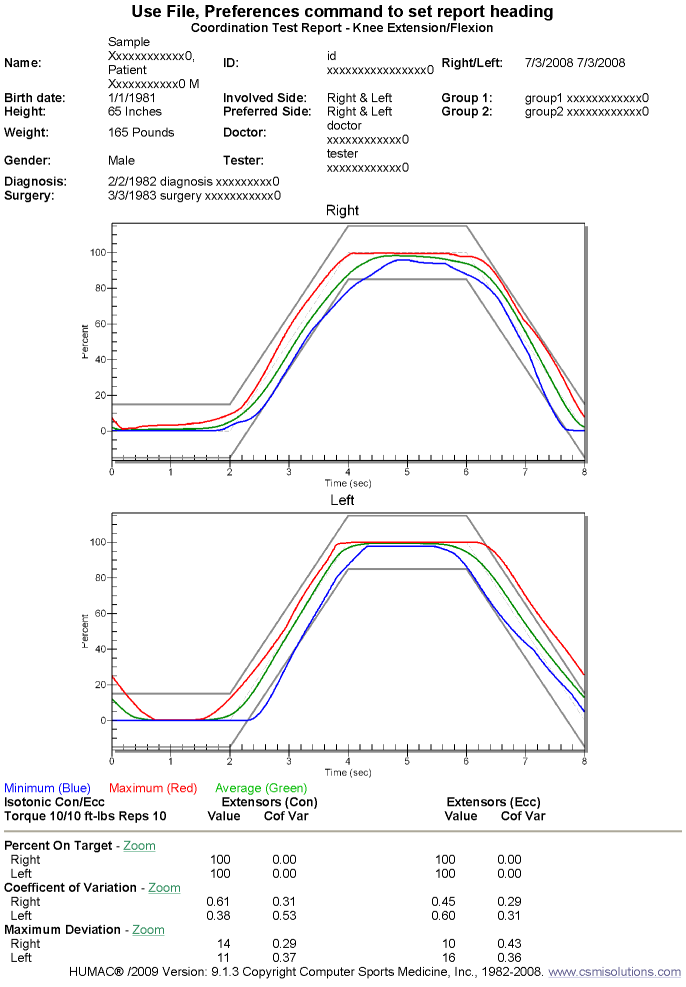


Figure 3-14 Report: Interactive Feedback – Roadway Report

Interactive Feedback – Response Time Report

The **Interactive Feedback Response Time Report** provides a report showing the time for the patient to react to the target change and the time to setting into the new target position.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Response Time Test** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

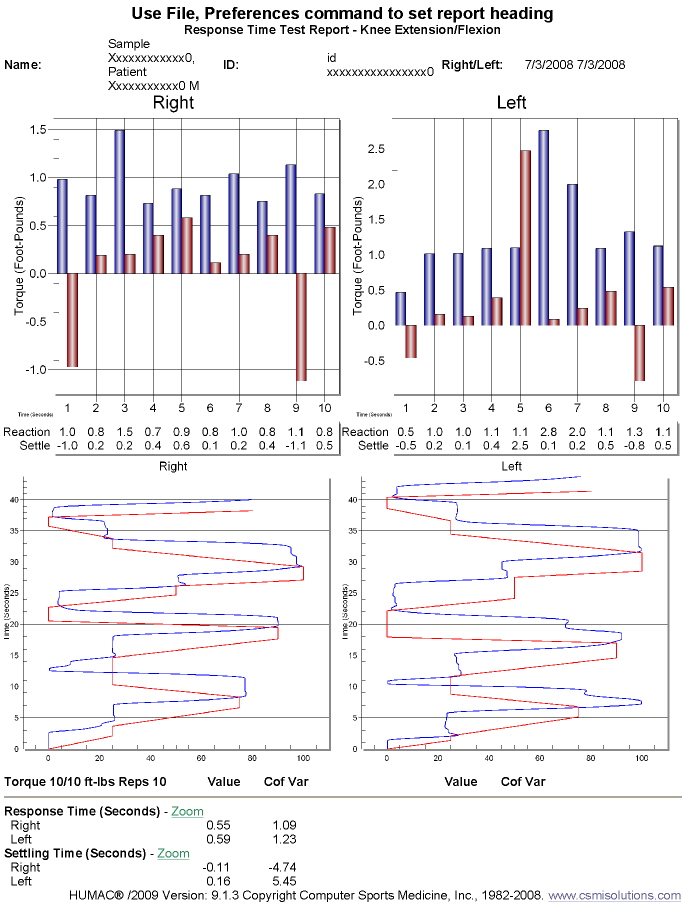


Figure 3-15 Report: Interactive Feedback – Response Time Report

Interactive Feedback – Proprioception Report

The **Interactive Feedback Proprioception Report** provides a report showing the patient position with visual feedback and without visual feedback.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Proprioception Test** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

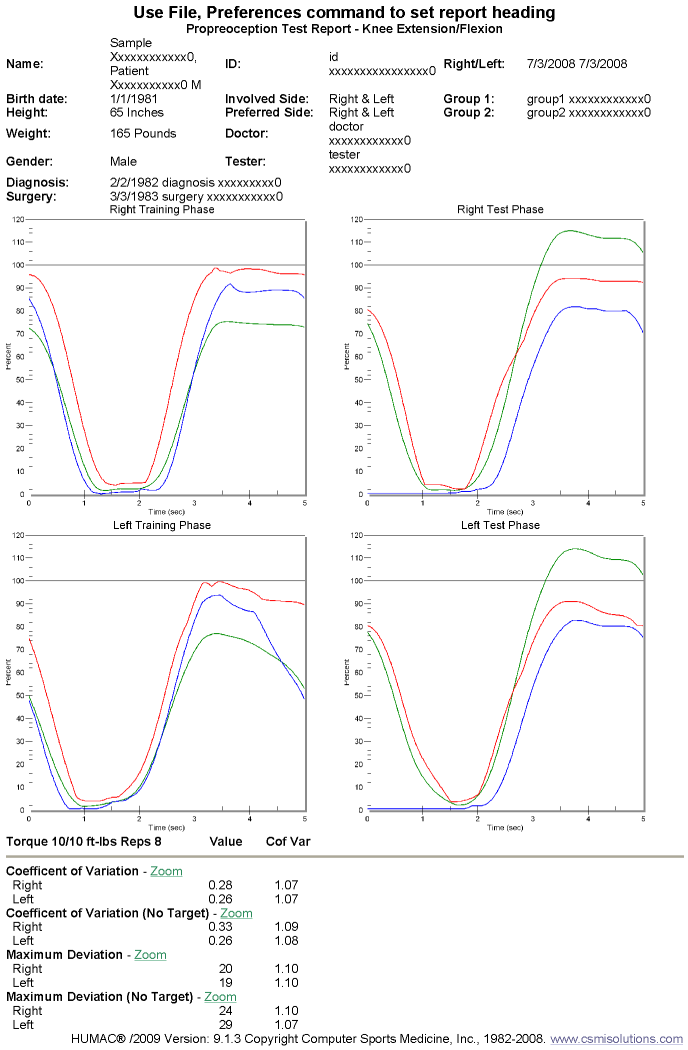


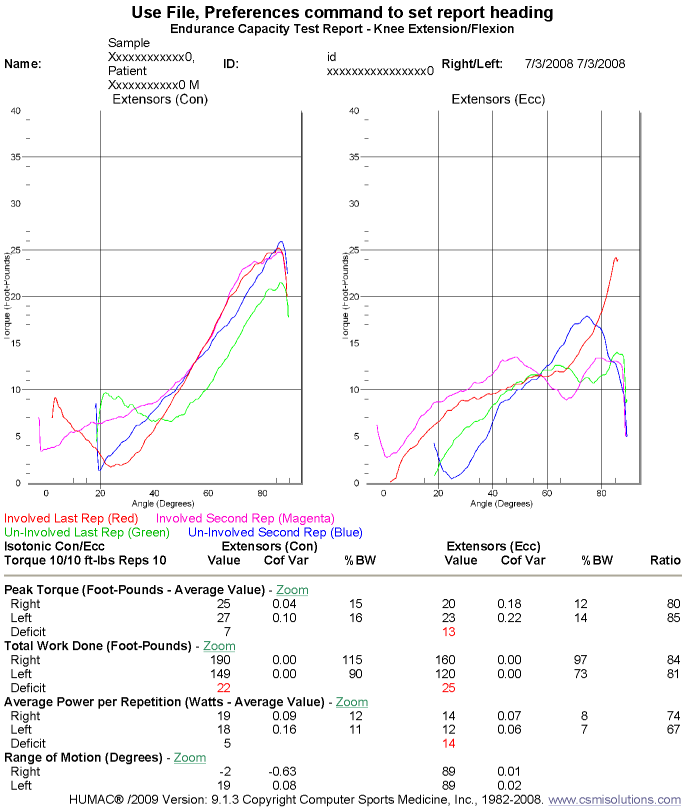
Figure 3-16 Report: Interactive Feedback – Response Time Report

Endurance Capacity Report

The **Endurance Capacity Report** provides a report showing the Torque vs. Position plots with measures of Torque, Work, Power and Range of Motion.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Endurance Capacity Test** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.



Use File, Preferences command to set report heading

Endurance Capacity Test Report - Knee Extension/Flexion

Name: Sample Xxxxxxxxxxx0, Patient Xxxxxxxxxx0 M ID: id xxxxxxxxxxxxxxx0 Right/Left: 7/3/2008 7/3/2008

Extensors (Con) Extensors (Ecc)

Torque (Foot-Pounds)

Angle (Degrees)

Involved Last Rep (Red) Involved Second Rep (Magenta)
Un-Involved Last Rep (Green) Un-Involved Second Rep (Blue)

Isotonic Con/Ecc	Extensors (Con)			Extensors (Ecc)			
Torque 10/10 ft-lbs Reps 10	Value	Cof Var	%BW	Value	Cof Var	%BW	Ratio
Peak Torque (Foot-Pounds - Average Value) - Zoom							
Right	25	0.04	15	20	0.18	12	80
Left	27	0.10	16	23	0.22	14	85
Deficit	7			13			
Total Work Done (Foot-Pounds) - Zoom							
Right	190	0.00	115	160	0.00	97	84
Left	149	0.00	90	120	0.00	73	81
Deficit	22			25			
Average Power per Repetition (Watts - Average Value) - Zoom							
Right	19	0.09	12	14	0.07	8	74
Left	18	0.16	11	12	0.06	7	67
Deficit	5			14			
Range of Motion (Degrees) - Zoom							
Right	-2	-0.63		89	0.01		
Left	19	0.08		89	0.02		

Figure 3-17 Report: Endurance Capacity

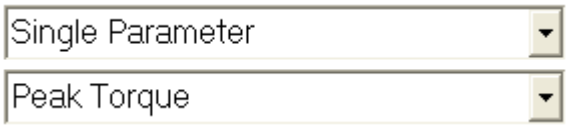
Single Parameter Per Set Report

The Single Parameter Per Set Report provides a single page report showing the values of a selected parameter over all sets in a protocol.

Note: *Use the Single Parameter Per Rep Report for a multi- page report of the value of each repetition of a parameter over each set.*

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired test protocol.
4. From the **Print/Preview** area, select **Single Parameter Per Set** as the report type.
5. From the **Print/Preview** area, select the **Parameter** you want reported, e.g. Peak Torque.



6. Click the **Preview** button to preview the report on the screen or the Print button to send the report to the printer.

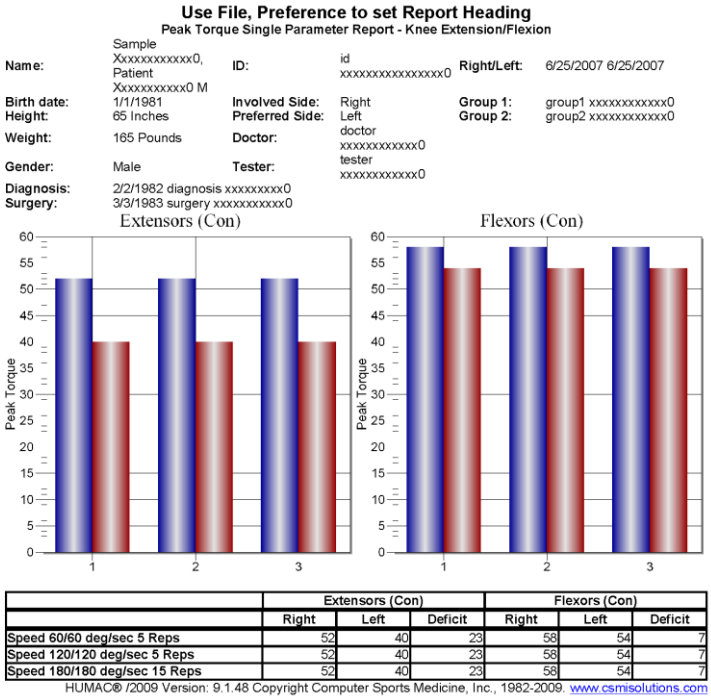


Figure 3-18 Report: Single Parameter Per Set

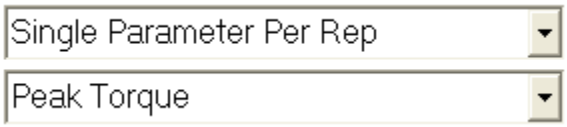
Single Parameter Per Rep Report

The Single Parameter Per Rep Report provides a multi- page report showing the values of a selected parameter over all repetitions in a protocol.

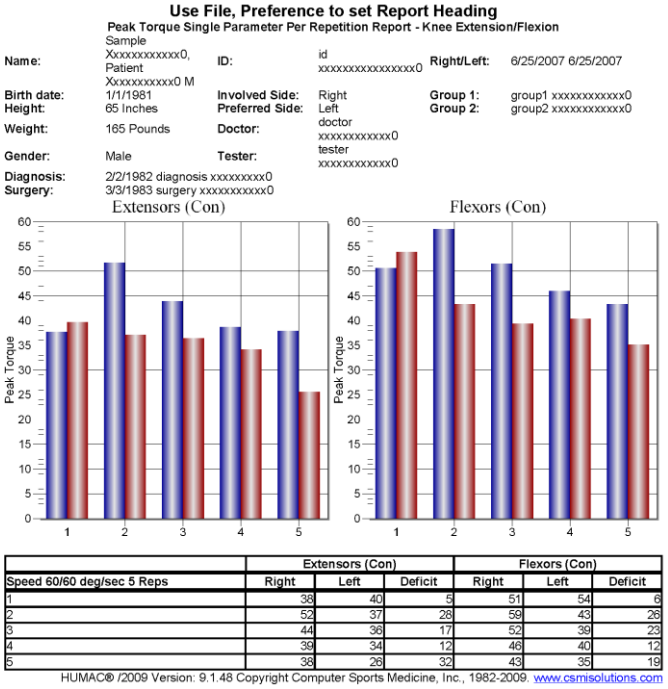
Note: *Use the Single Parameter Per Set Report for a single page report of the Best Repetition or Average Value for a parameter over each set.*

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired test protocol.
4. From the **Print/Preview** area, select **Single Parameter Per Rep** as the report type.
5. From the **Print/Preview** area, select the **Parameter** you want reported, e.g. Peak Torque.



6. Click the **Preview** button to preview the report on the screen or the Print button to send the report to the printer.



Use File, Preference to set Report Heading

Peak Torque Single Parameter Per Repetition Report - Knee Extension/Flexion

Name:	Sample Xxxxxxxxxxx0, Patient Xxxxxxxxxx0 M	**ID:**	id xxxxxxxxxxxxxxx0	**Right/Left:**	6/25/2007 6/25/2007
Birth date:	1/1/1981	**Involved Side:**	Right	**Group 1:**	group1 xxxxxxxxxxx0
Height:	65 Inches	**Preferred Side:**	Left	**Group 2:**	group2 xxxxxxxxxxx0
Weight:	165 Pounds	**Doctor:**	doctor xxxxxxxxxxx0		
Gender:	Male	**Tester:**	tester xxxxxxxxxxx0		
Diagnosis:	2/2/1982 diagnosis xxxxxxxx0				
Surgery:	3/3/1983 surgery xxxxxxxxxx0				

	Extensors (Con)			Flexors (Con)		
Speed 60/60 deg/sec 5 Reps	Right	Left	Deficit	Right	Left	Deficit
1	38	40	5	51	54	6
2	52	37	28	59	43	26
3	44	36	17	52	39	23
4	39	34	12	46	40	12
5	38	26	32	43	35	19

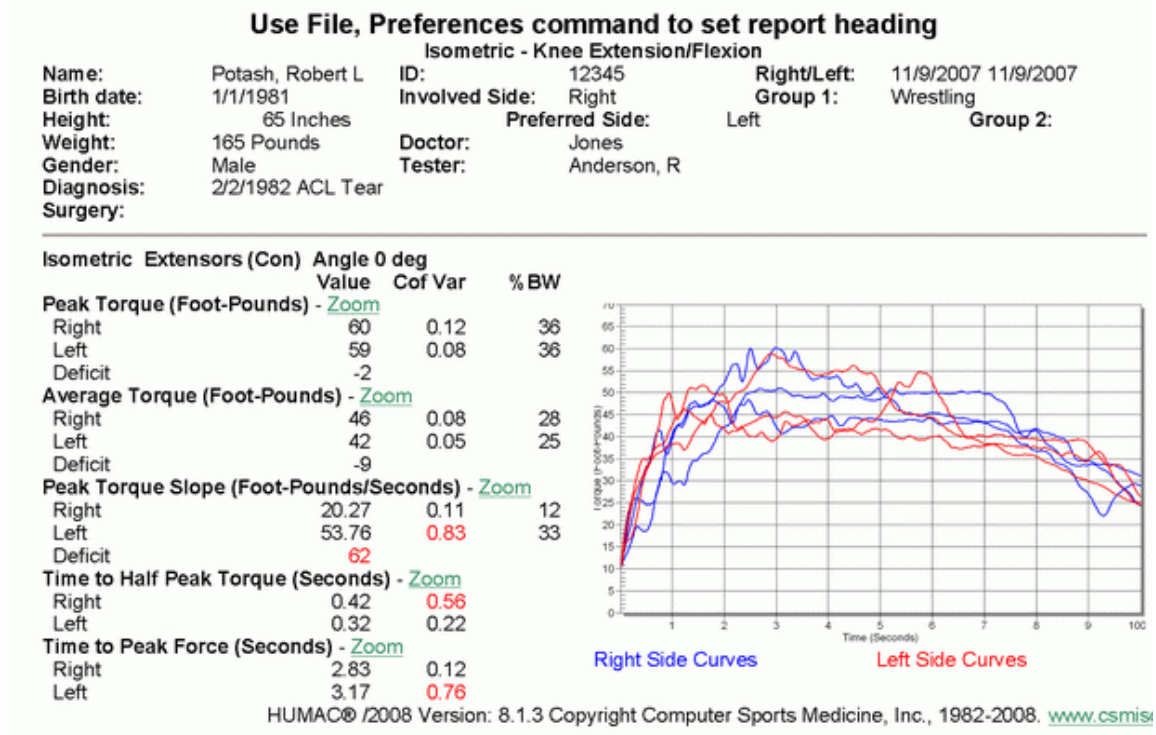
Figure 3-19 Report: Single Parameter Per Set

Isometric Report

The **Isometric Report** shows the numeric results and torque vs. time plots for the isometric sets in the protocol.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select Isometric as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.



Use File, Preferences command to set report heading

Isometric - Knee Extension/Flexion

Name:	Potash, Robert L	**ID:**	12345	**Right/Left:**	11/9/2007 11/9/2007
Birth date:	1/1/1981	**Involved Side:**	Right	**Group 1:**	Wrestling
Height:	65 Inches	**Preferred Side:**	Left	**Group 2:**	
Weight:	165 Pounds	**Doctor:**	Jones		
Gender:	Male	**Tester:**	Anderson, R		
Diagnosis:	2/2/1982 ACL Tear				
Surgery:					

Isometric Extensors (Con) Angle 0 deg

	Value	Cof Var	% BW
Peak Torque (Foot-Pounds) - Zoom			
Right	60	0.12	36
Left	59	0.08	36
Deficit	-2		
Average Torque (Foot-Pounds) - Zoom			
Right	46	0.08	28
Left	42	0.05	25
Deficit	-9		
Peak Torque Slope (Foot-Pounds/Seconds) - Zoom			
Right	20.27	0.11	12
Left	53.76	0.83	33
Deficit	62		
Time to Half Peak Torque (Seconds) - Zoom			
Right	0.42	0.56	
Left	0.32	0.22	
Time to Peak Force (Seconds) - Zoom			
Right	2.83	0.12	
Left	3.17	0.76	

Figure 3-20 Report: Isometric

Isometric Progress Report

The **Isometric Report** shows the numeric results and torque vs. time plots for the isometric sets in the protocol.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. From the **Report** menu, select **Progress**.
3. Select the initial test protocol and click the **Initial** button.
4. Select the follow-up test protocol and click the **Follow-Up** button.
5. From the **Print/Preview** area, select **Isometric** as the report type.
6. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

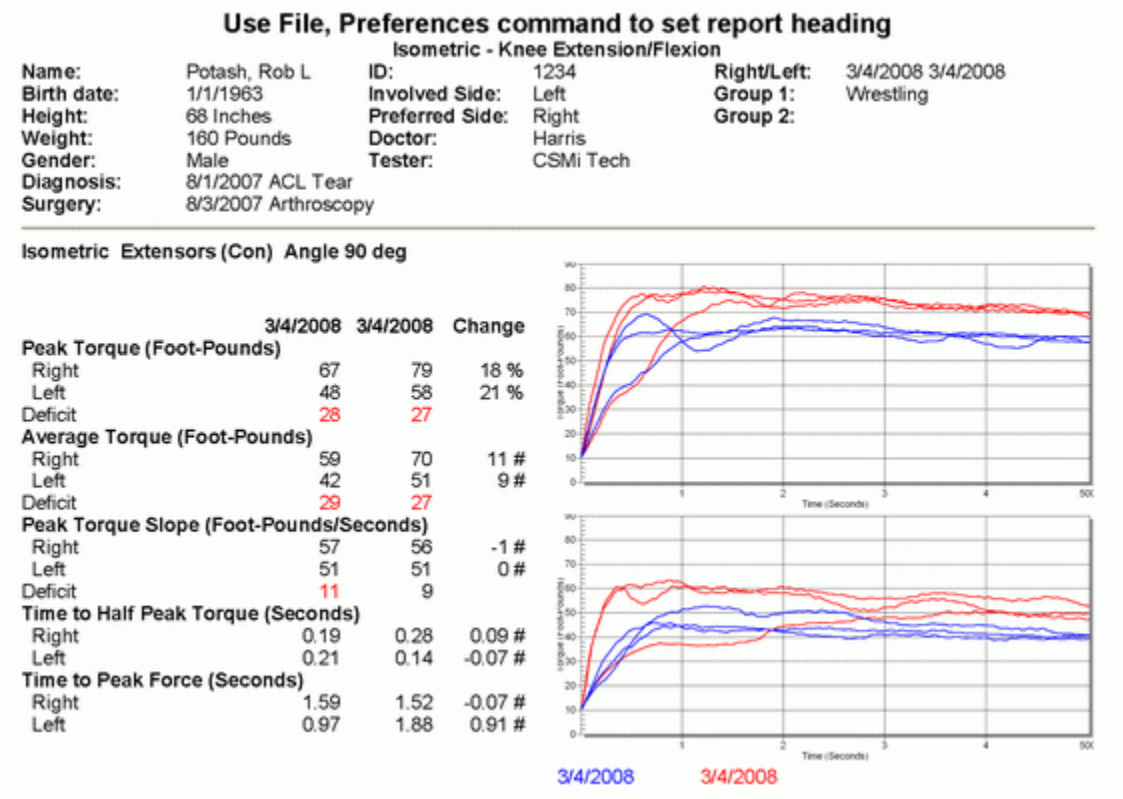


Figure 3-21 Report: Isometric Progress

Multi-Session Report

The Isokinetic **Multi-Session Report** shows a graph of the Peak Torque and Work values along with the Peak Torque, Work, Power and ROM numeric results for up to 12 test sessions.

The Isometric **Multi-Session Report** shows a graph of the Peak Torque and Average Torque values along with the Peak Torque and Average Torque numeric results for up to 12 test sessions.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Using the **Control** key, select the test protocols to be included in the report.
4. From the **Print/Preview** area, select **Multi-Session Report** as the report type.
5. In the **Multi-Session Report** area, select.
6. The **Side** to be reported.
7. The Dynamometer **Mode** and **Action** to be reported.
8. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

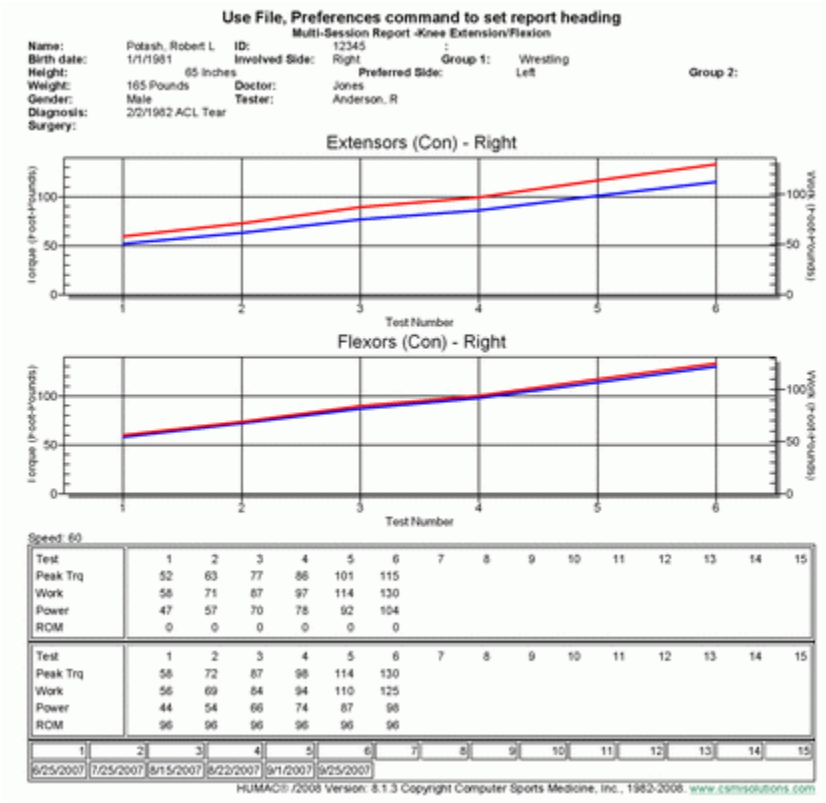


Figure 3-22 Report: Multi-session

Reps Torque vs. Position Report

The **Reps (Trq vs. Pos) Report** is a multi-page report providing torque vs. position plot and Torque, Work, Power and ROM numeric results for each repetition in the set.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select Reps **(Trq vs. Pos)** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

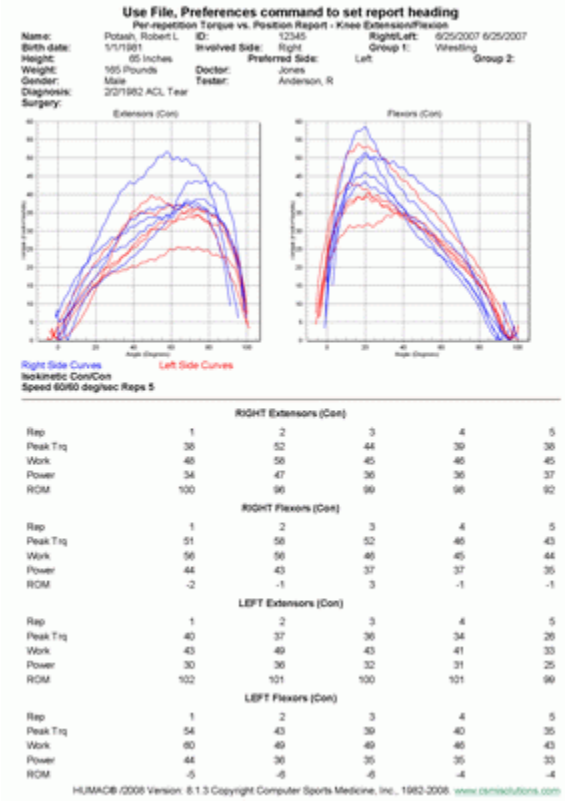


Figure 3-23 Report: Reps Torque vs. Position

Reps Torque vs. Time Report

The **Reps (Trq vs. Time) Report** is a multi-page report providing torque vs. time plots and Torque, Work, Power and ROM numeric results for each repetition in the set.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the desired **test protocol**.
4. From the **Print/Preview** area, select **Reps (Trq vs. Time)** as the report type.
5. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

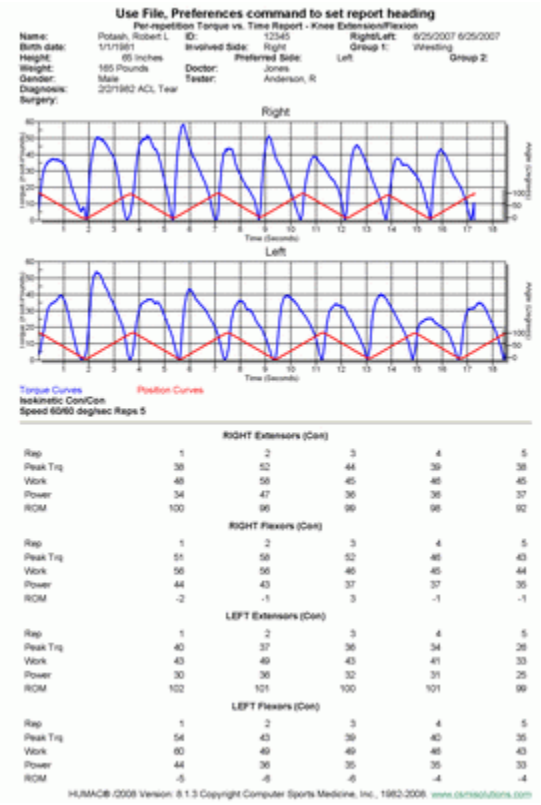


Figure 3-24 Report: Reps Torque vs. Time

Narrative Report

The **Narrative Report** allows you to merge data from a patient test with a Word Document.

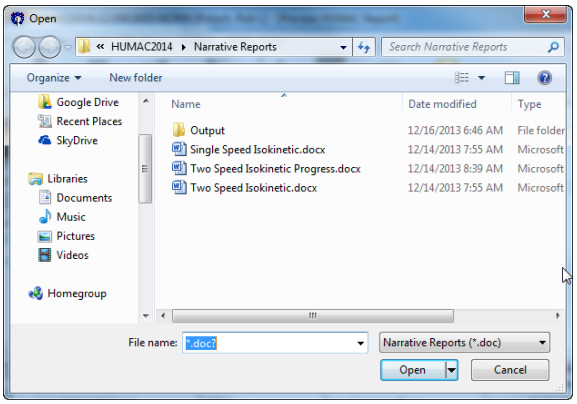
Note: The HUMAC includes sample Narrative Reports. The reports can be found in the following folder. We recommend you review these samples and copy them to use as the basis of your custom Narrative Reports.

C:\Users\Public\Documents\CSMi\HUMAC2015\Narrative Reports

Filename	Descriptoin
Narrative Report - All Isokinetic Values	All Isokinetic Parameters
Single Speed Isokinetic	Single Speed Isokinetic Report
Two Speed Isokinetic	Two Speed Isokinetic Report
Two Speed Isokinetic Progress	Two Speed Isokinetic Progress Report
Narrative Report - All Isometric Values	All Isometric Parameters
Single Set Isometric	Single Angle Isometric Report
Narrative Report - All Isotonic Values	All Isotonic Parameters
Single Set Isotonic	Single Set Isotonic Report

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. Click the **Report** button.
3. Select the **Test Protocol** to be included in the report.
4. Click the **Narrative** button to add **Modalities** and **Goals** for the report.
5. From the Print/Preview area, select **Narrative Report** as the report type.
6. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.
7. The HUMAC will display the Windows Open dialog box. Select the Word Document you want to merge with the Test Data and click the Open button.



8. The HUMAC will open the Merged document in Word and save a copy in the Output folder.

Note: *You can also create Narrative Reports from the Progress Report screen.*

Editing the Word Document

The HUMAC Narrative Reports are created using Microsoft Word. When creating a narrative report, the HUMAC looks for the following tags (<FullName>, <PTRI[s]>) and replaces them with data from the patient's test. The default location for the Narrative Reports is C:\Users\Public\Documents\CSMi\HUMAC2015\Narrative Reports. You can create any number of Narrative Reports.

As the HUMAC can now create multi-set and Progress Narrative Reports, the tags have been expanded to include the Set and Test number. For example:

Tag	Description
<PTRI[0]>	Single Test, **P**eak **T**orque, **R**ight **S**ide, **I**nitial Motion, First Set.
<PTRI[1]>	Single Test, **P**eak **T**orque, **R**ight **S**ide, **I**nitial Motion, Second Set.
<PTRI[0,0]>	Progress Report, **P**eak **T**orque, **R**ight **S**ide, **I**nitial Motion, First Test, First Set.
<PTRI[1,0]>	Progress Report, **P**eak **T**orque, **R**ight **S**ide, **I**nitial Motion, Second Test, First Set.
<PTRI[0,1]>	Progress Report, **P**eak **T**orque, **R**ight **S**ide, **I**nitial Motion, First Test, Second Set.
<PTRIChange[0]>	Progress Report, **P**eak **T**orque, **R**ight **S**ide, **I**nitial Motion, Change from First to Second Test, First Set.

Patient Information

Tag	Description
<FullName>	Full Name
<FirstName>	First Name
<LastName>	Last Name
<ID>	ID
<Sex>	Gender
<InvolvedSide>	Involved Side
<DateRight>	Date Right Side was tested. (Right and Left sides can have different test dates when print a Right/Left Re-Test.
<DateLeft>	Date Left Side was tested.
<DateRight[0]>	Progress Report, Date Right Side was tested on initial test.
<DateLeft[0]>	Progress Report, Date Left Side was tested on initial test.
<DateRight[1]>	Progress Report, Date Right Side was tested on follow-up test.
<DateLeft[1]>	Progress Report, Date Left Side was tested on follow-up test.
<WeightRight>	Weight when Right Side was tested. Both weights are displayed to confirm the Peak Torque, Work, Power to Body Weight ratios.
<WeightLeft>	Weight when Left Side was tested.
<Height>	Height
<Diagnosis>	Diagnosis
<InjuryDate>	Injury Date
<Surgery>	Surgery
<SurgeryDate>	Surgery Date
<Doctor>	Doctor
<Tester>	Tester
<Group1>	Group 1

Tag	Description
<Group2>	Group 2
<DynaHeightR>	Dynamometer Height for the Right Side
<DynaHeightL>	Dynamometer Height for the Right Side

Test Information

Tag	Description
<MGI[s]>	Muscle Group Initial Motion
<MGR[s]>	Muscle Group Reciprocal Motion
<ANGLE[s]>	Isometric Angle
<MUSCLE[s]>	Isometric Muscle Group
<SettingInit[s]>	Setting (Speed, Torque, Angle) for initial motion
<SettingRecip[s]>	Setting (Speed, Torque, Angle) for reciprocal motion
<Termination[s]>	Termination (repetitions)

Narrative Report button on Report screen

Tag	Description
<Modalities[s]>	Selected Modalities
<Goals[s]>	Selected Goals

The Narrative Reports can display the Average or Best Repetition (based on the Preferences) or the Per-Repetition values.

Torque Values – Average/Best

Single Test	Progress	Progress Change	Description
<PTRI[s]>	**<PTRI[t,s]>**	**<PTRIChange[s]>**	Peak Torque Right Side Initial Motion
<PTLI[s]>	**<PTLI[t,s]>**	**<PTLIChange[s]>**	Peak Torque Left Side Initial Motion
<PTDI[s]>	**<PTDI[t,s]>**	**<PTDIChange[s]>**	Peak Torque Initial Motion R/L Deficit
<PTRR[s]>	**<PTRR[t,s]>**	**<PTRRChange[s]>**	Peak Torque Right Side Reciprocal Motion
<PTLR[s]>	**<PTLR[t,s]>**	**<PTLRChange[s]>**	Peak Torque Left Side Reciprocal Motion
<PTDR[s]>	**<PTDR[t,s]>**	**<PTDRChange[s]>**	Peak Torque Reciprocal Motion R/L Deficit
<PTRIRR[s]>			Peak Torque Right Side Init/Recip Ratio
<PTLIRR[s]>			Peak Torque Left Side Init/Recip Ratio
<PTBWRI[s]>			Peak Torque Right Side Initial Motion / Body Weight
<PTBWLI[s]>			Peak Torque Left Side Initial Motion / Body Weight
<PTBWRR[s]>			Peak Torque Right Side Reciprocal Motion Initial / Body Weight
<PTBWLR[s]>			Peak Torque Left Side Reciprocal Motion / Body Weight

Total Work Values

Single Test	Progress	Progress Change	Description
<TWRI[s]>			Total Work Right Side Initial Motion
<TWLI[s]>			Total Work Left Side Initial Motion
<TWDI[s]>			Total Work Initial Motion R/L Deficit
<TWRR[s]>			Total Work Right Side Reciprocal Motion
<TWLR[s]>			Total Work Left Side Reciprocal Motion
<TWDR[s]>			Total Work Reciprocal Motion R/L Deficit
<TWRIRR[s]>			Total Work Right Side Init/Recip Ratio
<TWLIRR[s]>			Total Work Left Side Init/Recip Ratio
<TWBWRI[s]>			Total Work Right Side Initial Motion / Body Weight
<TWBWLI[s]>			Total Work Left Side Initial Motion / Body Weight
<TWBWRR[s]>			Total Work Right Side Reciprocal Motion Initial / Body Weight
<TWBWLR[s]>			Total Work Left Side Reciprocal Motion / Body Weight

Work Per Repetition Values – Average/Best

Single Test	Progress	Progress Change	Description
<WRI[s]>			Work Per Rep Right Side Initial Motion
<WLI[s]>			Work Per Rep Left Side Initial Motion
<WDI[s]>			Work Per Rep Initial Motion R/L Deficit
<WRR[s]>			Work Per Rep Right Side Reciprocal Motion
<WLR[s]>			Work Per Rep Left Side Reciprocal Motion
<WDR[s]>			Work Per Rep Reciprocal Motion R/L Deficit
<WRIRR[s]>			Work Per Rep Right Side Init/Recip Ratio
<WLIRR[s]>			Work Per Rep Left Side Init/Recip Ratio
<WBWRI[s]>			Work Per Rep Right Side Initial Motion / Body Weight
<WBWLI[s]>			Work Per Rep Left Side Initial Motion / Body Weight
<WBWRR[s]>			Work Per Rep Right Side Reciprocal Motion Initial / Body Weight
<WBWLR[s]>			Work Per Rep Left Side Reciprocal Motion / Body Weight

Velocity Values – Average/Best

Single Test	Progress	Progress Change	Description
<PVRI[s]>	**<PVRI[t,s]>**		Peak Velocity Right Side Initial Motion

Single Test	Progress	Progress Change	Description
<PVLI[s]>	**<PVLI[t,s]>**		Peak Velocity Left Side Initial Motion
<PVDI[s]>	**<PVDI[t,s]>**		Peak Velocity Initial Motion R/L Deficit
<PVRR[s]>	**<PVRR[t,s]>**		Peak Velocity Right Side Reciprocal Motion
<PVLR[s]>	**<PVLR[t,s]>**		Peak Velocity Left Side Reciprocal Motion
<PVDR[s]>	**<PVDR[t,s]>**		Peak Velocity Reciprocal Motion R/L Deficit
<PVRIRR[s]>			Peak Velocity Right Side Init/Recip Ratio
<PVLIRR[s]>			Peak Velocity Left Side Init/Recip Ratio

Power Values – Average/Best

Single Test	Progress	Progress Change	Description
<PPRI[s]>			Peak Power Right Side Initial Motion
<PPLI[s]>			Peak Power Left Side Initial Motion
<PPDI[s]>			Peak Power Initial Motion R/L Deficit
<PPRR[s]>			Peak Power Right Side Reciprocal Motion
<PPLR[s]>			Peak Power Left Side Reciprocal Motion
<PPDR[s]>			Peak Power Reciprocal Motion R/L Deficit
<PPRIRR[s]>			Peak Power Right Side Init/Recip Ratio
<PPLIRR[s]>			Peak Power Left Side Init/Recip Ratio
<PPBWRI[s]>			Peak Power Right Side Initial Motion / Body Weight
<PPBWLI[s]>			Peak Power Left Side Initial Motion / Body Weight
<PPBWRR[s]>			Peak Power Right Side Reciprocal Motion Initial / Body Weight
<PPBWLR[s]>			Peak Power Left Side Reciprocal Motion / Body Weight

Joint Angle Values

Single Test	Progress	Progress Change	Description
<JAPTRI[s]>			Joint Angle at Peak Torque Right Side Initial Motion
<JAPTLI[s]>			Joint Angle at Peak Torque Left Side Initial Motion
<JAPTRR[s]>			Joint Angle at Peak Torque Right Side Reciprocal Motion
<JAPTLR[s]>			Joint Angle at Peak Torque Left Side Reciprocal Motion
<JAPVRI[s]>			Joint Angle at Peak Velocity Right Side Initial Motion

Single Test	Progress	Progress Change	Description
<JAPVLI[s]>			Joint Angle at Peak Velocity Left Side Initial Motion
<JAPVRR[s]>			Joint Angle at Peak Velocity Right Side Reciprocal Motion
<JAPVLR[s]>			Joint Angle at Peak Velocity Left Side Reciprocal Motion
<JAPPRI[s]>			Joint Angle at Peak Power Right Side Initial Motion
<JAPPLI[s]>			Joint Angle at Peak Power Left Side Initial Motion
<JAPPRR[s]>			Joint Angle at Peak Power Right Side Reciprocal Motion
<JAPPLR[s]>			Joint Angle at Peak Power Left Side Reciprocal Motion

Per-Repetition Values

Single Test	Description
<PTRI[s]Rep[0]>	Peak Torque Right Side Initial Motion, First Repetition. ***Note:*** *The 0th repetition is the first repetition.*
<PTRI[s]Rep[1]>	Peak Torque Right Side Initial Motion, Second Repetition.
<PTRI[s]Rep[n]>	Peak Torque Right Side Initial Motion, (n-1)th Repetition.
<PTLI[s]Rep[n]>	Peak Torque Left Side Initial Motion, (n-1)th Repetition.
<PTRR[s]Rep[n]>	Peak Torque Right Side Reciprocal Motion, (n-1)th Repetition.
<PTLR[s]Rep[n]>	Peak Torque Left Side Reciprocal Motion, (n-1)th Repetition.
<PPRI[s]Rep[n]>	Same as above for Peak Power.
<PVRI[s]Rep[n]>	Same as above for Peak Velocity.
<PTBWRI[s]Rep[n]>	Same as above for Peak Torque to Body Weight.
<PPBWRI[s]Rep[n]>	Same as above for Peak Power to Body Weight.
<TTPTRI[s]Rep[n]>	Same as above for Time to Peak Torque.
<TTPPRI[s]Rep[n]>	Same as above for Time to Peak Power.
<TTPVRI[s]Rep[n]>	Same as above for Time to Peak Velocity.
<JAPTRI[s]Rep[n]>	Same as above for Joint Angle at Peak Torque.
<JAPPRI[s]Rep[n]>	Same as above for Joint Angle at Peak Power.
<JAPVRI[s]Rep[n]>	Same as above for Joint Angle at Peak Velocity.

Torque Plots - Isokinetic

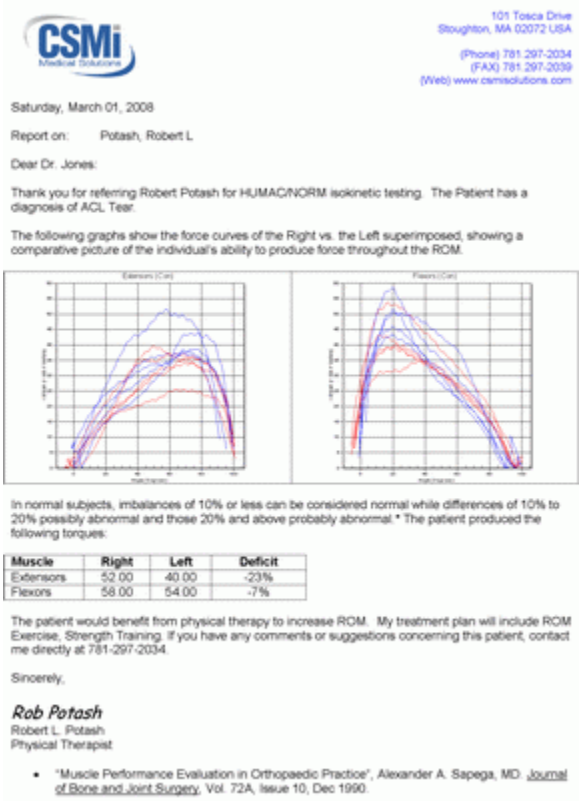
Tag	Description
<PTGraphInit[s]>	Right-Left Torque vs. Position Graph for Initial Motion
<PTGraphRecip[s]>	Right-Left Torque vs. Position Graph for Reciprocal Motion
<PTGraphInitR[s]>	Progress Report Right Side Torque vs. Position Graph for Initial Motion
<PTGraphInitL[s]>	Progress Report Left Side Right Torque vs. Position Graph for Initial Motion
<PTGraphRecipR[s]>	Progress Report Right Side Torque vs. Position Graph for Reciprocal Motion
<PTGraphRecipL[s]>	Progress Report Left Side Right Torque vs. Position Graph for Reciprocal Motion

Torque Plots - Isometric

Tag	Description
<PTGraphInit[s]>	Right-Left Torque vs. Time Graph
<PTGraphInitR[s]>	Progress Report Right Side Torque vs. Time Graph
<PTGraphInitL[s]>	Progress Report Left Side Torque vs. Time Graph

Power Plots

Tag	Description
<PPGraphInit[s]>	Right-Left Power vs. Position Graph for Initial Motion
<PPGraphRecip[s]>	Right-Left Power vs. Position Graph for Reciprocal Motion
<PPGraphInitR[s]>	Progress Report Right Side Power vs. Position Graph for Initial Motion
<PPGraphInitL[s]>	Progress Report Left Side Right Power vs. Position Graph for Initial Motion
<PPGraphRecipR[s]>	Progress Report Right Side Power vs. Position Graph for Reciprocal Motion
<PPGraphRecipL[s]>	Progress Report Left Side Right Power vs. Position Graph for Reciprocal Motion



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Saturday, March 01, 2008

Report on: Potash, Robert L

Dear Dr. Jones:

Thank you for referring Robert Potash for HUMAC/NORM isokinetic testing. The Patient has a diagnosis of ACL Tear.

The following graphs show the force curves of the Right vs. the Left superimposed, showing a comparative picture of the individual's ability to produce force throughout the ROM.

In normal subjects, imbalances of 10% or less can be considered normal while differences of 10% to 20% possibly abnormal and those 20% and above probably abnormal.* The patient produced the following torques:

Muscle	Right	Left	Deficit
Extensors	52.00	40.00	-23%
Flexors	58.00	54.00	-7%

The patient would benefit from physical therapy to increase ROM. My treatment plan will include ROM Exercise, Strength Training. If you have any comments or suggestions concerning this patient, contact me directly at 781-297-2034.

Sincerely,

Rob Potash
Robert L. Potash
Physical Therapist

- *"Muscle Performance Evaluation in Orthopaedic Practice", Alexander A. Sapega, MD. Journal of Bone and Joint Surgery, Vol. 72A, Issue 10, Dec 1990.

Figure 3-25 Report: Narrative

Export a Test to Excel

Figure 3-26 Export Test to Excel

When exporting a test, two Worksheets are created in the Spreadsheet.

Page	Description
Set	Average or Maximum values for the Set based on File, Preferences.
Repetition	Per-repetition values for the Set.

	A	O	P	Q	R	S	T	U	V	W	X	Y
1	FullName	Side	Motion	Stat	Inv	Dom	pt	pt_bw	t_deficit	t_ratio	InitialPeal	InitialPeal
2	Sample X›	0	0	0	TRUE	FALSE	51	31	-24	114	51	31
3	Sample X›	0	0	1	TRUE	FALSE	0.139255	0	0	0	0	0
4	Sample X›	0	1	0	TRUE	FALSE	58	35	-9	0	58	35
5	Sample X›	0	1	1	TRUE	FALSE	0.116464	0	0	0	0	0
6	Sample X›	1	0	0	FALSE	TRUE	39	24	0	136	39	24
7	Sample X›	1	0	1	FALSE	TRUE	0.156024	0	0	0	0	0
8	Sample X›	1	1	0	FALSE	TRUE	53	32	0	0	53	32
9	Sample X›	1	1	1	FALSE	TRUE	0.166011	0	0	0	0	0
10	Sample X›	0	0	0	TRUE	FALSE	51	31	-24	114	51	31
11	Sample X›	0	0	1	TRUE	FALSE	0.140846	0	0	0	0	0
12	Sample X›	0	1	0	TRUE	FALSE	58	35	-7	0	58	35

Figure 3-27 Report: Excel Export

Exported Parameters

FieldName	Description
AvgTrq	Average Torque
AvgTrqBW	Average Torque to Body Weight Ratio
AvgTrqDeficit	Involved/Uninvolved Average Torque Deficit
AvgTrqRatio	Reciprocal/Initial Average Torque Ratio
AvgVelocity	Average Velocity
AvgVelocity_bw	Average Velocity to Body Weight Ratio
AvgVelocity_deficit	Involved/Uninvolved Average Velocity Deficit
AvgVelocity_ratio	Reciprocal/Initial Average Velocity Ratio
BirthDate	Date of Birth
CoeffOfVar	Coefficent of Variation between Target and Actual
CoeffOfVarNoFeedback	Proprioception: Coefficent of Variation between Target and Actual without Visual Feedback
DirectionalControlActual	Acutal Distance Travelled by Patient
DirectionalControlMin	Minimum Distanct to Target
DirectionalControlRatio	Min/Actual Ratio

FieldName	Description
DirectionalControlTime	Min/Actual Ratio
dt	Delay Time
EllipseMajorRadius	95% Ellipse Radius
EllipseMinorRadius	95% Ellipse Radius
EllipseRotation	95% Ellipse Rotation
EllipseX0	95% Ellipse Center
EllipseY0	95% Ellipse Center
EnvelopeAngle	Stability Envelope Angle
EnvelopeArea	Stability Envelope Area
EnvelopeLength	Stability Envelope Length
fdt	Force Decay Time
FullName	Patient Full Name
Height	Patient Height
ID	Patient ID
InitialPeakPower	Initial Peak Velocity first 3 reps) on Endurance Test
InitialPeakPower_bw	Initial Peak Velocity to Body Weight Ratio
InitialPeakPower_deficit	Involved/Uninvolved Initial Peak Velocity Deficit
InitialPeakPower_ratio	Reciprocal/Initial Initial Peak Velocity Ratio
InitialPeakTorque	Initial Peak Torque (first 3 reps) on Endurance Test
InitialPeakTorque_bw	Initial Peak Torque to Body Weight Ratio
InitialPeakTorque_deficit	Involved/Uninvolved Initial Peak Torque Deficit
InitialPeakTorque_ratio	Reciprocal/Initial Initial Peak Torque Ratio
InitialPeakVelocity	Initial Peak Velocity (first 3 reps) on Endurance Test
InitialPeakVelocity_bw	Initial Peak Velocity to Body Weight Ratio
InitialPeakVelocity_deficit	Involved/Uninvolved Initial Peak Velocity Deficit
InitialPeakVelocity_ratio	Reciprocal/Initial Initial Peak Velocity Ratio
intAction	Dyna Action: 0:Con/Con, 1:Con/Ecc, 2:Ecc/Con, 3:Ecc/Ecc
intMode	Dyna Mode: 0:IsoK, 1:CPM, 2:IsoM, 3:IsoT
japp	Joint Angle at Peak Velocity
japt	Joint Angle at Peak Torque
japv	Joint Angle at Peak Velocity
Machine	Machine the test was performed on
MaxDeviation	Maximum Deviation between Target and Actual
MaxDeviationNoFeedback	Proprioception: Maximum Deviation between Target and Actual without Visual Feedback
Motion	0: Initial Motion, 1: Reciprocal Motion
p_deficit	Involved/Uninvolved Power Deficit
p_fatigue	Initial Peak Velocity Fatigue Index
p_ratio	Reciprocal/Initial Power Ratio
PathLength	Path Length Traveled
PctOnTarget	Interactive Line/Path: Percent on target
pdt	Velocity Decay Time
PeakPower	Peak Power

FieldName	Description
PeakPower_bw	Peak Power to Body Weight Ratio
PeakPower_deficit	Involved/Uninvolved Peak Power Deficit
PeakPower_ratio	Reciprocal/Initial Peak Power Ratio
PeakTrqSlope	Peak Torque/Time To Peak Torque
PeakTrqSlopeBW	Peak Torque Slope to Body Weight Ratio
PeakTrqSlopeDeficit	Involved/Uninvolved Peak Torque Slope Deficit
PeakTrqSlopeRatio	Reciprocal/Initial Peak Torque Slope Ratio
PeakVelocity	Peak Velocity
PeakVelocity_bw	Peak Velocity to Body Weight Ratio
PeakVelocity_deficit	Involved/Uninvolved Peak Velocity Deficit
PeakVelocity_ratio	Reciprocal/Initial Peak Velocity Ratio
power	Power (Computed over Complete Repetition)
power_bw	Power to Body Weight Ratio
pt	Peak Torque
pt_bw	Peak Torque to Body Weight Ratio
rd	Reciprocal Delay
ReactionTime	Response Time Test: Reaction Time
rom	Position at Range of Motion Limit
RowNbr	The Set in the Protocol with 0 being the first set.
SDX	Std Dev of X
SDXY	Std Dev of (X, Y)
SDY	Std Dev of Y
Seq	The Repetition, Motion pair. 0: First Rep, Initial Motion, 1: First Rep, Recip Motion, 2: Second Rep, Initial Motion
SettingInit	Dyna Init Motion setting. Isokinetic, CPM:Speed, Isotonic:Torque, Isometric:Angle.
SettingRecip	Dyna Recip Motion setting. Isokinetic, CPM:Speed, Isotonic:Torque, Isometric:Hold Time.
SettleTime	Response Time Test: Time to Settle in Target
Sex	Patient Gender
Side	0: Right Side, 1: Left Side
StabilityIndexCombined	Mean Distance from Origin
StabilityIndexX	Mean Distance from Origin in X Axis
StabilityIndexY	Mean Distance from Origin in Y Axis
StabilityScore	95% Stability Score vs. NORMS
Stat	0: Average Value, 1: Coeff of Var
SwayIndex	Standard Deviation of all Point
t_deficit	Involved/Uninvolved Torque Deficit
t_fatigue	Initial Peak Torque Fatigue Index
t_ratio	Reciprocal/Initial Torque Ratio
Test	True: Test, False: Exercsie
TestRunningTime	Time in seconds for complete exercise.
TimeToHalfPeakTrq	Time to Half Peak Torque
TotalMotionTime	Time to Move Through Complete Motion (PS to PE)

FieldName	Description
TotalWork	Total Work (Sum of all repetition)
TotalWork_bw	Total Work to Body Weight Ratio
TotalWork_deficit	Involved/Uninvolved Total Work Deficit
TotalWork_ratio	Reciprocal/Initial Total Work Ratio
tpph	Time Peak Velocity Held
tpth	Time Peak Torque Held
tpvh	Time Peak Velocity Held
ttpp	Time to Peak Velocity
ttpt	Time to Peak Torque
ttpv	Time to Peak Velocity
v_fatigue	Initial Peak Velocity Fatigue Index
vdt	Velocity Decay Time
w_deficit	Involved/Uninvolved Work Deficit
w_fatigue	Endurance Ratio
w_ratio	Reciprocal/Initial Work Ratio
work	Work (Per Repetition)
work_bw	Work to Body Weight Ratio

Progress Report

The Progress Report allows you to view the change in patient performance between to tests.

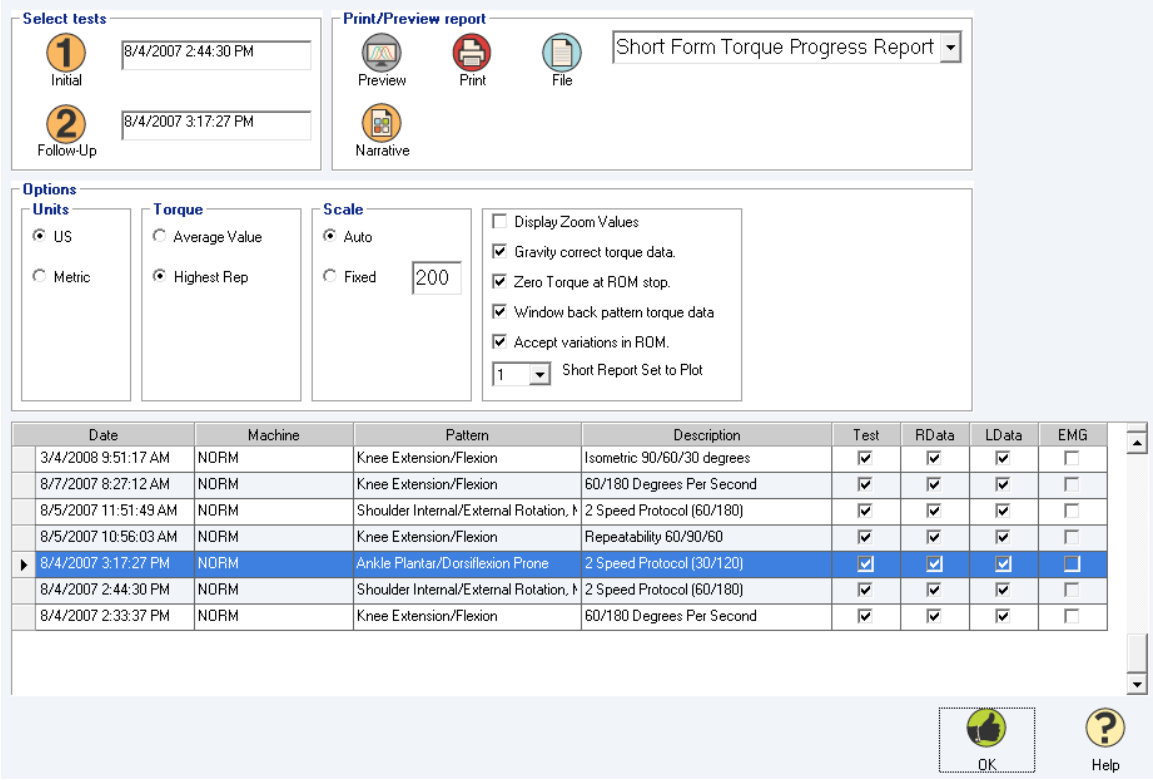


Figure 3-28 Progress Report Form

Actions

Tag	Description
OK	Close the report screen and return to the main HUMAC screen.
Initial	Set the selected test as the initial test.
Follow-Up	Set the selected test as the follow-up test.
Preview	Preview the selected report on the screen.
Print	Send the selected report to the printer.
e-mail	E-mail the selected report.
Type	Select the type of report to generate.

Preview a Short Progress Report

1. Click the **Report** button. (or on the **File** menu, click **Report**, **Single**.)
2. Click the **Initial Test/Exercise** session then click the **Initial** button.
3. Click the **Follow-up Test/Exercise** session then click the **Follow-Up** button.
4. Select **Short (Trq vs. Pos)** as the report **Type**.
5. Click the **Preview** button to preview the report.

Report Types

Tag	Description
Short (Trq vs. Time)	Single page report showing the torque vs. time plots for the first set in the protocol and the most commonly used numeric results for the first three sets along with the change which occurred.
Long (Trq vs. Time)	Multi-page report showing the torque vs. time plots and the numeric results along with the change which occurred for each set in the protocol.
Isometric	Multi-page report showing the torque vs. time plots for the numeric results along with the change which occurred for each set in the protocol.

Short Progress Report

The **Short Progress Report** provides a single page report showing the patient background information, torque vs. position plots for the first set in each session, and the numeric results for the first three sets in each session along with the change which occurred.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. From the **Report** menu, select **Progress**.
3. Select the initial test protocol and click the **Initial** button.
4. Select the follow-up test protocol and click the **Follow-Up** button.
5. From the **Print/Preview** area, select **Short Progress** as the report type.
6. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

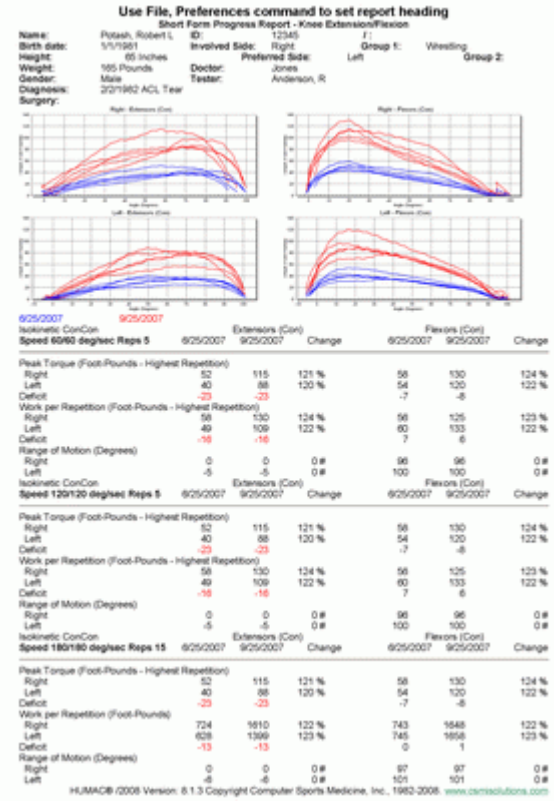


Figure 3-29 Report: Short Progress

Long Progress Report

The Long Progress Report provides a multi-page report showing the, torque vs. position plots and the complete numeric results for each session along with the change which occurred.

Printing the Report

1. From the main HUMAC Screen, click the **Patient** button to select the patient.
2. From the **Report** menu, select **Progress**.
3. Select the initial test protocol and click the **Initial** button.
4. Select the follow-up test protocol and click the **Follow-Up** button.
5. From the **Print/Preview** area, select **Long Progress** as the report type.
6. Click the **Preview** button to preview the report on the screen or the **Print** button to send the report to the printer.

Figure 3-30 Report: Long Progress

Involved Side Re-Test Report

The Involved Side Re-test Report allows you to combine the results of an initial test for one side with the results of a follow-up test for the other side into a single report. This is typically used when you test both side during an initial evaluation and only re-test the involved side during a follow-up visit.

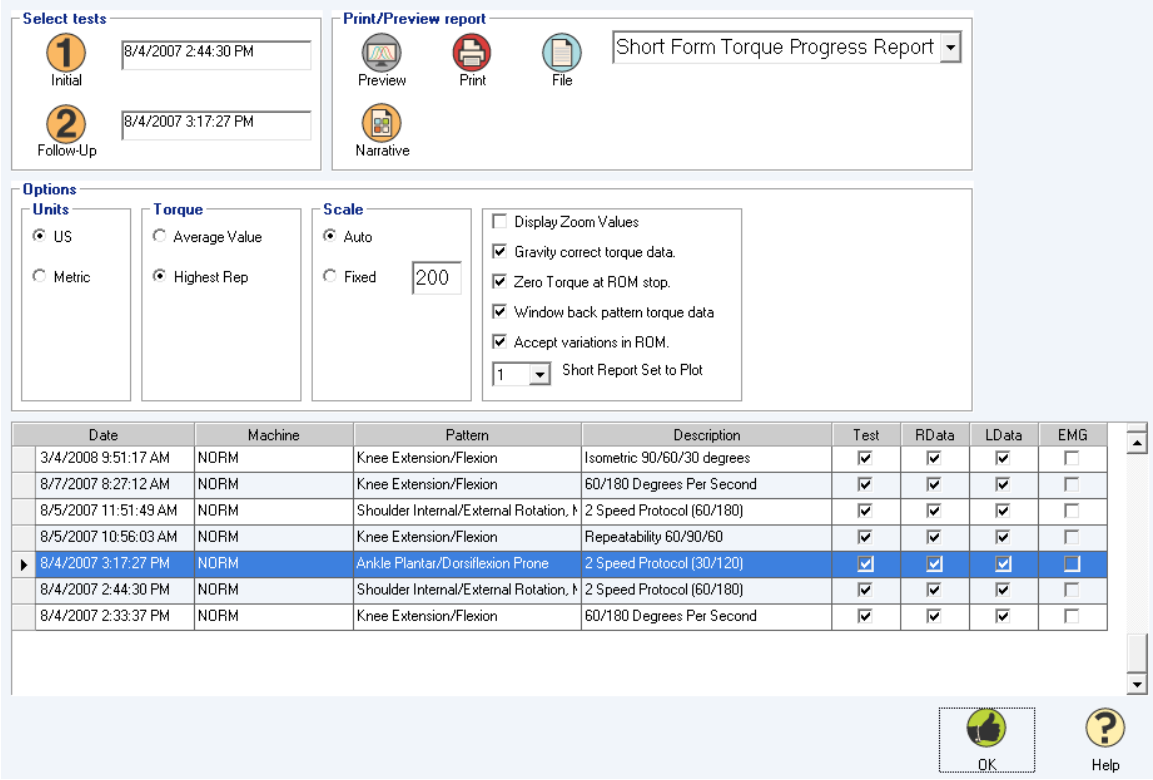


Figure 3-31 Report: Re-Test Form

Actions

Tag	Description
OK	Close the report screen and return to the main HUMAC screen.
Right	Set the selected test for the right side data.
Left	Set the selected test for the left side data.
Preview	Preview the selected report on the screen.
Print	Send the selected report to the printer.
e-mail	E-mail the selected report.
Type	Select the type of report to generate.

Preview a Short Torque vs. Position Re-Test Report

1. Click the **Report** button. (or on the **File** menu, click **Report**, **Involved Re-Test**.)
2. Click the **Right Side Test/Exercise** session then click the **Right** button.
3. Click the **Left Side Test/Exercise** session then click the **Left** button.
4. Select **Short (Trq vs. Pos)** as the report **Type**.
5. Click the **Preview** button to preview the report.

Usage Report

The Usage Report shows each protocol run on the system grouped by patient. The report is sorted first by Patient Name, then by the Date the protocol was run.

Create System Usage Report

To generate a Usage Report across all patients:

1. On the **File** menu, select **Report**, **Usage Report**.

Create a Patient Usage Report

To generate a Usage Report for a specific patient:

1. Click the **Patient** button and select the Patient.
2. On the **Report** menu, select **Usage Report**.

HUMAC2014 Usage Report

Date	Description	Protocol	Test
Potash, Rob L			
8/4/2007 2:33:37PM	Knee Extension/Flexion	60/180 Degrees Per Second	Yes
8/4/2007 2:44:30PM	Shoulder Internal/External Rotation, I	2 Speed Protocol (60/180)	Yes
8/4/2007 3:17:27PM	Ankle Plantar/Dorsiflexion Prone	2 Speed Protocol (30/120)	Yes
8/5/2007 10:56:03AM	Knee Extension/Flexion	Repeatability 60/90/60	Yes
8/5/2007 11:51:49AM	Shoulder Internal/External Rotation, I	2 Speed Protocol (60/180)	Yes
8/7/2007 8:27:12AM	Knee Extension/Flexion	60/180 Degrees Per Second	Yes
3/4/2008 9:51:17AM	Knee Extension/Flexion	Isometric 90/60/30 degrees	Yes
3/4/2008 9:59:53AM	Knee Extension/Flexion	Isometric 90/60/30 degrees	Yes
3/27/2009 9:56:40AM	Arm Curl - Unilateral	Power Test 10, 12lbs 5, 10 Reps	Yes
3/27/2009 10:01:25AM	Arm Curl - Unilateral	Power Test 10, 12lbs 5, 10 Reps	Yes
3/27/2009 10:03:58AM	Arm Curl - Unilateral	Power Test 10, 12lbs 5, 10 Reps	Yes
3/27/2009 10:09:23AM	Leg Vertical Jump - Unilateral	5 Reps - 0, 10 Lbs Postion Bars	Yes
3/27/2009 10:26:05AM	Leg Right/Left Cut	10 Feet Right to Left 0, 10 lbs	Yes
3/27/2009 11:41:24AM	Leg Vertical Jump - Unilateral	5 Reps - 0, 10 Lbs Postion Bars	Yes
3/29/2009 11:22:25PM	Knee Extension/Flexion	2 Speed Protocol (60/180)	Yes
1/1/2013 1:42:46PM	Standing Balance - Bilateral	CTSIB :15 Eyes Open Eyes Closed	Yes
1/2/2013 10:27:34AM	Standing Balance - Bilateral	Concussion Test Eyes O/C, Surface N/P	Yes
1/15/2013 11:35:34PM	Standing Balance - Bilateral	CTSIB :15 Eyes Open Eyes Closed	Yes

Figure 3-32 Report: Patient Usage

Patient Access Report

The Patient Access Report shows for each user, the Patient Records and Days the records were accesses.

Create Patient Access Report

1. On the **File** menu, select **Report**, **Patient Access**.

Measured Parameters

The HUMAC provides numerical results for torque, position, and time data.

Torque Parameters

Torque

Torque is caused by force applied about an axis of rotation. It is an instantaneous measurement, taken by the NORM System at every half—degree in the range of motion. The formula for torque is:

Torque (ft-lbs) = Force (lbs) x Distance (ft)

where "distance" indicates the perpendicular distance from the input of force to the center of rotation. Because the NORM System measures torque directly at this center of rotation, the force and distance components are not measured.

The amount of torque that can be produced is related to musculotendinous tension levels, joint contact forces and, in some cases, joint translation forces.

Torque usually decreases as angular velocity increases. Therefore, it is important to analyze torque data at a variety of speeds.

Gravity Effect Torque

When testing with the NORM System it is possible to begin the test by determining the gravity effect torque of the limb and the input adapter; the computer can then correct for the effect of gravity. This is called MAX GET, which stands for Maximum Gravity Effect Torque. The computer uses this value and multiplies it by the cosine of the angle at each point in the patient's range of motion. This is the amount of torque that is being contributed or taken away due to the weight of the limb and input accessory. For example, during knee extension, when gravity resists the motion, the appropriate gravity effect torque value is added. During knee flexion, when gravity assists the patient, the appropriate gravity effect torque value is subtracted.

If you decide to perform gravity correction, you must duplicate this procedure every time you test the patient in order to maintain consistent data. This will prevent any changes in patient body weight from confounding the data you are collecting.

Peak Torque

The maximum torque production during an extension/flexion.

Taking into account changes due to biomechanical leverage and the muscular length-tension relationship that occurs throughout the range of motion, peak torque is indicative of maximum muscular tension capability.

You can also analyze additional peak torque measurements at angles other than the angle of peak torque. If you note points in the initial torque curves that are affected by injury or pathology, you may wish to evaluate progress at those points during subsequent tests.

Torque to Body Weight Ratios

Clinical experience has shown this ratio to be a valuable tool for inter-individual comparisons and for evaluation of the functional strength of an individual's weight-bearing musculature. Torque to body weight ratios allow for comparisons to normative data.

Peak Torque at Additional Angles

Torque measurements at angles other than the angle of peak torque are important for a number of reasons. For example, it is useful to evaluate torque capabilities at specific, functionally critical angles. Or, you may want to observe changes or progress at an angle that the torque curve shows to be particularly affected by some injury or pathology. The NORM System Overlay Report allows you to request peak torque measurements at four additional angles at the time the report is generated.

Agonist/Antagonist Torque Ratios

Opposing muscle group torque ratios express the normally weaker muscle group torque as a percentage of the normally stronger muscle group torque. For example, in a knee extension/flexion test, knee flexion torque is expressed as a percent of knee extension torque. So, if the patient produced a peak torque in flexion of 104 ft-lbs and a peak torque in extension of 189 ft-lbs on his right side, then he had an opposing muscle group ratio of 55% on that side (104 / 189 = .55 x 100 = 55%).

This means that on the right side, at peak torque, the patient's flexors were 55% as strong as his extensors.

This ratio can exceed 100% as a result of specific training of the weaker muscle group or as a result of injury, pain or pathology affecting the normally stronger muscle group's torque development capability.

It is well established that certain patients benefit greatly from altering the "normal" opposing muscle group ratio by significantly strengthening one muscle group to offset a specific joint deficiency. For example, hamstrings strength may be increased closer to normal levels of quadriceps strength to improve stability of an anterior cruciate deficient knee. Opposing muscle group ratios are an important factor regardless of the torque capabilities of the individual muscle groups.

Initial Peak Torque

The average of the Peak Torque values for the first three repetitions of an endurance test.

Final Peak Torque

The average of the peak torque values for the last three repetitions in an endurance test. This parameter does not appear on the final report but is used in the calculation of the Fatigue Index.

Average Torque

The average production during an isometric contraction.

Fatigue Index

The percentage peak torque declined during the endurance test. Computed as the percent change from the Initial Peak Torque and the Final Peak Torque. Note A negative Fatigue Index indicates the patient produced more torque at the end of the test then the beginning.

Work per Repetition

Work is typically defined as force times distance. For rotational systems (i.e. systems which measure torques and angles), work is defined as torque times angle, where the torque is in foot-pounds and the angle is in radians. Work = Torque(ft-lbs) * Angle(deg) * 0.0175(rad/deg).

Total Work Done

The Total Work performed over an entire set.

Endurance Ratio

The ratio of the total work from the first ½ of the set to the last ½ of the set.

Average Power per Repetition

Power is defined as Work per unit time. Given the Work per Repetition in foot-pounds and the Time per Repetition in seconds, Power (watts) is computed as:

$$Power(watts) = \left(\frac{Work(ft-lbs)}{Time(\text{sec}onds)} \right) * 1.3558179$$

Position Parameters

Joint Angle at Peak Torque

The point in the range of motion where peak torque first occurs.

Range of Motion

The maximum limb excursion during extension(flexion). Each test pattern has an anatomical zero or neutral position. For an ankle Plantar/Dorsiflexion test it is with the ankle at a right angle. Ankle position is specified relative to anatomical zero. One would say the patient had a range of motion from 40 degrees of Plantarflexion to 12 degrees of Dorsiflexion, specifying both an angle (40 degrees) and a location (Plantarflexion). In order to eliminate the need for specifying angles and locations the HUMAC assigns position measurements positive and negative values based on where in the range of motion they occur. For the ankle test the HUMAC would report a range of motion from 40 to 12 degrees.

This number helps the clinician determine whether or not differences in total work performed are a result of differences in active range of motion or actual differences in muscular work output capability. For example, if part of your treatment program is designed to increase functional range of motion, accomplishing this alone will increase total work output. The patient will be able to apply torque through a greater range of motion (i.e. increased distance). Comparisons of Average Power can also be used to make this determination. At faster test speeds, limb inertia helps the agonist move the limb farther against the passive resistance of the opposing tissue structures. (This may not be true, however, in patients with neuromuscular inhibition that results in abnormal or premature antagonist activation.)

Time Parameters

Time to Peak Torque

The time from the beginning of torque development until the point where peak torque is first developed.

Time Peak Torque Held
The time during which peak torque is maintained.

Force Decay Time
The time from the end of peak torque production to the end of the motion.

Reciprocal Delay
The time required to reverse the limb direction.

Delay Time
The time from the beginning of a motion until the beginning of torque development.

Time to Half Peak Torque (Isometric Report)
The time from the beginning of torque development until the point where the torque is 1/2 the peak torque.

Interactive Parameters

Percent on Target
The percent of time the patient was within the target zone.

Coefficient of Variation
The Coefficient of Variation between the patient position (isotonic mode) or torque (isometric mode) and the target value.

Maximum Deviation
The maximum deviation (difference) between the patient position (isotonic mode) or torque (isometric mode) and the target value.

Response Time
The time between when the Response Time target moved and the patient responded.

Settling Time
The time between when the patient responded to the new target position and when the patient first entered the target zone and maintained their position inside the zone for the target time. For example, assume the target time is 0.2s. If the patient begins moving toward the target at time 0.3s, reaches the target at 0.8s, moves out of the target at 0.9s (0.1s after entering the target), re-enters the target at 1.4s and then stays inside the target for 0.2s, their settling time is 1.1s (1.4s - 0.3s).

Coefficient of Variance
The Coefficient of Variance (COV), a statistical measurement for the accuracy of the data being collected. It is derived by dividing the standard deviation by the mean.

SECTION 4.DASHBOARD

The HUMAC Dashboard allows you to control the basic functions of the HUMAC and provide patient feedback without running a test or exercise protocol. Data is not saved when using the Dashboard.

Accessing the Dashboard

1. Click the **Dashboard** button or from **Utilities** menu, select **Dashboard**.

Pattern

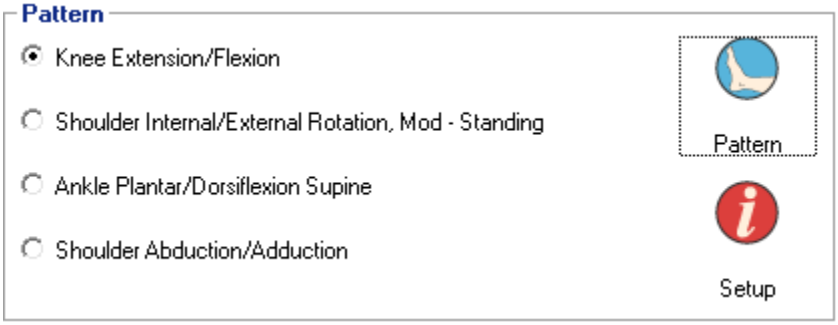


Figure 4-1 Dashboard: Pattern

- The most commonly selected patterns are displayed as the first three quick choices.
- To select a different pattern, click the **Pattern** button. The newly selected pattern will be displayed as the forth quick choice.
- Click the **Setup** button for instructions on the dynamometer setup.

Mode and Action

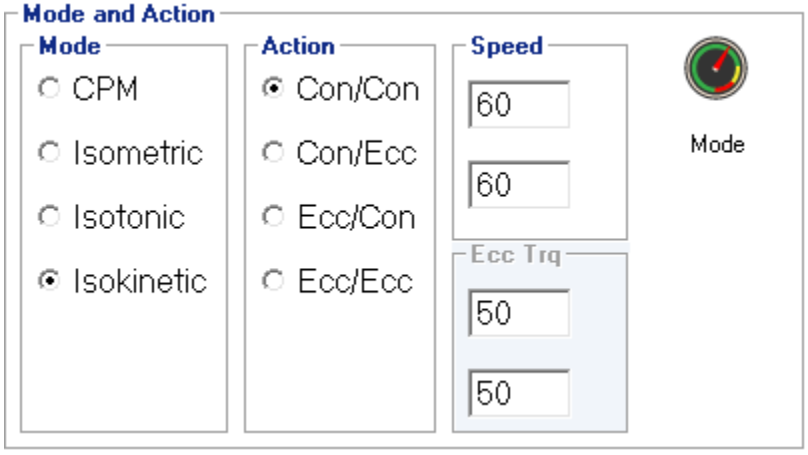


Figure 4-2 Dashboard: Mode & Action

- The most common Mode and Action settings displayed as the quick choices.
- For more detailed settings, click the **Mode** button.

The Dashboard allows you to run System Protocols. To run a protocol:

1. Clear the **Manual Settings** checkbox.
2. Select a **Protocol** from the Pull-Down list.
3. Select the first row in the Protocol.
4. Click the **Single Set** or **All Sets** button.

*Note: The **Single Set** or **All Sets** buttons (like the **Go** button) are only enabled after you have set the ROM.*

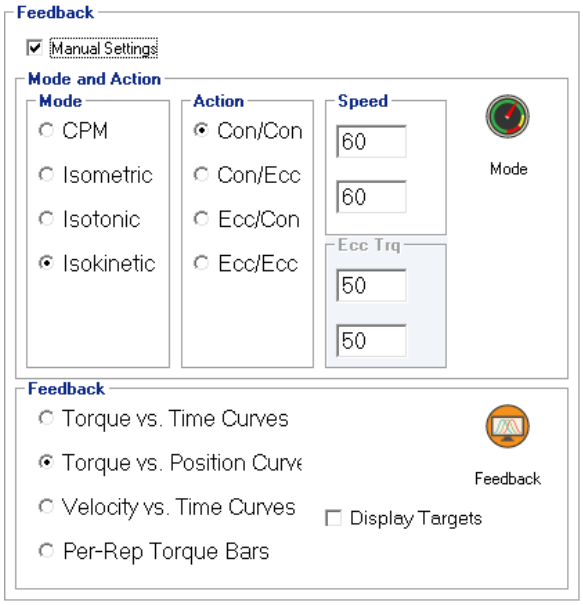


Figure 4-3 Dashboard: Manual Settings

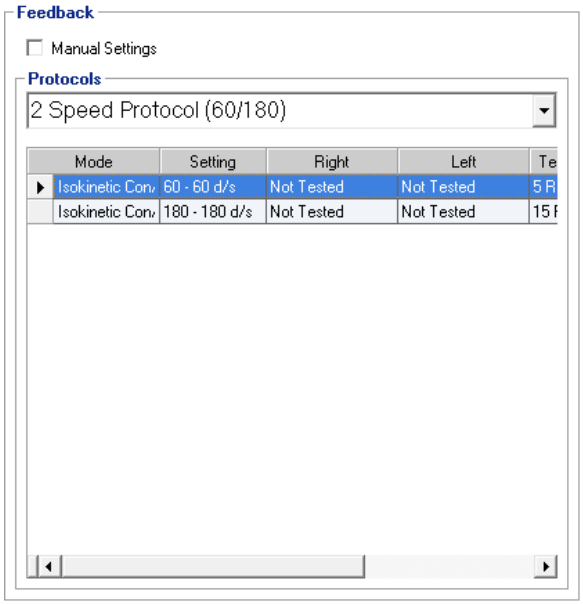


Figure 4-4 Dashboard: Protocols

Feedback

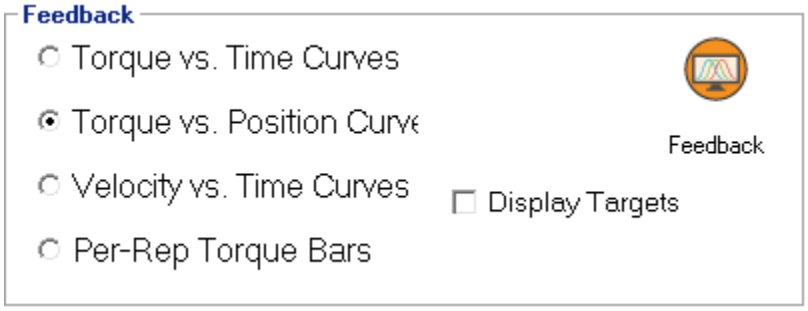


Figure 4-5 Dashboard: Feedback

1. The most commonly selected feedback modes are displayed as the first three quick choices.
2. To select a mode, click the **Feedback** button. The newly selected mode will be displayed as the forth quick choice.

Side

Figure 4-6 Dashboard: Side

1. Select the side to be exercised.

Anatomical Zero

Figure 4-7 Dashboard: AZ

1. Set the Anatomical Zero. If the patient cannot reach the AZ, enter the limb **offset** the click the **SetAZ** button.

Range of Motion

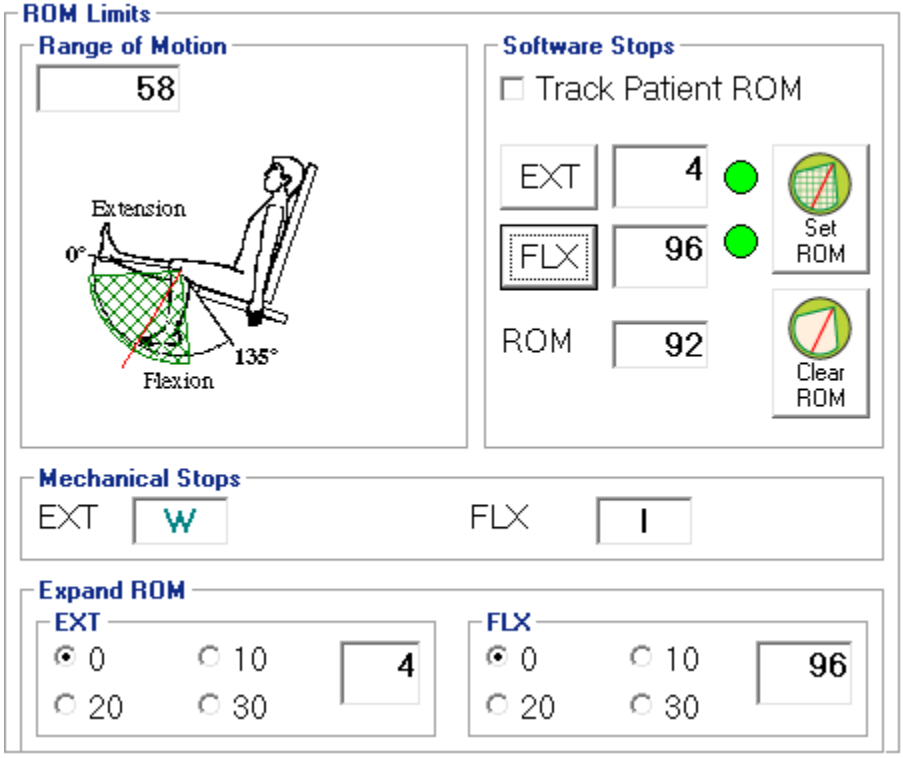


Figure 4-8 Dashboard: ROM Limits

1. Set the Range of Motion limits for the exercise.

Note: *Refer to the "Range of Motion Limits" Section for a complete description of the ROM Limit options.*

Zero Gravity

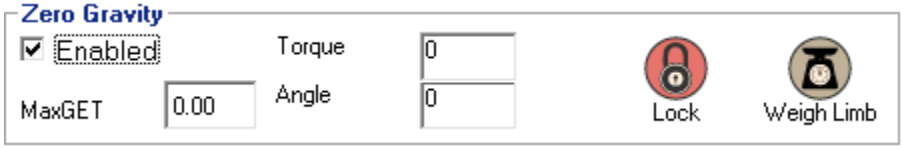


Figure 4-9 Dashboard: Zero Gravity

In Zero-Gravity mode the dynamometer provides active compensation for the limb and input adapter weight so the limb feels weightless. (For a complete description of Zero Gravity Mode, see Section on "*Protocol-Mode*".)

To enable Zero Gravity:

1. Click the **Enabled** checkbox.
2. Move the patient limb as close to Horizontal as possible without initiating a stretch.
3. Click the **Lock** button to hold the limb in-place.
4. Click the **Weigh Limb** button.
5. Click the **Unlock** button.
6. Zero Gravity will be turned-on when the feedback display is showing.

Begin the Exercise

1. Click the **Start** button to begin the exercise.

Note: *After completing an Isometric exercise, the dynamometer remains in isometric mode. Use the UnLock button to switch the dynamometer to isokinetic mode.*

Proprioception Testing

In addition to the Proprioception test in the Testing Protocols, the HUMAC includes a Proprioception testing function from the Dashboard which can be used in Isometric (to test position-based proprioception) or CPM mode (to test velocity-based proprioception).

Running a Position-Based Test

1. From the main HUMAC screen, click the **Dashboard** button.
2. Select **Isometric** mode and the desired joint angle.
3. Set the **ROM**.
4. Click the **Proprioception** button.
5. Click the **Demonstrate** button to show the patient the isometric test angle.
6. When you are ready to test the patient, click the **Test Patient** button. The HUMAC will enter Isokinetic Con/Con mode so the patient is free to move their limb.
7. When the patient feels they are at the test angle, click the **Read Value** button. The HUMAC will record the actual position and compute the difference between the test angle and the actual angle.

Up to three independent trials (**Read Value**) can be performed. The HUMAC automatically compute the Correlation between the test angle and the patient angle.

Running a Velocity-Based Test

1. From the main HUMAC screen, click the **Dashboard** button.
2. Select **CPM** mode and the desired test speed.
3. Set the **ROM**.
4. Click the **Proprioception** button.
5. Click the **Demonstrate** button to show the patient the CPM test speed.
6. When you are ready to test the patient, click the **Test Patient** button. The HUMAC will enter Isokinetic Con/Con mode so the patient is free to move their limb.
7. When the patient feels they are at the test speed, click the **Read Value** button. The HUMAC will record the actual speed and compute the difference between the test speed and the actual speed.

Up to three independent trials (Read Value) can be performed. The HUMAC automatically compute the Correlation between the test speed and the patient speed.

Note:

1. *At any time you can use the **Demonstrate** button to show the patient the test angle/speed again.*
2. *The **Clear** button erases the measured trial values.*

SECTION 5.GROUP SUMMARY

The HUMAC Group Summary program computes summary data over various patient populations. Summaries are stored in a Group Summary database, allowing the clinic to build a library of summary data results. Reports can be printed for a stored group or comparing a patient to the group.

Computing a Group Summary

1. From the **Group Summary** menu, select **My Data**.

Adding a New Group Summary to the Database

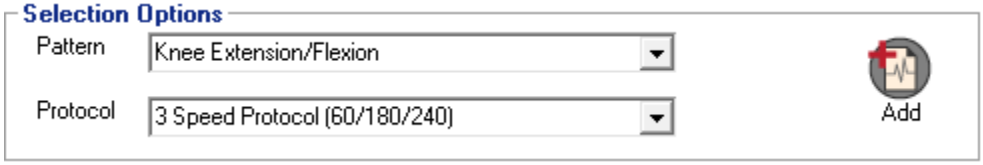


Figure 5-1 Group Summary: Add

1. Select the **Pattern**, e.g. Knee Ex/Fl.
2. Select the **Protocol**.
3. Click the **Add** button.
4. Enter the **Summary name**, e.g. Three Speed Knee Protocol and click the OK button.
5. The HUMAC will add the new summary to the Group Summary Database.

Note: *The HUMAC has added a blank group summary record for the selected pattern and protocol. When you click the Summarize button, the HUMAC reads through the database of tests and populates the group summary record.*

Computing the Summary

Setting the Group Criteria

The Group Summary filter allows you to select which patients will be included in the summary. The following example includes patents from 25 to 40 years old when the test was performed with an ACL Tear. Only tests which were performed within 31 days of the injury will be included. You can independently specify the From and To values.

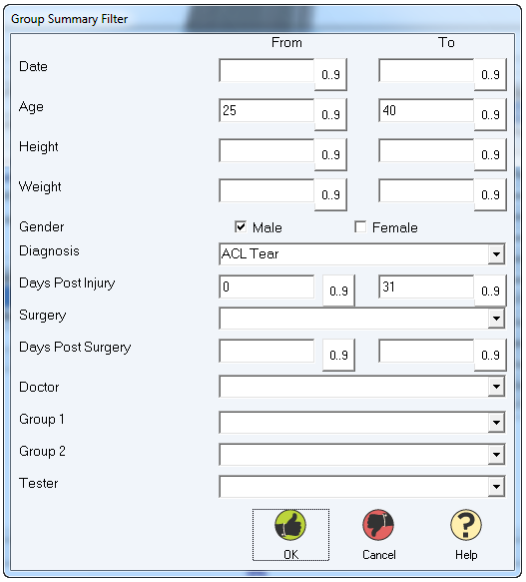


Figure 5-2 Group Summary: Filter

1. Click the **Background** button.
2. Enter the criteria.
3. Click the **OK** button to save the criteria.

From	To	Description
Blank	**Blank**	Ignore the field
Blank	**40**	All patients <= 40 years old when the test was performed.
25	**Blank**	All patients >= 25 years old when the test was performed.
25	**40**	All patients from 25 to 40 years old when the test was performed.

Select Tests

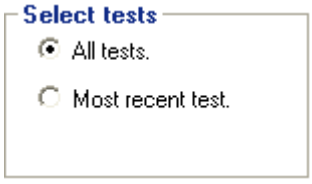


Figure 5-3 Group Summary: Select Tests

Tag	Description
All Tests	Include all tests for each patient in the summary.
Most Recent Test	Include the most recent test for each patient in the summary. This option prevents a patient who has been tested multiple times from skewing the results.

Side

Figure 5-4 Group Summary: Side

Tag	Description
Right vs. Left	Average Right side data vs. Left side data.
Dominant vs. Non-Dominant	Average Dominant side data vs. Non-Dominant side data.
Involved vs. UnInvolved	Average Involved side data vs. UnInvolved side data.

Summarizing the Data

Click the Summarize button. The HUMAC will read each test in the database, compute the measured parameters, and store them in the Summary Database.

Note:

1. *When you change the summary criteria, you must re-summarize the data to compute the results for the new group.*
2. *When you test additional patients which you want to include in the Group Summary, simply select the Stored Summary and click the Summarize button. The HUMAC will re-compute the summary for all tests stored in the database.*

Exporting a Summary to Microsoft Access

1. From the Group Summary database area, select the **Group Summary record** you want to Export.
2. Click the **Access** button.
3. The HUMAC display the File Open dialog box and export the data computed in the Summary to an Access data file.

Group Summary - Access Data Format

The Group Summary program can export the summarized results to an Access 2000 data file. The file includes a collection of tables containing the more detailed Patient Information, Dynamometer Settings, and Per-repetition values. Advanced users may want to use the Linked Table to perform advanced Queries and Data Analysis.

1. To export to Access, click the **Access** button.

Tables

Tag	Description
Protocol	Table containing one row for each patient test or exercise session.
ProtocolRow	Table containing the settings for each set (row) in the Protocol.

Tag	Description
Demographics	The patient background information for each Protocol.
Vals	The per-repetition values for each row in the ProtocolRow.
Stats	The Average (or Peak based on the Preferences) and Coefficient of Variation for each row in the ProtocolRow.

Fields

Each table include a description of its' data fields. To access the field descriptions:

1. Open the exported Access table.
2. Single-click the **table** to select it.
3. Click the **Design** icon.
4. The **Description** column contains the field description.

Group Summary - Access Data Format

The Group Summary results can be exported to an Excel Spreadsheet. (See "*Export a Test to Excel*" for a description of the exported file.)

1. To export to Excel, click the **Excel** button.

Printing a Summary Report

2. In the **Group Summary Database** area, select the Group Summary record you want to Preview/Print.
3. Click the **Preview** or **Print** button.

Comparing a Patient to a Group Summary

1. From the Main HUMAC menu, select the **Patient**.
2. From the **Group Summary** menu, select **My Data**.
3. In the **Group Summary Database** area, select the Group Summary record you want to compare the patient to.
4. In the **Patient** area, select the Patient session you want to compare to the Group Summary.
5. In the **Patient** area click the **Preview** or **Print** button.

Deleting a Group Summary

1. From the **Group Summary Database** area, select the Group Summary record you want to Delete.
2. Click the **Delete** button.

Note: *Deleting the Group Summary only deletes the summarized results. The original patient tests remain in the HUMAC database.*

SECTION 6.UTILITIES

Calibration

Calibration, in general, is a process for adjusting or "fine tuning" the accuracy of the gradations of a measurement system.

- The NORM System is capable of measuring form 0 to 500 ft-lbs (678 Nm.) of torque and attaining speed of up to 500 deg/sec.
- The weight calibration procedure makes use of the principle that *A quantity of weight on an input arm set to a specific, pre-determined length will generate a known amount of torque when it falls*.
- During the Torque calibration, a quantity of weight (100 lbs) is “dropped”. The long adjustable arm is set to a specific length. The system is shown the amount of torque is should "read" when the specific quantity of weight is dropped.
- Following the weight-drop, the system adjusts is internal conversion factors.

Initial calibration of the NORM System is performed by CSMI personnel during installation. Thereafter, to ensure its measurement accuracy, the NORM System should be periodically calibrated. Torque calibration should also be performed after any reinstallation of software, or anytime new or updated software is installed.

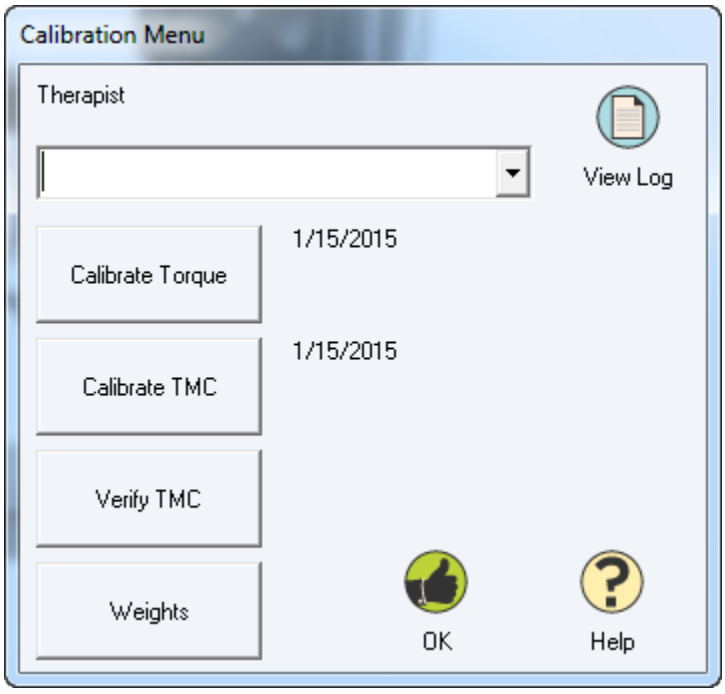


Figure 6-1 Calibration Menu

Dynamometer Calibration Setup

The parts and accessories listed below are needed to perform the torque calibration.

- **The Calibration Weights:** Weights, totaling 100 lbs. are needed. Four 25-lb. weights are included with the NORM System. The calibration weights are certified at CSMi and their actual weights recorded on the side of each plate.
- **The Knee/Hip Adapter:** In the calibration process, this accessory will be connected directly to the dynamometer input arm and hold the specified weights.

Note: *The original CSMi/NORM dynamometer torque calibration procedure assumed a calibration torque of 150 ft-lbs, which ignores the torque of the input adapter. The actual value with the weights and input adapter is 154.5 ft-lbs. We suggest using the value of 154.5 ft-lbs which results in more accurate torque data reporting. Use the HUMAC Preferences form to select which calibration value you want to use.*

Calibration Weights

The original NORM weights were manufactured to 25 lbs. The original CYBEX weights have the word "CYBEX" in raised letters on the side of each plate.

The newer CSMi weights are weighed and their weights recorded directly on the weight. The CSMi weights do not have the word "CYBEX" in raised letters on the side of each plate.

Entering the Weight Values

1. From the **Utilities** menu, select **Calibration**.
2. From the **Calibration** form, click the **Weights** button.
3. Original CYBEX Weights: From the Calibration Weights form, enter the 25 for each Weight value and click the OK button.
4. CSMi Weights: From the Calibration Weights form, enter the value written on the side of each weight in the corresponding field and click the OK button. ***Note:*** *When performing a Calibration or Verification with the CSMi weights, you should use the numbered weights as indicated on the HUMAC Screen.*

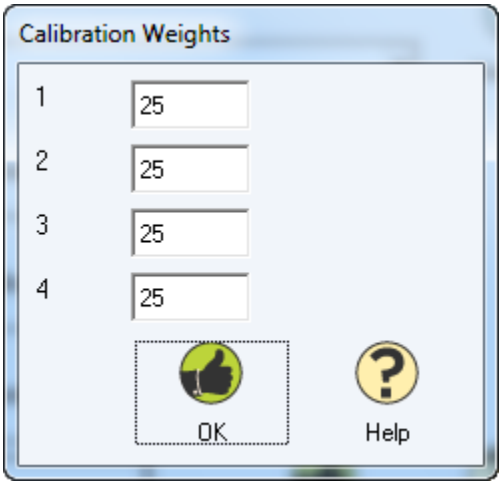
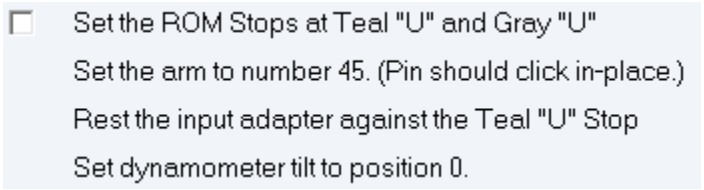


Figure 6-2 Calibration: Weights

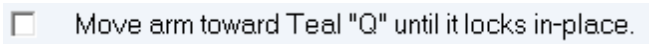
Calibrate Torque

1. On the **Utilities** menu, click **Calibration**.

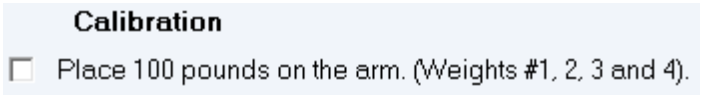
2. From the **Calibration Menu**, click **Calibrate Torque**.
3. Setup the dynamometer for the calibration. Only the Knee/Hip Adapter should be installed on the dynamometer input arm. Rest the input adapter against (above) the Teal “U” stop. Click the box when the dynamometer is positioned correctly.



4. Raise the input adapter toward the Teal “Q” stop until the arm locks into isometric mode, then click the box.

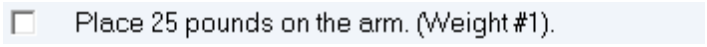


5. Carefully load 100 pounds of weight onto the Knee/Hip adapter. After the weights are loaded, make sure the monitor and keyboard are clear of the dynamometer, stand clear of the dynamometer input arm, and check the box. The arm will go through one cycle from the Teal “Q” to the Gray “Q” and back to the Teal “Q”.



6. After the arm reaches the Teal “Q” it will stop moving. The calibration is now complete. Click the Checkbox to begin the verification.

7. The arm will go through one cycle from the Teal “Q” to the Gray “Q” and back to the Teal “Q”. After the arm reaches the Teal “Q” it will stop moving. Remove weights #2, 3, and 4 and click the Checkbox to begin the 25 pound verification.



8. The HUMAC will display the verification results for the CW and CCW directions.

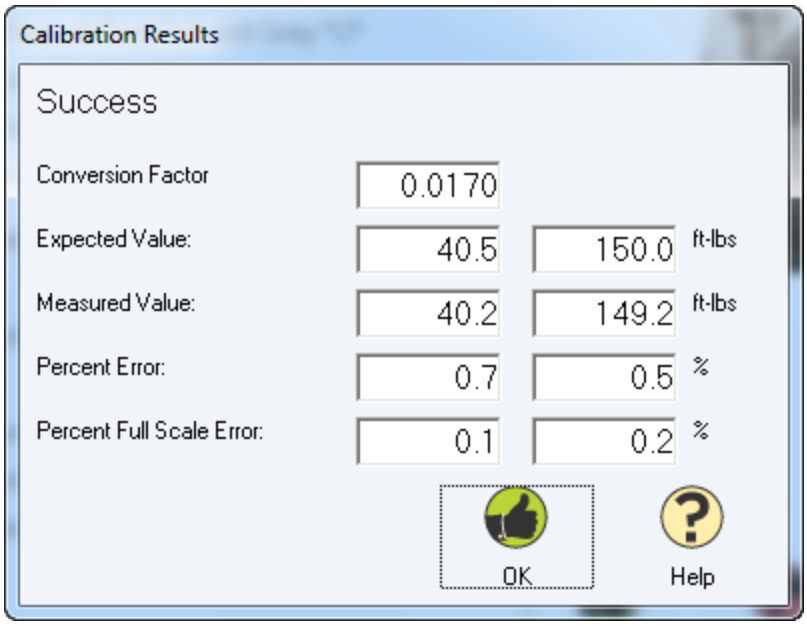


Figure 6-3 Calibration: Results

Note: *If the HUMAC reports Verification Error, you should repeat the calibration and verification procedures. If the HUMAC reports an error a second time, contact CSMI Technical Support.*

TMC Calibration Setup

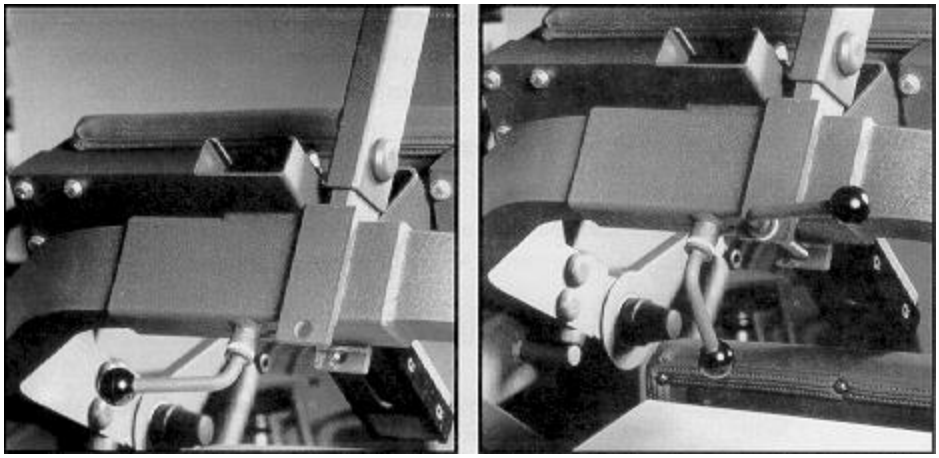
The parts and accessories listed below are needed to perform the torque calibration.

- **Calibration Weights:** Weights, totaling 750 lbs. are needed. Three 25-lb. weights are included with the NORM System.
- **Calibration T-Bar and Locking Knob:** The T-bar is locked onto the TEF Modular Component's input arm assembly during calibration and is used to hold the specific weight.

Note: *Because of the design of the TMC and Calibration Bar, the Calibration and Verification functions must be run separately.*

TMC Calibration Setup

1. Position the reclining chair and dynamometer as indicated on the screen.
2. Dock the TEF Modular Component as indicated.
3. Prepare the TEF Modular Component.
    a. Remove the chest pad and hang it on the chest pad storage bracket.
    b. Loosen the scapular pad locking lever and move the scapular pad to its lowest position.
    c. Tighten the scapular pad but leave its locking lever in a position where it will not interfere with the calibration T-bar's locking lever. Notice the holes in the base of the T-bar. The inside of one hole is smooth while the other is threaded. Place the T-bar over the input arm assembly as close to the scapular pad adjustment channel as possible, with the threaded hole toward the front of the TEF Modular Component (the push buttons on the top of the T will be facing forward). Insert the T-bar's locking lever through the first hole in the base of the T-bar and screw it into the second.



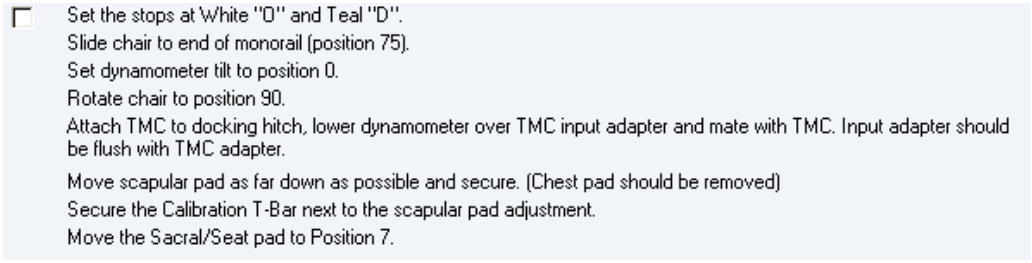
    d. Move the sacral/seat pad to the position indicated.
    e. Move the TEF Modular Component's input arm through its range of motion. Make sure there are not obstructions in the path of the input arm assembly as it should not be hindered during the data collection process. It should move freely within the range of motion indicated by the ROM stops.

Note When performing a calibration it does not matter if the T-bar is placed to the left or right of the scapular pad adjustment channel. However, it is recommend that the T-bar be consistently placed in the same position whenever a calibration or verification is performed.

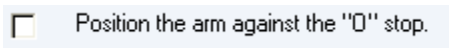
Caution Exercise caution whenever the T-bar is attached to the input arm assembly.

Calibrate TMC

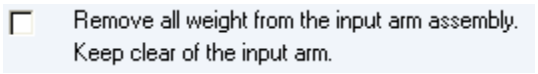
1. On the **Utilities** menu, click **Calibration**.
2. From the **Calibration Menu**, click **Calibrate TMC**.
3. Setup the TMC for the calibration. Click the box or press the space key when the TMC is setup correctly.



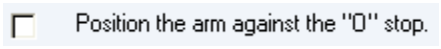
4. Raise the input adapter toward full extension until the arm locks into isometric mode. Click the box or press the space key to continue.



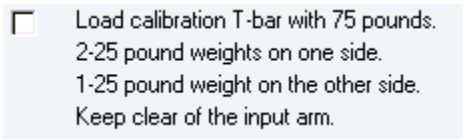
5. Verify no weights are on the T-bar. Stand clear of the dyna input arm, and check the box. The T-bar will begin to fall and will pause near horizontal for a few seconds.



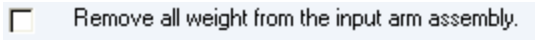
6. When the first drop is completed, the following box will be enabled. Raise the input adapter toward full extension until the arm locks into isometric mode. Click the box or press the space key to continue.



7. Carefully load 75 pounds onto the T-bar. Two 25-pound weights should be placed on one side of the T-bar. One 25-pound weight should be placed on the other side. ***Important*** Stand clear of the TEF Modular Component and T-bar assembly when placing the weights on the T-bar. Do not stand below the T-bar. Check this box when the weights are loaded on the arm. The TMC will begin the weight drop and will pause near horizontal for a few seconds.



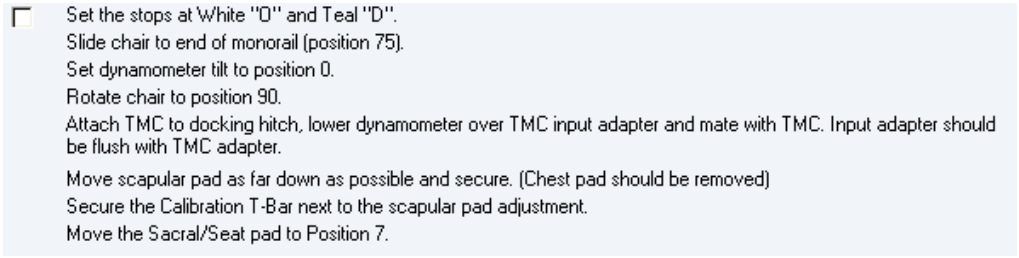
8. When the second drop is completed, the following box will be enabled. Remove the weights from the T-bar and then check this box.



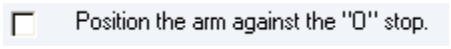
Note: *After performing a calibration, you should Verify the TMC Torque.*

Verify TMC

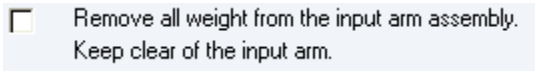
1. On the **Utilities** menu, click **Calibration**.
2. From the **Calibration Menu**, click **Calibrate TMC**.
3. Setup the TMC for the calibration. Click the box or press the space key when the TMC is setup correctly.



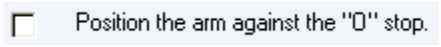
4. Raise the input adapter toward full extension until the arm locks into isometric mode. Click the box or press the space key to continue.



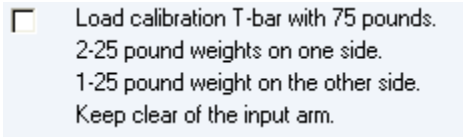
5. Verify no weights are on the T-bar. Stand clear of the dyna input arm, and check the box. The T-bar will begin to fall and will pause near horizontal for a few seconds.



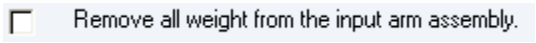
6. When the first drop is completed, the following box will be enabled. Raise the input adapter toward full extension until the arm locks into isometric mode. Click the box or press the space key to continue.



7. Carefully load 75 pounds onto the T-bar. Two 25-pound weights should be placed on one side of the T-bar. One 25-pound weight should be placed on the other side. ***Important:*** *Stand clear of the TEF Modular Component and T-bar assembly when placing the weights on the T-bar. Do not stand below the T-bar. Check this box when the weights are loaded on the arm. The TMC will begin the weight drop and will pause near horizontal for a few seconds.*



8. When the second drop is completed, the following box will be enabled. Remove the weights from the T-bar and then check this box.



9. The HUMAC will display the verification results.

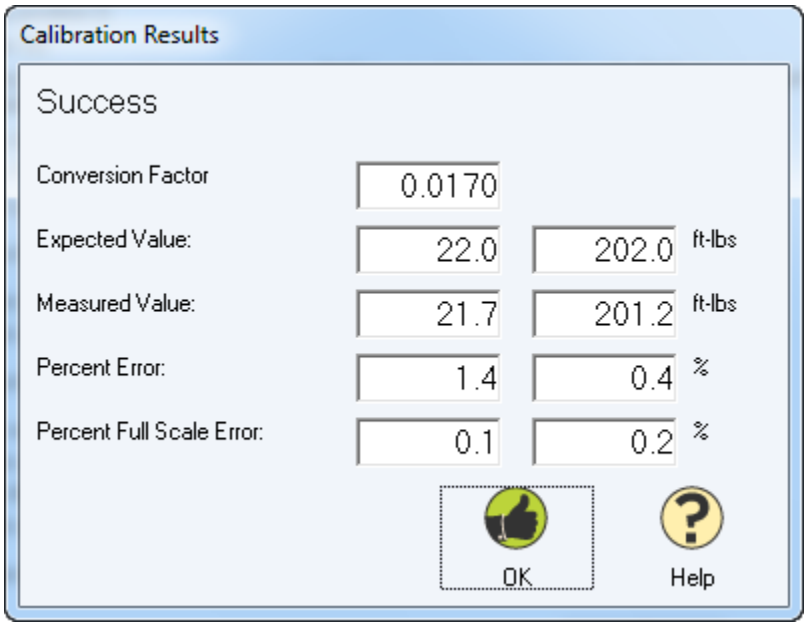


Figure 6-4 TMC Calibration: Results

Note: *If the HUMAC reports Verification Error, you should repeat the calibration and verification procedures. If the HUMAC reports an error a second time, contact CSMI Technical Support.*

Calibration Log

The HUMAC Calibration Log displays your calibration and verification values.

Tag	Description
Date	Date the Calibration or Verification was run.
Calibration	Yes indicates a calibration was done. No indicates a verification was done.
Type	The data channel (Torque, Position, or Speed) which was calibrated/verified.
Machine	The machine which was calibrated/verified.
ConvFact	The calculated Conversion Factor. The HUMAC uses the Conversion Factor to convert data from the HUMAC Interface to foot-pound and degree values. This is only displayed for Calibrations.
Verify1	The measured torque during the small weight drop. This is only displayed for Verifications.
Verify2	The measured torque during the large weight drop. This is only displayed for Verifications.
Therapist	The therapist who performed the Calibration or Verification.
Small	The HUMAC A/D value during the small weight drop.
Big	The HUMAC A/D value during the big weight drop.
Baseline	For the LiftTask and Weight Stack machines, this contains the 0 force baseline value. For all other CSMi machines this value is blank. This is only displayed for Calibrations.
Adapter	If true, the calibration was performed adjusting for the input adapter weight.

Tag	Description
Dyna	The dynamometer number. The CSMI-1000 utilizes 2 dynamometers (0 and 1). For all other machines the Dyna is 0.
Side	The dynamometer side. The CSMI-1000 and 1200 utilizes double-sided shafts. The shaft side next to the speed setting knob is 0, the other shaft side is 1. For all other machines the Side is 0.

Sensor Test

The HUMAC Sensor Test command displays the unconverted torque and position data from the HUMAC Interface. The sensor test is used to verify the HUMAC is receiving the torque and position signals from the dynamometer.

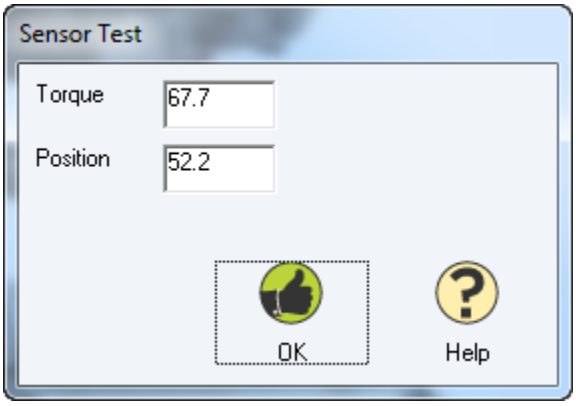


Figure 6-5 Sensor Test

Running the Sensor Test

1. On the **Utilities** menu, click **Sensor Test**.
2. Move the dynamometer input arm back and forth to verify the torque and position numbers change.

Auxiliary Outputs

The HUMAC board provides Auxiliary Torque, Position, and Velocity analog outputs.

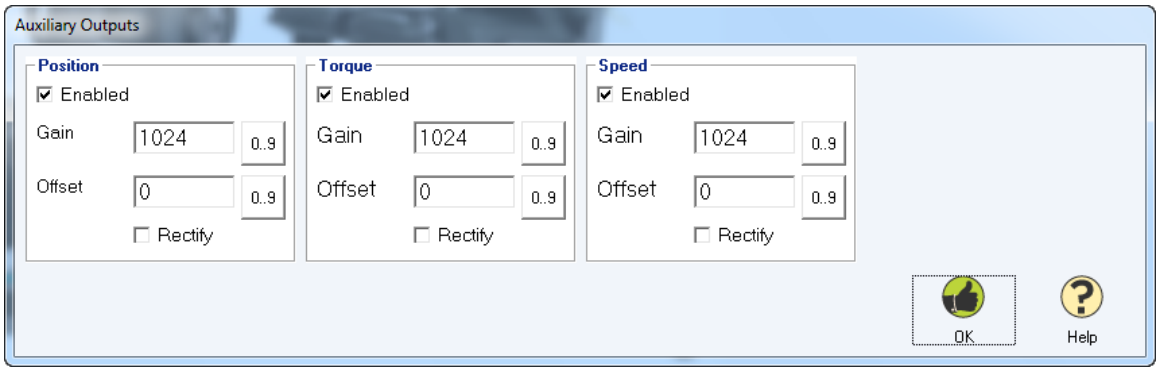


Figure 6-6 Auxiliary Outputs

The conversion from the sampled digital data to the analog outputs uses the following equations:

Channel	Equation
Position Output	(Gain * (Sampled Position + Offset) / 1024) * (10v/32768)
Torque Output	(Gain * (Sampled Torque + Offset) / 1024) * (10v/32768)
Velocity Output	(Gain * (Sampled Velocity + Offset) / 1024) * (10v/32768)
Enabled	When checked the HUMAC outputs the analog data.
Rectify	When checked the auxiliary output computes the Absolute Value(Sampled Data + Offset) before applying the Gain. This is typically used if you want the torque to always be a positive voltage.

Note

- Sampled Position is in units of 1/16 degree.
- Sampled Torque is in units of Foot-Pounds * 32768 / 500. (This is an approximate value. Exact values must be obtained by calibrating the analog output to a known torque input.)
- Sampled Velocity is in units of 1/16 degree.

Adjust Auxiliary Outputs

1. On the **Utilities** menu, click **Auxiliary Outputs**.
2. Enter the desired conversions values.

Auxiliary Output Connector – 32-bit HUMAC Interface

1. Three 16-bit analog outputs, 1 digital direction output.
2. Output range is ±10v.
3. HUMAC Program allows the user to set the output Gain, Offset, and Rectification.

NORM

The Auxiliary Outputs are accessible via the DB-9 connector at the rear of the HUMAC Interface. Mating connector is DB-9 Male. Amp 747904-2 or equivalent.

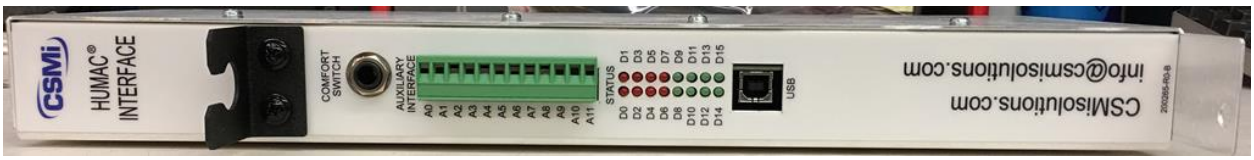
PIN	SIGNAL
1	COMMON
2	COMMON
3	COMMON
4	COMMON
5	COMMON
6	POSITION
7	TORQUE
8	VELOCITY
9	DIRECTION

Biodex System2, System3

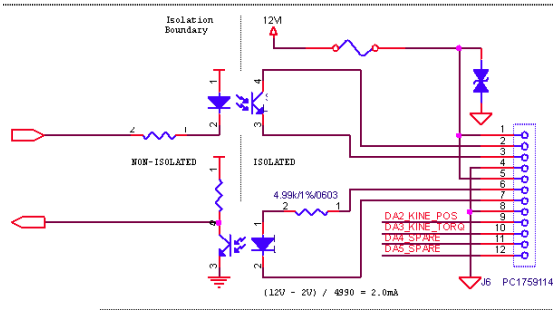
The Auxiliary Outputs are accessible via J15 on the HUMAC interface. Mating connector is CST-100 Housing & Terminals (8-Position). Housing is AMP 770602-8 or equivalent. Terminals are AMP 770666-1 or equivalent.

PIN	SIGNAL
1	POSITION
2	COMMON
3	TORQUE
4	COMMON
5	VELOCITY
6	COMMON
7	DIRECTION
8	COMMON
9	Direction

64-Bit Interface



1. Four 16-bit analog outputs, 1 digital sync input, 1 digital sync output and a +12v supply.
2. Output range is ±10v.
3. All Auxiliary signals are electrically isolated.
4. HUMAC Program allows the user to set the output Gain, Offset, and Rectification.



NORM, Biodex System2

The Auxiliary Outputs are accessible via the green screw-type connector at the front of the HUMAC Interface.

POS	LABEL	SIGNAL	DESCRIPTION
12	A0	DIRECTION	16-BIT ANALOG DIRECTION
11	A1	VELOCITY	16-BIT ANALOG VELOCITY
10	A2	TORQUE	16-BIT ANALOG TORQUE
9	A3	POSITION	16-BIT ANALOG POSITION
8	A4	GROUND	GROUND
7	A5	SYNC_IN_0	DIGITAL SYNC INPUT
6	A6	SYNC_IN_1	DIGITAL SYNC INPUT
5	A7	+12V	+12V
4	A8	GROUND	GROUND
3	A9	SYNC_OUT_0	DIGITAL SYNC OUT EMITTER
2	A10	SYNC_OUT_1	DIGITAL SYNC OUT BASE
1	A11	+12v	+12V

Biodex System3, System4

The Auxiliary Outputs are accessible via the DB-15 connector at the rear of the Biodex. ***Note:*** *Requires HUMAC Internal Biodex Aux Output adapter cable.*

DB-15 PIN	SIGNAL	DESCRIPTION
1	COMMON	COMMON
2	TORQUE	16-BIT ANALOG TORQUE
3	VELOCITY	16-BIT ANALOG VELOCITY
4	POSITION	16-BIT ANALOG POSITION
5	SYNC_OUT	SYNC_OUT (NOT USED)
6-9	RESERVED	DO NOT USE
10	COMMON	COMMON
11-15	N/C	NO CONNECTION

Error Log

The HUMAC maintains an error log which lists the machine mode, settings, error and time/date the error occurred.

Displaying the Error Log

1. From the **Utilities** menu, select **Error Log**.

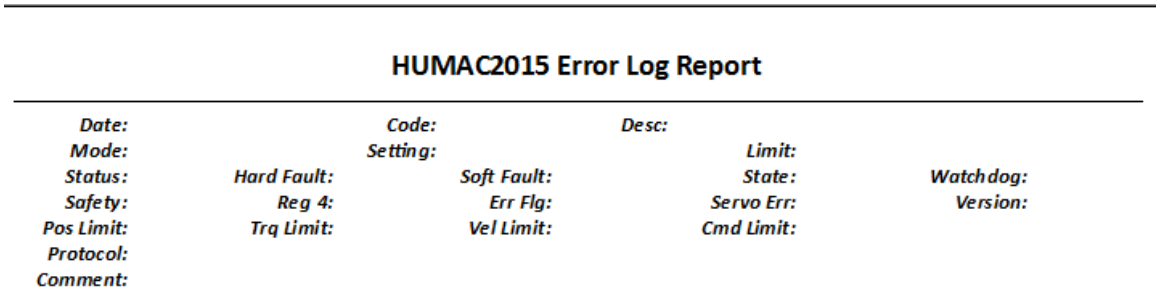


Figure 6-7 Error Log

Edit Background Information

The HUMAC allows you to edit the patient background information for stored tests. This is typically used after you complete a test or exercise session and realize the patient's weight, injury, or other information was is incorrect.

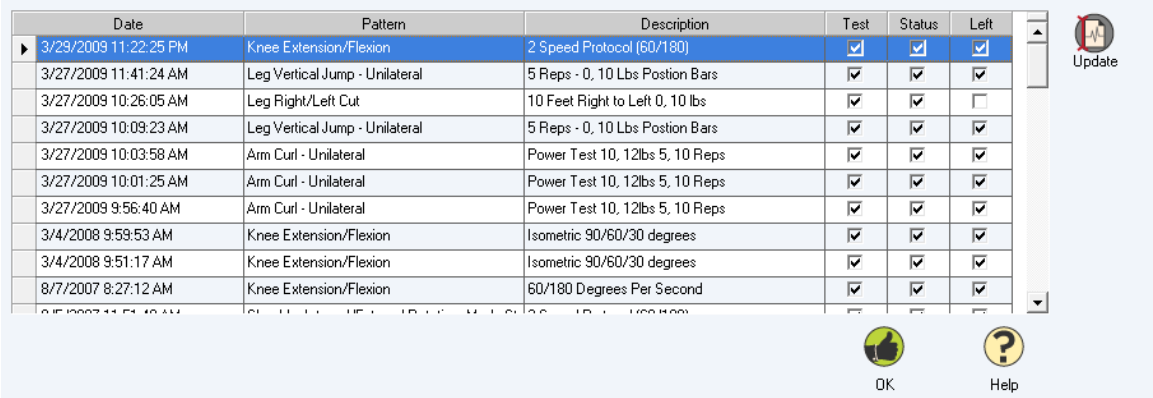


Figure 6-8 Edit Background Information

Edit Background Information

1. Select the Patient who's data you want to edit.
2. On the **Database** menu, click **Edit Background**.
3. Click the **Test/Exercise record** you want to edit.
4. Click **Update** to open the patient background information form.
5. Edit the patient information and click **OK** to save your changes.

Deleting Stored Tests

The **Database**, **Delete Record** command allows you to delete stored test and exercise records from the database.

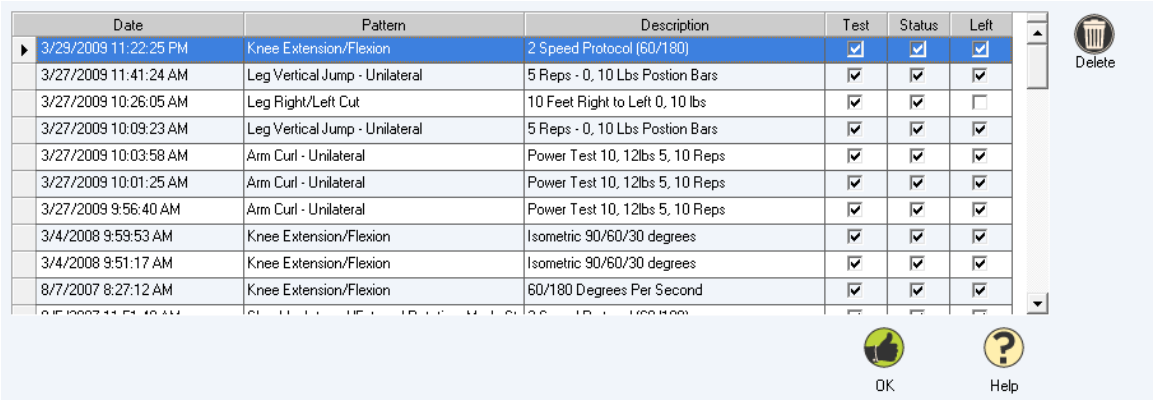


Figure 6-9 Delete Stored Test

Deleting a Stored Test

1. On the **Database** menu, click **Delete Record**.
2. Click the **Test/Exercise record** you want to delete.
3. Click **Delete** to delete the record.

Note:

- *Deleted records cannot be restored.*
- *Use the delete function in the patient selection form to quickly delete a patient and all their stored test and exercise sessions.*

Backup

We suggest you perform periodic backups to assure your data can be restored in the event of a computer failure. You can do a backup via an **External File Copy** or with the **HUMAC Backup Command**.

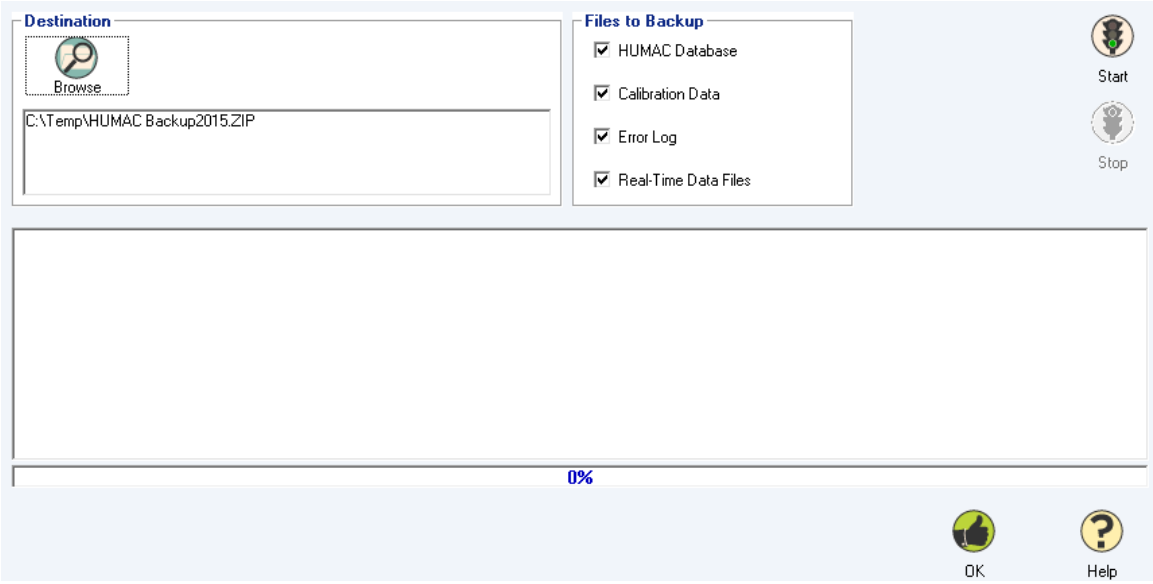


Figure 6-10 Backup Database

Actions

Tag	Description
Set Backup Destination	During a backup the HUMAC compresses your data into a file called **HUMAC Backup.ZIP**. This file can be on floppy disk, a ZIP drive, a local hard drive (which should be different than the drive holding the HUMAC database), or a network. The **Set Backup Destination** option allows you to specify where the backup file will be created.
Files to Backup	The Files to Backup area allows you to select which files will be added to your backup. Typically you would select all of the files. When contacting CSMI to resolve a question, we may request you only select one type of file for backup and then send the backup to CSMI.
Backup	Start the backup.
Abort	Abort the backup currently in progress and delete the backup file.

Backup Your Data

1. On the **File** menu, click **Backup**.
2. Click **Set Backup Destination**.
3. From the Windows **File Open** dialog box, select the destination for the backup.
4. Select the **Files to Backup**. Typically you would select all files.
5. Click the **Backup** button.

Note *Some sites prefer to use CD-R or CD-RW media for backup. These media require special programs provided with the CD drive to write data to the CD. If you will be using the HUMAC Backup Command you*

must perform the backup to a folder on the computer's hard drive and then use the CD-supplied software to copy the HUMAC Backup.ZIP file to the CD.

Data File Location

The HUMAC database can be stored on your local computer or on a network.

1. On the **File** menu, click **Database**, **Open**.
2. When the Windows **Open File** dialog box appears, locate and open your HUMAC database (**User HUMAC2015.MDB**).

Compress

If you make frequent changes in the HUMAC database, sections of the database may become fragmented. Therefore, it is a good idea to periodically compress the database.

Schedule the compression depending on how much the data changes. If the data does not change that often, you do not have to compress that much. If there are many and frequent updates, inserts, and deletes, compress more. Even though there is no formal rule for how often to compact, Microsoft recommends that you compress on a regular basis.

For a detailed description of the compress function, see the Microsoft Knowledge Base article *Q209769 ACC2000: Defragment and Compact Database to Improve Performance*.

Compress the Database

1. On the **File** menu, click **Compress**.
2. Click **Yes** to compress the database.

Note *During the compress function the mouse pointer will change to an hourglass. Because the compress function is a Microsoft internal database function you will not see any progress indicators. The HUMAC will display a message when the compression is successfully completed.*

Import: Database

The HUMAC **Import Database** command allows you to combine data from multiple HUMAC databases into a single database for reporting and group summary analysis. Each HUMAC Database is a unique GUID. Use the **Help**, **About** command to view the GUID for your database.

IMPORTANT: *The Import Database function is used to combine multiple databases into a single HUMAC Database at a central location. To upgrade an existing database to the HUMAC2015 format, use the File, Upgrade command.*

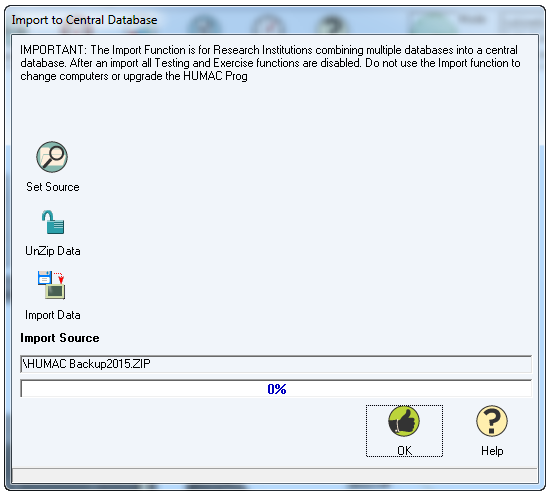


Figure 6-11 Import Database

Actions	Description
Set Source	Point to the source media (CD, ZIP disk) containing the HUMAC Backup data.
UnZip Data	UnZip a HUMAC Backup file.
Import Data	Read the backup data into the database.

Importing Data When the Sending Sites Backup Their HUMAC Data

1. Each site creates a backup of their data and sends it to the central location.
2. On the **File** menu, click **Import**, **Database**.
3. Click **Set Source**.
4. From the Windows **File Open** dialog box, select the HUMAC Backup file submitted by the site.
5. Click **UnZip Data** to expand the HUMAC Backup file.
6. Click **Import Data** to import the submitted data into the main HUMAC database.

Importing Data When the Sending Sites Copy Their HUMAC Data

1. Each site copies the HUMAC Data Files to a CD-R, ZIP or other large-format storage media.
2. On the **File** menu, click **Import**, **Database**.
3. Click **Set Source**.

4. From the Windows **File Open** dialog box, select the **User HUMAC.MDB** file submitted by the site.
5. Click **Import Data** to import the submitted data into the main HUMAC database.

Import: Protocols

The HUMAC **Import Protocols** command allows you to import System Protocols from other users into your HUMAC System.

1. On the **File** menu, click **Import**, **Protocols**.
2. Each HUMAC protocol has a unique code. The HUMAC will ask if you want to **Overwrite duplicate protocols**, e.g. those with the same unique code.
    1. Yes: Import the protocol, overwriting the existing system protocol with the imported protocol. ***Note:*** *No changes are made to tests which were previously run with the protocol.*
    2. No: Do not import the protocol.
3. From the Windows **File Open** dialog box, select the **Protocols2015.MDB** file and click the **Open** button.
4. The HUMAC will import the System Protocols to your database.

Exporting Data

The HUMAC allows you to Export real-time data to an Excel Spreadsheet or to a Text File.

Exporting a Stored Test

1. Select the Patient who's data you want to export.
2. On the **Database** menu, click **Export Data**.
3. Click the **Test/Exercise record** you want to export.
4. Click **Excel** to export the data to an Excel Spreadsheet. Click **Text** to export the data to a text file.

Excel File Format

The HUMAC will create an Excel Workbook containing one sheet for each test/exercise set. Each sheet will contain the real-time time, torque and position data along with a plot of the torque and position data vs. time.

Text File Format

The HUMAC will create a text file for each test speed and side run. The files are placed in the HUMAC/Export folder with the file name identifying the specific patient and test.

Patient Name, Date/Time of Test, Speed, Repetitions, Protocol Set Number, ".CSV"

The Protocol Set Number indicates the set in the protocol, because you can create a protocol with multiple sets of the same speed and number of repetitions. For example, if we tested Rob Potash on September 13 at 60 deg/sec 15 repetitions and 180 deg/sec 15 repetitions, the HUMAC would create the following files.

Potash_ Robert L 9_12_98 7_48_40 AM 60 5 Right 0.CSV

Potash_ Robert L 9_12_98 7_48_40 AM 60 5 Left 0.CSV

Potash_ Robert L 9_12_98 7_48_40 AM 180 15 Right 1.CSV

Potash_ Robert L 9_12_98 7_48_40 AM 180 15 Left 1.CSV

These tests can be read into Excel, by double-clicking the filename.

The HUMAC Export to Text now adds a number of annotations, e.g. where each repetition ran, the peak torque location. This saves researchers the task of manually annotating the data. The following points are annotated in the data:

Annotation	Description
EndPnt 0	Repetition/motion extent
Pos Start	Position Start. Point where the patient moved ½ degree into the motion.
Peak Trq Start	Start of Peak Torque production
Peak Trq End	End of Peak Torque production.

Annotation	Description
Half Peak Trq	Half Peak Torque Point (Isometric Tests)
Stim	Simulus to patient (Reaction Time Test).
Reaction Start	Patient moved toward stimulus (Reaction Time Test)
Target Found	Patient entered the Target (Reaction Time, LOS Test)
Target End	Patient was in target for required time (Reaction Time, LOS Test)

Note: *Because there is an initial and reciprocal motion, the annotations are numbered:*

Number	Description
0	Initial Motion, First Repetition
1	Reciprocal Motion, First Repetition
2	Initial Motion, Second Repetition

Time (Seconds)	Position (Degrees)	Torque (Foot-Pounds)	Speed (deg/sec)	End Pnt 0	Peak Trq Start
1.44	97.3	2.5333	8	0	
1.45	97.1	0.0222	16.6	0	
1.46	96.9	2.9	25.1	0	
1.47	96.6	6.1	32.2	0	
1.48	96.3	9.7556	37.4	0	
1.49	95.8	14.3	43.6	0	
2.14	57.5	133.7556	59.6	0	
2.15	56.8	134.1111	59.7	0	
2.16	56.2	134.3556	59.9	0	
2.17	55.7	134.5111	59.9	0	
2.18	54.9	134.5778	60	0	0
2.19	54.4	134.4889	59.9	0	
2.2	53.8	134.2556	59.8	0	
3.1	0.9	4.0556	16.4	0	
3.11	0.8	0	2.1	1	
3.12	0.8	0	-9.9	1	
3.13	0.9	0	-19.2	1	
3.14	1.3	0	-30.3	1	
3.15	1.6	0.6296	-35.8	1	
3.16	1.9	8.4864	-40.1	1	

Submitting a Test to CSMi

The HUMAC allows you to submit tests to CSMi via for review.

Submitting a Test

1. Select the **Patient** who's data you want to submit.
2. On the **Database** menu, click **Database**, **Submit Test**.
3. Click the **Browse** button to set the destination for the submitted test file. If you do not have internet access from the CYBEX computer, you can set the destination to a USB key and e-mail the test to CSMi from a different computer.
4. Select the **Test** or **Exercise** you want to submit.
5. Click the **Start** button to create the Submit file.
6. Send the file to CSMi by going to www.csmisolutions.com. Scroll to the bottom and click the link titled *"Send files to CSMi"*. Add your contact information and a description of the issue you would like CSMi to review in the mail when submitting the test.

Note: *Patient identifying information (Name, ID, Doctor, etc.) is removed from the test before it is submitted to CSMi. In addition the Submit file is encrypted and password protected.*

Submitting a Test to INRTEK

The HUMAC allows you to Export data to Inrtek Testing Services.

Submitting a Test

1. Select the **Patient** who's data you want to export.
2. On the **Database** menu, click **INRTEK**.
3. Select the **Knee Ex/FL Test** you want to export and click the **Knee** button.
4. Select the **Shoulder Ex/FL Test** you want to export and click the **Shoulder** button.
5. Select the **Trunk Fl/Ex Test** you want to export and click the **Trunk** button.
6. Select the **Destination** for the export file.
    a. **A: drive**. You will need to submit the test to Inrtek.
    b. **C: drive**. When you exit the HUMAC program, the Inrtek program is called to automatically submit the tests to Inrtek.
7. Click the **Export** button to create the Inrtek file.

Submitting a Test to IPCS

The HUMAC allows you to Export data to IPCS Testing Services.

Submitting a Test

1. Select the **Patient** who's data you want to export.
2. On the **Database** menu, click **IPCS**.
3. Select the **Knee Ex/FL Test** you want to export and click the **Knee** button.
4. Select the **Shoulder Ex/FL Test** you want to export and click the **Shoulder** button.
5. Select the **Trunk Fl/Ex Test** you want to export and click the **Trunk** button.
6. Select the **Destination** for the export file.
7. Click the **Export** button to create the IPCS (Submit2015.ZIP) file.
8. The exported file is stored in the HUMAC Export File location.

System Protocols

The HUMAC allows you to define System Protocols. System Protocols can be selected for use by any patient.

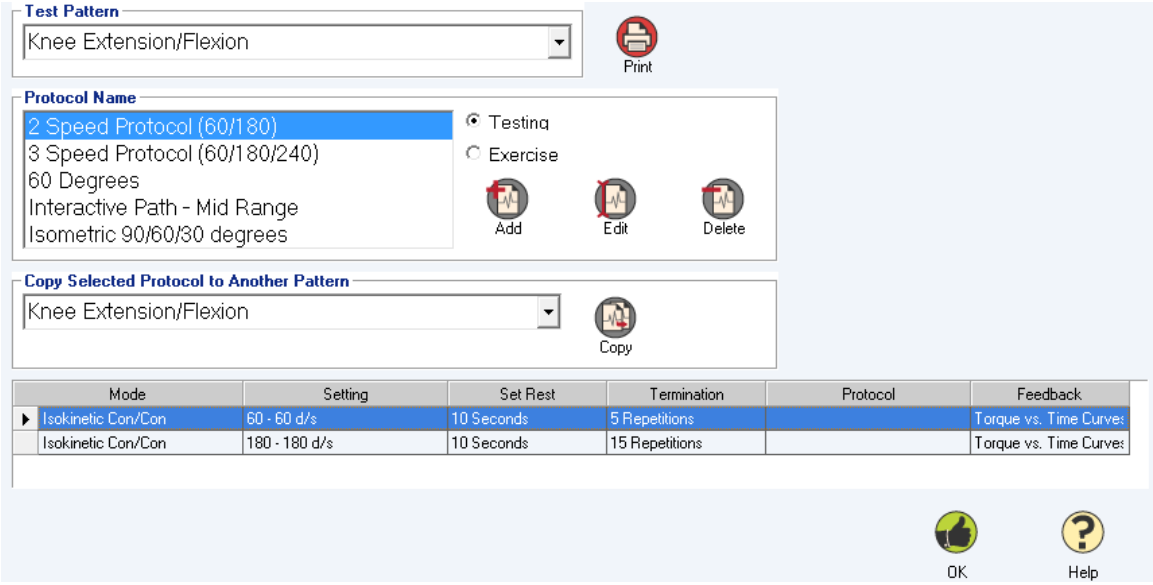


Figure 6-12 System Protocol Editor

Editing a System Protocol

1. From the **Utilities** menu, select **Protocol Editor**.
2. In the **Test Pattern** area, select the pattern you want to add/edit a protocol for. The HUMAC will display all available system protocols for the selected Pattern in the Protocol Name area.
3. Select **Testing** or **Exercise** to edit the appropriate protocol.
4. Single-click the protocol name. The HUMAC will display all sets in the selected protocol.
5. Select **Edit** to edit the selected protocol.

Adding a System Protocol

1. From the **Utilities** menu, select **Protocol Editor**.
2. In the **Test Patter**n area, select the pattern you want to add/edit a protocol for. The HUMAC will display all available system protocols for the selected Pattern in the Protocol Name area.
3. Select **Testing** or **Exercise** to edit the appropriate protocol.
4. Select **Add** to add a new protocol.

Deleting a System Protocol

1. From the **Utilities** menu, select **Protocol Editor**.
2. In the **Test Pattern** area, select the pattern you want to add/edit a protocol for. The HUMAC will display all available system protocols for the selected Pattern in the Protocol Name area.
3. Select **Testing** or **Exercise** to edit the appropriate protocol.

4. Single-click the protocol name. The HUMAC will display all sets in the selected protocol.
5. Select **Delete** to delete the selected protocol.

Printing Protocols

1. From the **Utilities** menu, select **Protocol Editor**.
2. Click the **Print** button.

Copying a Protocol to a New Pattern

You can copy protocols from one pattern to another. For example, if you have a Knee Ex/Fl protocol you want to copy to the Knee Ex/Fl – Prone pattern, rather than re-entering the protocol you can copy it from the first pattern to the second. For example:

1. From the **Utilities** menu, select **Protocol Editor**.
2. In the **Test Pattern** area, select Knee Ex/Fl.
3. In the **Copy Selected Protocol to Another Pattern** area, select Knee Ex/Fl – Prone.
4. Click the **Copy** button.

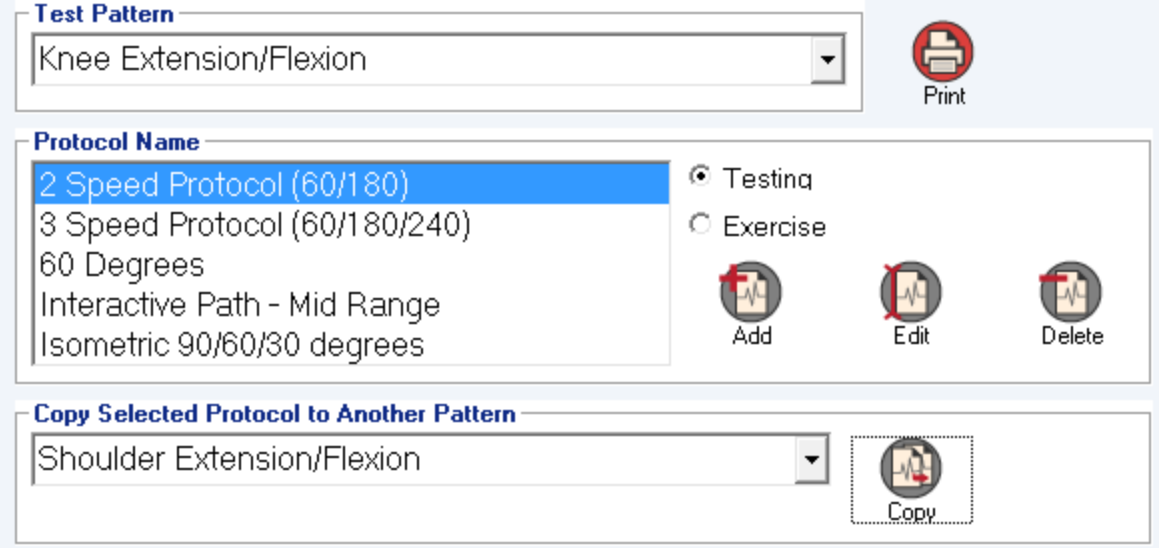


Figure 6-13 Copy System Protocol

Interactive Protocols

The HUMAC allows you to define a number of interactive protocols. The interactive protocols are described in detail below. The procedures for adding, editing and deleting interactive protocols are similar for each protocol type.

Adding a New Protocol

1. From the **Utilities** menu, select **Interactive Feedback Editor**, **Protocol Type**.
2. Click the **Add** button.
3. Enter the protocol values. The HUMAC automatically updates the feedback display.
4. In the area above the display enter a **Descriptive Name** for the protocol.

Editing a Protocol

1. From the **Utilities** menu, select **Interactive Feedback Editor**, **Protocol Type**.
2. In the table on the left, click the **Protocol Name** you want to edit.
3. Enter the protocol values. The HUMAC automatically updates the feedback display.
4. In the area above the display enter a **Descriptive Name** for the protocol.

Deleting a Protocol

1. From the **Utilities** menu, select **Interactive Feedback Editor**, **Protocol Type**.
2. In the table on the left, click the **Protocol Name** you want to delete.
3. Click the **Delete** button.

Protocol Editor: Interactive Line

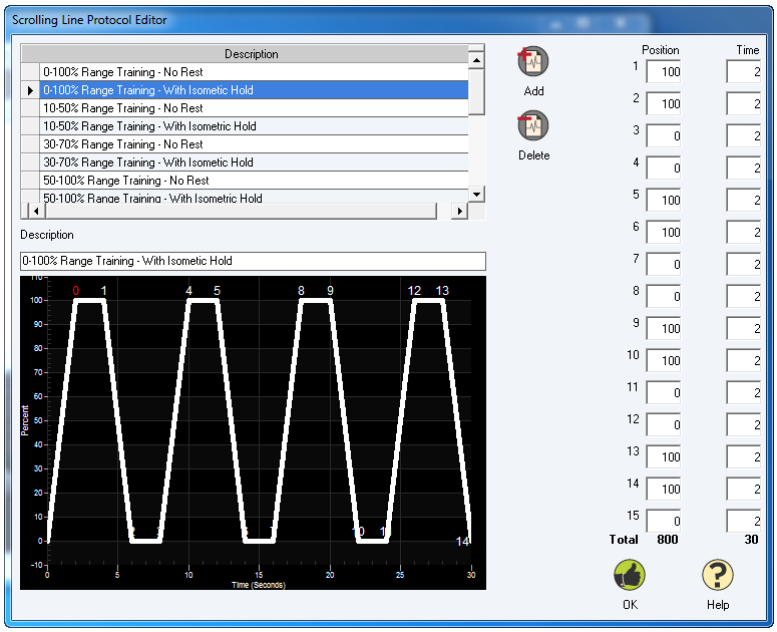


Figure 6-14 Protocol Editor: Interactive Line

Parameter	Description
Position	The percent of the full-scale Y-axis value. For Isometric mode, 100% represents the patient's full isometric contraction. For Isotonic Mode, 100% represents the patient's full range of motion.
Time	The time in seconds to reach the new position.

Protocol Editor: Interactive Path

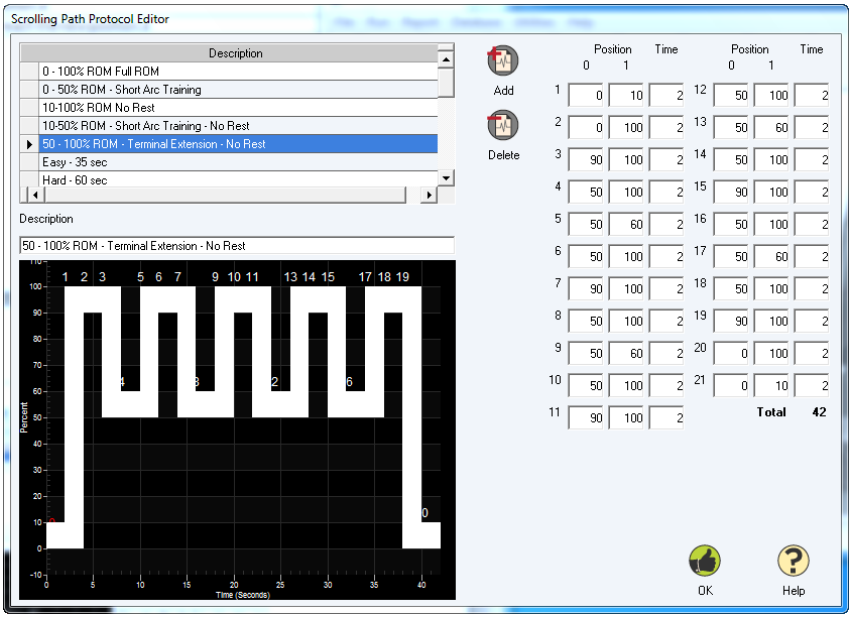


Figure 6-15 Protocol Editor: Interactive Path

Parameter	Description
Position	The percent of the full-scale x-axis value. For Isometric mode, 100% represents the patient's full isometric contraction. For Isotonic Mode, 100% represents the patient's full range of motion.
Time	The time in seconds to reach the new position.

Protocol Editor: Roadway

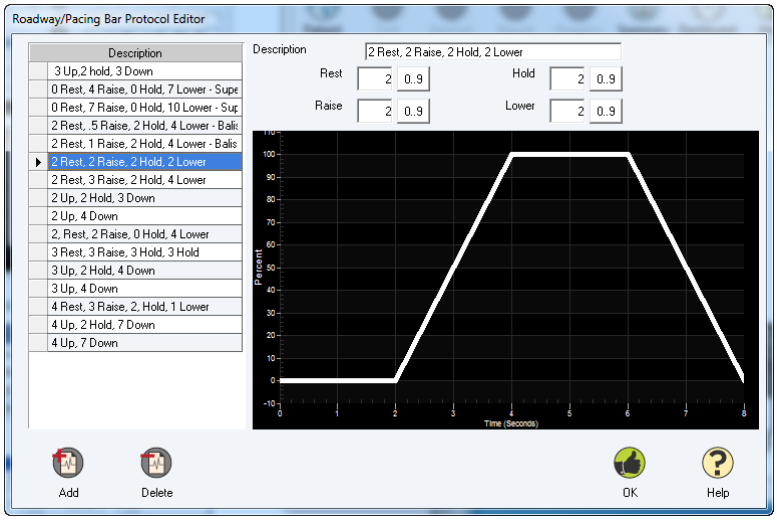


Figure 6-16 Protocol Editor: Roadway

Parameter	Description
Relax Time	Time during which the patient relaxes at the start of a repetition.

Parameter	Description
Raise Time	Time during which the patient is moving toward the ROM target in Isotonic mode or the Torque target in Isometric mode.
Hold Time	Time during which the patient holds at the ROM target in Isotonic mode or the Torque target in Isometric mode.
Lower Time	Time during which the patient is relaxing and moving toward the starting position in Isotonic mode or not generating torque in Isometric mode.

Protocol Editor: Pacing Bar

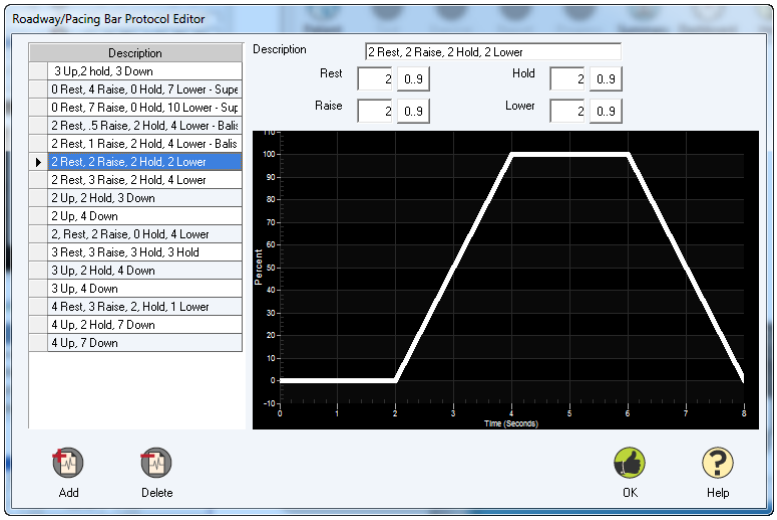


Figure 6-17 Protocol Editor: Pacing Bar

Parameter	Description
Relax Time	Time during which the patient relaxes at the start of a repetition.
Raise Time	Time during which the patient is moving toward the ROM target in Isotonic mode or the Torque target in Isometric mode.
Hold Time	Time during which the patient holds at the ROM target in Isotonic mode or the Torque target in Isometric mode.
Lower Time	Time during which the patient is relaxing and moving toward the starting position in Isotonic mode or not generating torque in Isometric mode.

Protocol Editor: Proprioception Testing

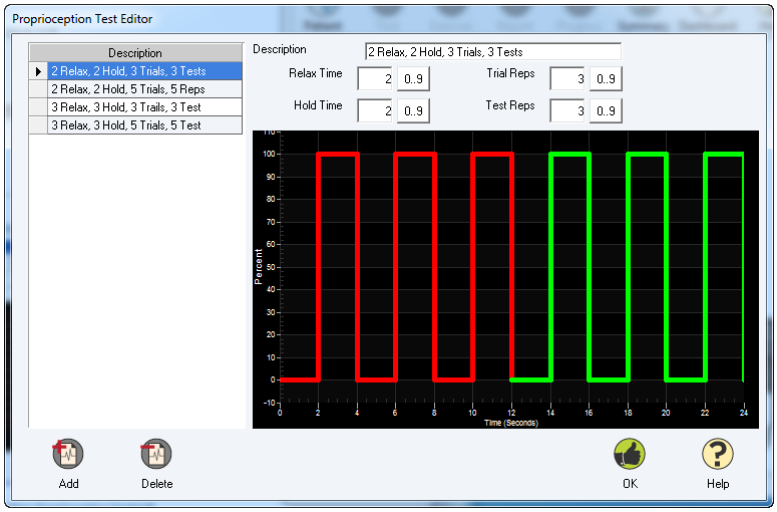


Figure 6-18 Protocol Editor: Proprioceptive Testing

Parameter	Description
Relax Time	Time during which the patient relaxes at the start of a repetition.
Hold Time	Time during which the patient holds at the ROM target in Isotonic mode or the Torque target in Isometric mode.
Trial Reps	The number of repetitions where the patient position feedback is displayed.
Test Reps	The number of repetitions where the patient position feedback is hidden.

Protocol Editor: Response Time

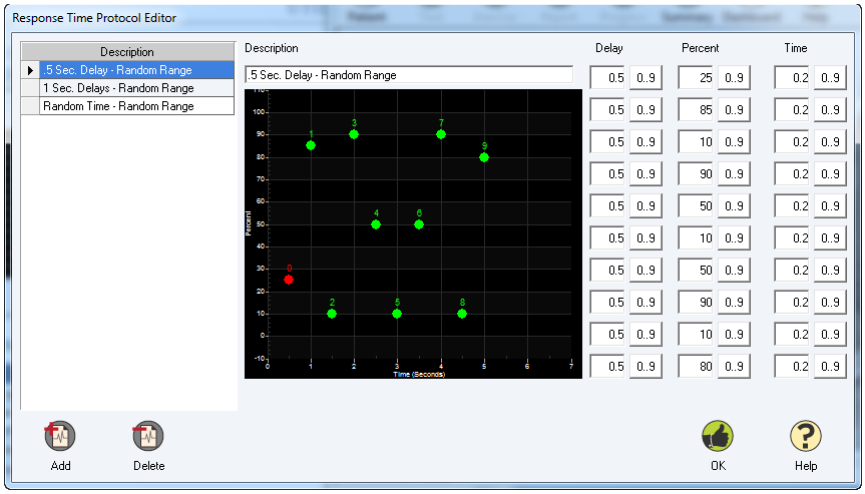


Figure 6-19 Protocol Editor: Response Time

Parameter	Description
Delay	Time (seconds) before target moves to the new position.
Position	Position (% ROM in Isotonic mode, % Torque Target in Isometric mode) which the target moves to.

Parameter	Description
Time	Time the patient must remain in the Target for the system to conclude the patient has reached the target. This prevents the system from considering success when the patient just moves through the target without setting in the target.

HUMAC Data File Locations

Files

The HUMAC uses an Access Databases and a collection of real-time data files to store the CYBEX data.

Parameter	Description
User HUMAC2015.MDB	Patient names, demographic information, dynamometer settings, protocols, and pointers to the real-time data files.
User Calibration2015.MDB	Dynamometer calibration and verification data.
User Error Log2015.MDB	Log of Errors reported by the HUMAC System.
Results2015.MDB	Temporary computed test results.
***.H09**	Real-time data files containing the torque and position data collected during each test and exercise set.
***.doc?**	Narrative Report merge documents.

File Locations

Vista, Windows7, Windows8

Parameter	Description
MDB Files	C:\Users\Public\Public Documents\CSMi\HUMAC2015
***.H09 files**	C:\Users\Public\Public Documents\CSMi\HUMAC2015\Data and all sub-folders.
***.Doc?**	C:\Users\Public\Public Documents\CSMi\HUMAC2015\Narrative Reports
Exported Text Files	C:\Users\Public\Public Documents\CSMi\HUMAC2015\Export

WindowsXP

Parameter	Description
MDB Files	C:\Documents and Settings\All Users\Shared Documents\CSMi\HUMAC2015
***.H09 files**	C:\Documents and Settings\All Users\Shared Documents\CSMi\HUMAC2015\Data and all sub-folders.
***.Doc?**	C:\Documents and Settings\All Users\Shared Documents\CSMi\HUMAC2015\Narrative Reports
Exported Text Files	C:\Documents and Settings\All Users\Shared Documents\CSMi\HUMAC2015\Export

Users

The HUMAC program allows you to setup user accounts which include passwords and administrative privileges.

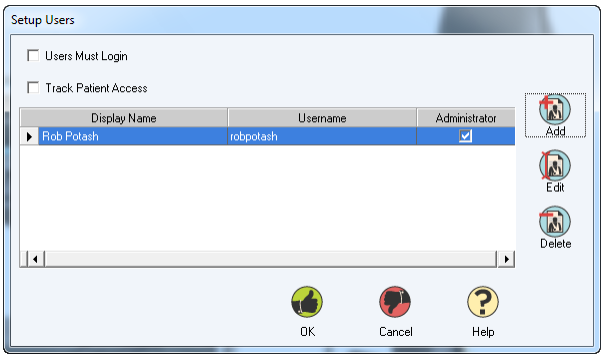


Figure 6-20 Setup Users

Setting-Up Users

1. From the **File** menu, select **Setup Users**, **Setup**.
2.

Parameter	Description
Users Must Login	When the HUMAC starts, the user must enter their username and password.
Track Patient Access	Record the therapist name, patient name and date/time when a patient is selected.
Add	Add a new user
Edit	Edit the selected user's record.
Delete	Delete the selected user. ***Note:*** *Deleting the selected user removes them from the Login options. All recorded database access is retained after the user is deleted.*

Adding a New User

1. Click the **Add** button.

Parameter	Description
Display Name	The therapist's name recorded in the access log.
Username	The therapist's login name.
Password	The therapist's login password. Note: Passwords are case sensitive.
Administrator	Only administrators can access the File, Setup Users function.

Editing an Existing User

1. Select the **user**.
2. Click the **Edit** button.

Deleting an Existing User

1. Select the user.
2. Click the **Delete** button.

The selected user is deleted from the database. No delete confirmation is requested. ***Note:*** *Deleting the selected user removes them from the Login options. All recorded database access is retained after the user is deleted.*

Login

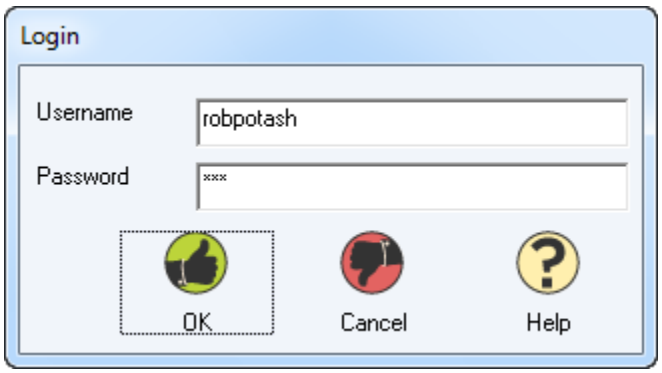


Figure 6-21 Login

1. If **Users Must Login** is selected, the HUMAC will display the Login screen at startup.
2. Use the **File**, **Setup Users**, **Login** command to change the logged-in user without re-starting the HUMAC,

Printing an Access Log

1. From the **File** menu, select **Report**, **Access Log**.

SECTION 7.PREFERENCES

The HUMAC **File**, **Preferences** command allows you to customize the operation of your HUMAC System. The Preferences dialog box is divided into four tabs: **Program**, **Feedback**, **Data Analysis**, and **Reporting**.

General Tab

Language

The HUMAC is available in a number of languages. To set the language:

1. On the **File** menu, click **Preferences**.
2. Click the **General** tab.
3. Select the **Language**.
4. Click the **OK** button.
5. Exit and re-start the HUMAC program to switch to the new language.

Note: *The Windows Operating System must include the fonts required to display the selected language. Selecting Japanese on an English version of Windows will display ??? for the text as the Japanese fonts are not available on English Windows systems.*

Touch Screen Display

The HUMAC can increase the grid sizing for use with touch screen monitors.

1. On the **File** menu, click **Preferences**.
2. Click the **General** tab.
3. Set the **Touch Screen** option.

Parameter	Description
Checked	Use larger grid size.
Cleared	Use standard grid size.

Machine

The **Machine** setting selects the type of CSMi machine you are working with. The HUMAC program is compatible with the CSMI II/II+, 300, TEF, TR, Lift Task, 1000, 1200, 6000, and NORM systems.

1. On the **File** menu, click **Preferences**.
2. Click the **General** tab.
3. Select the Machine Class, e.g. Extremity.
4. Select the type of machine you are working with from the **Machine** list.

TMC Location

Sets the side of your machine on which the TMC is installed. The TMC location is used by the HUMAC during the TMC calibration and when setting the ROM limits for testing and exercise.

Stand in front of the chair facing the dynamometer. Your right hand corresponds to the right side, your left hand corresponds to the left side. The NORM power switch is located on the Left side of the enclosure.

1. On the **File** menu, click **Preferences**.
2. Click the **General** tab.
3. Select the **TMC Location**.

HUMAC Interface Type

Selects the type of interface (Demo, USB Port) used to connect to the HUMAC.

1. On the **File** menu, click **Preferences**.
2. Click the **General** tab.
3. Select the **Interface**.

Parameter	Description
None, run program in Demo mode	This is used if you want to evaluate the HUMAC program before installation on a CSMi. The HUMAC will simulate the CSMI machine allowing you to test all HUMAC functions.
USB Port	Available with NORM and Biodex systems. The HUMAC interface supports both USB 1.1 and 2.0 ports.
USBCOMM	Available with the HUMAC360 and Weight Stack systems.

Use Sound to Count Repetitions

The HUMAC can count repetitions through the PC's speakers during testing and exercise.

1. On the **File** menu, click **Preferences**.
2. Click the **Feedback** tab.
3. Click on **Use sound to count repetitions**.

Reset Torque Scales for Each Set

The HUMAC auto-scales the feedback display during testing and exercise. The very first time a patient is tested, the HUMAC starts with a 20 ft-lbs scale. If the patient exceeds 20 ft-lbs, the HUMAC moves to a 50 ft-lbs scale. The HUMAC continues with 100, 200, and 500 ft-lbs scales until the best scale for the patient is found. This best value is stored in the HUMAC database. The next time the patient is tested, the HUMAC starts with best value.

Because of the potential strength difference between involved and un-involved limbs and different test speeds in a protocol, some clinicians prefer to have the HUMAC find the best torque scale for each set.

1. On the **File** menu, click **Preferences**.
2. Click the **Feedback** tab.
3. Check **Reset torque scales for each set** to have the HUMAC find the best torque scale for each set. Clear **Reset torque scales for each set** to have the HUMAC find the best torque scale for the patient and apply it to all sets.

Interactive Feedback Max Slope

The Interactive Line feedback display draws a line for the patient to follow. If the rate of change of the line is fast (near vertical), it may be hard for the patient to remain on-target. The Interactive Feedback Max Slope allows you to set the maximum slope for the interactive line. For example, if you set the value to 45, the HUMAC will choose the Y-Axis scale so the maximum slope for the line on will be 45 degrees (90 degrees is vertical, 0 degrees is horizontal).

1. On the **File** menu, click **Preferences**.
2. Click the **Feedback** tab.
3. Enter the desired **maximum slope**.

Note: *This does not change the challenge presented to the patient, only the display is re-scaled to provide an easier visual path for the patient to follow.*

Data Analysis Tab

Average vs. Best Values

The HUMAC can report the average value or the best value.

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. In the Torque Parameters area, select **Compute average value of all repetitions** or **Compute best value from all repetitions.**

Value	Description
Compute average value of all repetitions	The HUMAC computes and reports the average value. The HUMAC report displays Peak Torque (Foot-Pounds - **Average Value**) to indicate the average of the repetitions is displayed.
Compute highest value from all repetitions	The HUMAC computes and reports the best value. The HUMAC report displays Peak Torque (Foot-Pounds - **Best Repetition**) to indicate the data is for the repetition with the best value.

Note:

1. *The best value is computed for the following parameters: Peak Torque, Peak Torque Slope, Average Torque, Work, Power, Reaction Time, Settling Time.*
2. *The Highest Value is the best value for the following parameters: Peak Torque, Peak Torque Slope, Average Torque, Peak Torque Slope, Work, Power, Peak Torque to Body Weight, Peak Torque Slope to Body Weight, Average Torque to Body Weight, Power to Body Weight, Percent On Target, Joint Angle at Peak Torque, Range of Motion, Time to Half Peak Torque, Time Peak Torque Held.*
3. *The Lowest Value is best for the following parameters; Torque Ratio, Peak Torque Slope Ratio, Average Torque Ratio, Work Ratio, Power Ratio, Torque Deficit, Initial Peak Torque Deficit, Peak*

Torque Slope Deficit, Average Torque Deficit, Work Deficit, Total Work Deficit, Power Deficit, Torque Fatigue Index, Work Fatigue Index, Reaction Time, Settling Time, Coefficient of Variation, Coefficient of Variation No Feedback, Maximum Deviation, Maximum Deviation No Feedback, Time To Peak Torque, Force Decay Time, Reciprocal Delay, Delay Time.

4. *Because the HUMAC stores the real-time (unprocessed) data it is possible to print reports for a given test with the average value or the highest value. To do this, select **Compute average value of all repetitions** and print the report. Then select **Compute best value from all repetitions** and re-print the report.*

Fatigue Parameters

The HUMAC can report the Fatigue based on the Torque or the Work.

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. In the **Torque Parameters** area, select **Fatigue Index based on Torque** or **Endurance Ratio based on Work**.
4.

Value	Description
Fatigue Index based on Torque	Compute the fatigue as the percent decline in peak torque from the first three repetitions in the set to the last three repetitions.
Endurance Ration based on Work	Compute the fatigue as the percent decline in work from the first half of the set to the work in the last half of the set.

Window Back Pattern Torque Data

Data windowing is used when analyzing data from back testing patterns.

Value	Description
TMC, TEF	Do not include the torque data in the first 0.2 seconds when computing the peak torque value. Use all torque data to compute the work and power values.
TR	Do not include the torque data in the first 0.3 seconds when computing the peak torque value. Use all torque data to compute the work and power values.
Lift Task	The Lift Task allows the user to enter a starting and a stopping height. Only torque data from the starting to the stopping height is used to compute the peak torque, work, and power values.

Issues to consider with Windowing

If the motion is smaller than the data window the peak torque will be reported as 0. Example: The patient moves less than 54 degrees at 180 deg/sec on a TEF, then the extension motion will be less than the window of 0.3 seconds. If during a follow-up test the patient's range of motion increases and their data falls in the range, the reported torque would be non-zero.

When reporting the average peak torque on tests where the length of the patient's test is near the window size the displayed value may be incorrect. Example: The patient's second and third repetitions are just

short of the window. The reported average will be the sum of all the repetitions (including the zero values) divided by the total number of repetitions.

If the peak occurs near the window edge you may see changes in the reported torque based on the peak falling before or after the window. Example: Assume the patient's peak torque occurs just before the data window. In this case the HUMAC will not report that value as the peak. On a follow-up test the peak occurs just after the window start it would then be reported as the patient's peak.

Set the Window Torque Data Option

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. Select **Window back pattern torque data** to print reports with the torque data windowed.

Note:

- *Because the HUMAC stores the real-time (unprocessed) data it is possible to view both windowed and non-windowed test results. To do this, select Window back pattern torque data and print a test report. Then un-check the Window back pattern torque data and re-print the report.*
- *The original CYBEX/DOS applications enabled Data Windowing.*

Gravity Correct Torque Data

During testing and exercise the patient's limb may be assisted or resisted by gravity. When you enable gravity correction, the HUMAC asks you to weigh the patient's limb. From this the HUMAC computes the MaxGET (Maximum Gravity Effected Torque). The MaxGET, limb position, and direction of motion are used to adjust the torque values for the effects of gravity using the following equation.

Value	Description
Limb is assisted by gravity	Reported Torque = Measured Torque - (MaxGET * Cosine(Angle))
Limb is resisted by gravity	Reported Torque = Measured Torque + (MaxGET * Cosine(Angle))

The Angle is the position of the limb relative to vertical not the limb's anatomical position. The Angle is 0 when the limb is horizontal and 90 when the limb is vertical.

The Reported Torque values are used to compute the Peak Torque, Work, and Power values.

Set the Gravity Correction Option

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. Select **Gravity Correct Torque Data** to enable gravity correction.

Zero Torque at ROM stop

As the patient's limb enters a software ROM limit, the dynamometer must decelerate the limb to 0 deg/sec. As a result of the deceleration, you may observe an increase in the measured torque. The Zero Torque at ROM Stop option causes the HUMAC to set the measured torque to 0 during the time the limb is decelerating into the software stop. This is the same functionality as the original CYBEX 6000 and NORM software.

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. Select the desired Zero Torque mode.

Value	Description
Cleared	Display the un-adjusted torque data.
Checked	Zero the torque data as the patient enters the software stop.

Note

- *Because the HUMAC stores the real-time (unprocessed) data it is possible to view both Zeroed and Non-Zeroed test results. To do this, select Zero Torque at ROM stop and print the test results. Then from the Preferences screen, disable the Zero Torque at ROM stop, then print the same report. The HUMAC will display the results without Torque Zeroing.*
- *The torque is never zeroed in the real-time patient feedback display.*

Accept Variations in ROM

When analyzing test results, the HUMAC can use two different methods for counting repetitions.

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. Select the desired **Allow variations in ROM** option.

Value	Description
Cleared	Count repetitions based on the patient's total range of motion.
Checked	Count repetitions based on a fixed change of direction (typically 1/4 degree).

Counting Repetitions

Minimum Position Requirement

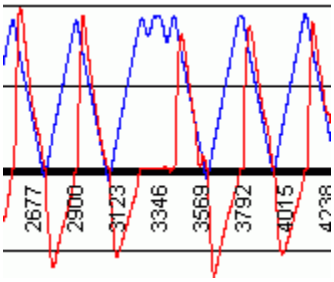
During a test or exercise session, the HUMAC counts a repetition each time the patient moves at least 1 degree (1/4" inch on the Lift Task) in a new direction. Once a new repetition is started, the patient must move at least 10 degrees (3" on the Lift Task) before the HUMAC will look for another repetition. This eliminates counting small changes in direction (< 10 degrees) as multiple repetitions.

When analyzing the data from a test or exercise set, the HUMAC knows the patient's total range of motion for the set and can use a more sophisticated algorithm for counting repetitions.

Percent of Total Range

After a set is completed, the HUMAC can measure the patient's total range of motion for the set. When the Accept Variations in ROM preference is not checked the HUMAC only counts repetitions where the patient moved at least 60% of their total range. This eliminates more extreme cases of the patient stopping and starting during a test.

The following curves from an actual patient test show the patient stopping during the test and moving their leg back and forth for three small repetitions, then continuing the test. During these "repetitions" the torque (red line) was near zero. If the HUMAC counted these as actual repetitions, the computed average torque, work, and power values would be incorrect.



Note:

1. *The original CYBEX application used 1/4 degree to detect a change in direction, which would count small motions as complete repetitions.*
2. *Because the HUMAC uses different methods for counting repetitions during a test and for counting repetitions when analyzing a test you may find a case where the HUMAC reports all 0's as the test results. In the above example, the feedback display counted the small motions as repetitions because the patient moved at least 10 degrees. The data analysis routine did not count them and thus reported not enough repetitions were completed.*

Fixed Change of Direction

When the Accept Variations in ROM preference is checked the HUMAC uses the same method for counting repetitions as is used during the test or exercise session and thus will not report not enough repetitions were found. In some cases you may want to enable this to view the results.

Minimum Torque Requirement

Another most common condition to detect is the patient moving the limb back and forth at the start of a test. For example, assume we have a patient setup for a knee extension/flexion test. While waiting for the test to begin, the patient is lightly swinging their leg back and forth. The patient then notices the feedback display, moves the limb to full flexion, and then begins the test. We do not want to count the time when the patient was swinging the leg back and forth as repetitions during the test. The HUMAC will not begin analyzing the data from the CYBEX until the patient reaches a minimum torque requirement. For the ankle, elbow, forearm, and wrist patterns the threshold is 1 ft-lb. For all other patterns the threshold is 3 ft-lbs.

Filter Torque Data

The HUMAC2015 includes advanced filtering algorithms.

To enable the new filtering:

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. Select **Filter Torque Data**.

Value	Description
Cleared	New filtering not applied.
Checked	New filtering applied to torque data.

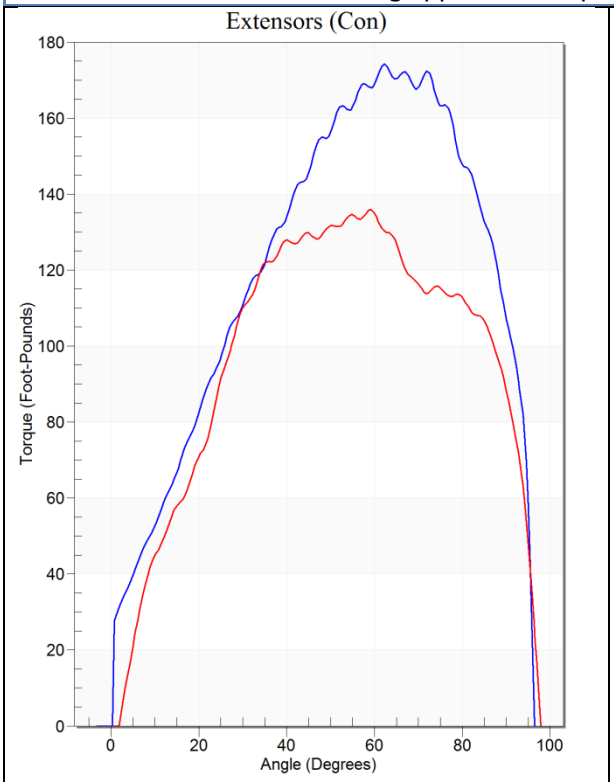


Figure 7-1 Unfiltered Torque Data

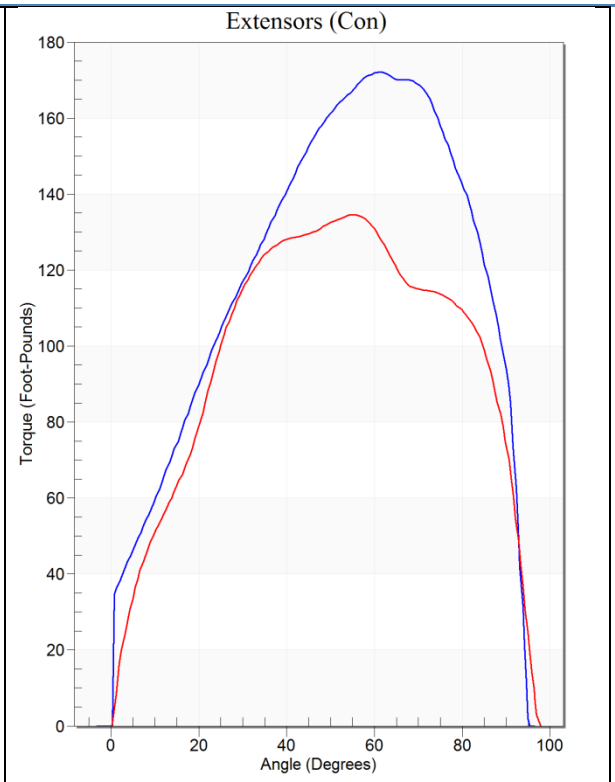


Figure 7-2 Filtered Torque Data

Reporting Tab

Torque vs. Position Plots

The HUMAC reports can plot the torque vs. position data for all repetitions in a set or only the repetition with the highest peak torque value.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. Select the desired **Torque vs. Position Plot** type.

Value	Description
Highest value repetition	Displays a single torque vs. position curve of the repetition with the highest peak torque value. ***Note:*** *The HUMAC plots the Initial and reciprocal curves from the repetition with the highest peak torque during the initial motion. For example,*

Value	Description
	on a knee extension/flexion test, if the third repetition had the highest peak torque extension value, the HUMAC will plot the extension and flexion curves from the third repetition.
All repetitions	Plot the torque vs. position curves for all repetitions.
Min/Max/Average	Plot the curves, the minimum torque at each position, the maximum torque at each position, and the average torque at each position. ***Note:*** *The HUMAC computes the values over each repetition, so for example, the maximum torque at 37 degrees may be from the 1st repetition and the maximum torque at 65 degrees may be from the 3rd repetition.*

Note

1. *Because the HUMAC stores the real-time (unprocessed) data you have the ability to plot reports for a test, with one option and then print the same report with a different option.*

Strength Test Work Parameters

The HUMAC can report the work per repetition or the total work during strength tests. (Test with < 10 repetitions).

1. On the **File** menu, click **Preferences**.
2. Click the **Data Analysis** tab.
3. In the **Torque Parameters** area, select **Work per Repetition** or **Total Work**.

Value	Description
Work per Repetition	Compute the work per repetition.
Compute the Total Work	Compute the total work over all repetitions.

Note: *The HUMAC always computes the total work for endurance tests (>= 10 repetitions).*

Report ROM or Power on Short Report

In order to keep the HUMAC Short Report to one page, only the most important parameters are selected. In addition to the Torque and work, the HUMAC gives you the option of printing the ROM or Power on the short report.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. Select the desired **Report ROM or Power on Short Report** type.

Value	Description
Range of Motion	Report the Range of Motion.
Power	Report the Power.

Report Heading

The HUMAC allows you to specify a heading (typically your clinic name and address) to be printed at the top of each report.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. Enter the **Report Heading**.

Highlight Deficits

When printing reports, the HUMAC can automatically highlight right to left side deficits in red.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. Select the **Highlight deficits greater than or equal to**.
4. Enter the threshold for deficits to be printed in red. Any right-left deficits less than this amount will be printed in black. Right-left deficits greater than or equal to this amount will be printed in red.

Highlight CV

When printing reports, the HUMAC can automatically highlight Coefficient of Variation values in red.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. Select **Highlight CV values greater than**.
4. Enter the threshold for deficits to be printed in red. Any CV values less than this amount will be printed in black. DV values greater than or equal to this amount will be printed in red.

Default Torque Scale

The HUMAC can auto-scale the feedback display during testing and exercise. Some clinics prefer to use a fixed torque scale during patient feedback and report generation.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. To use a fixed torque scale during feedback and report generation, check the **Default Torque Scale** box and enter the desired **Torque Scale**. To have the HUMAC auto-scale, clear the **Default Torque Scale** box.

Display Bi-Polar Torque Plots

The HUMAC can display Uni-Polar (absolute value of torque) or Bi-Polar (positive and negative torque) plots on the reports.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.

3. Check **Display Bi-Polar Torque Plots** to generate bi-polar plots. Clear **Display Bi-Polar Torque Plots** to generate uni-polar plots.

Display Zoom Values

When previewing reports, the HUMAC can add a hyperlink to Zoom values, for example:

Peak Torque (Foot-Pounds - Best Repetition) - Zoom

Clicking the Zoom link displays the per-repetition values for the parameter.

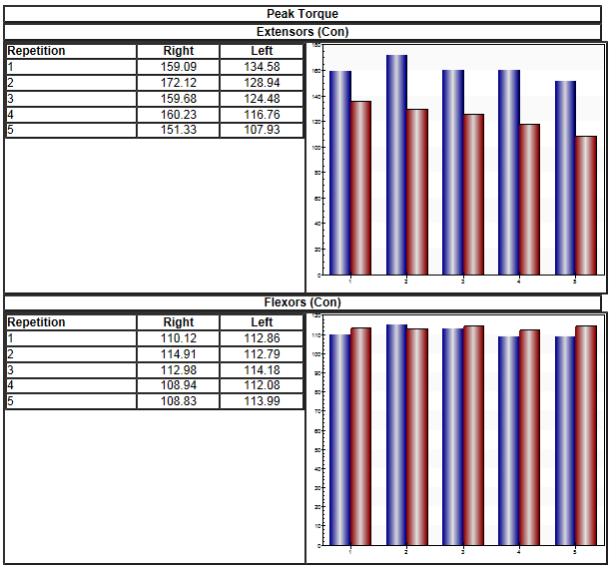


Figure 7-3 Zoom Values

To setting the Zoom Values option:

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. Select the **Display Zoom Values** option.

Value	Description
Cleared	Hyperlinks to Zoom values are not added to the reports.
Checked	Hyperlinks to Zoom values are added to the reports.

Note: *Displaying Zoom Values will increase the time required to generate a report when the Preview option is selected. Zoom values has no effect on the time required to Print a report. The HUMAC can display Uni-Polar (absolute value of torque) or Bi-Polar (positive and negative torque) plots on the reports.*

Short Report Set to Plot

In order to keep the HUMAC Short Report to one page, only one set is plotted on the report. The HUMAC gives you the option of selecting the set to plot.

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. Select the desired **Short Report Set to Plot**.
4. The HUMAC display the set number 1, 2, or 3 which was plotted.

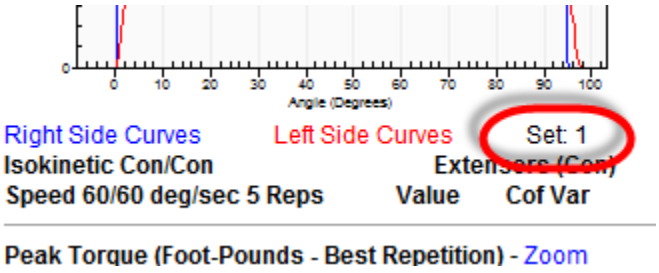


Figure 7-4 Short Report Plotted Set Number

Units

The HUMAC supports US and Metric units. TO set the Units:

1. On the **File** menu, click **Preferences**.
2. Click the **Reporting** tab.
3. In the **Units** section, select **US Units** or **Metric Units**.

Parameter	US	Metric
Height	Inches	Centimeters
Weight	Pounds	Kilograms
Torque Limit	Foot-Pounds	Newton-Meters
Torque	Foot-Pounds	Newton-Meters
Force	Pounds	Newtons
Work	Foot-Pounds	Newton-Meters

SECTION 8.RESEARCH TOOLKIT

The HUMAC includes a Research's Toolkit which allows the user to utilize the system beyond the standard HUMAC parameters. This includes:

- Tune the dynamometer performance (acceleration, cushion).
- Adjust the sampling rate up to 2,500 samples/second.
- Adjust the ROM up to +/-8 revolutions.
- Acquire data at full system resolution.
- Adjust the system parameters at full resolution (Position +/-1/16deg, Velocity +/-1/16d/s, Torque +/-0.1 ft-lbs.

Toolkit Displays

The Research Toolkit has two main displays.

- Controller: Adjust dynamometer modes, actions, and settings.
- Feedback: Plot, store real-time data.

Toolkit Status

The HUMAC Research's Toolkit displays the dynamometer status.

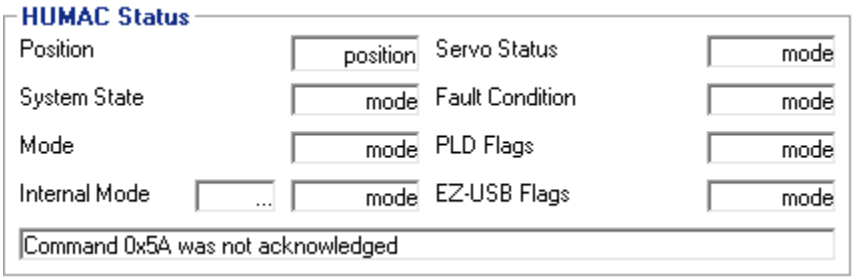
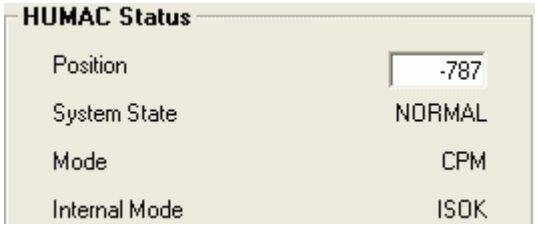


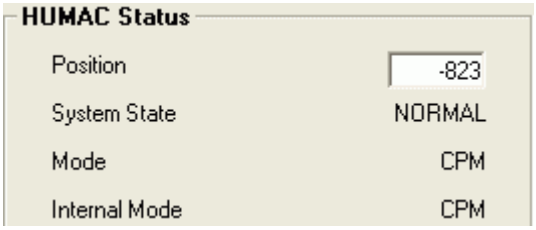
Figure 8-1 Toolkit: Status

Parameter	Description
Position	The absolute input adapter position. This value should be approximately a multiple of 5760, (e.g. -5760, 0, 5760) when the input adapter is positioned at 6:00. If not, repeat the Reset procedure.
System State	**RESET:** The Reset button was just pressed. **SETUP:** The system is in Setup mode, allowing you to set the ROM limits. **NORMAL:** The system is in Isokinetic, CPM, Isometric, or Isotonic mode.
Mode	Mode requested by the user.
Internal Mode	Mode the dynamometer is currently in. See Dynamometer Mode Switching topic below.
Servo Status	OFF: The servo amplifier is disabled. READY: The servo amplifier is enabled.
Fault Condition	**NONE:** No pending faults.

Dynamometer Mode Switching



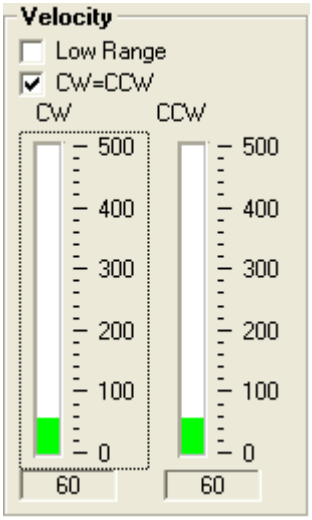
User requested CPM mode. Dynamometer is in Isokinetic mode until the input adapter is moved to the starting location at which time the system will switch to CPM mode.

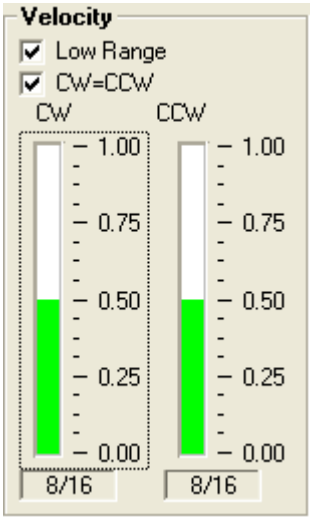


Dynamometer is in CPM mode.

Using the Toolkit Sliders

The toolkit sliders allow you to easily change the dynamometer settings.





Displayed Value

The slider displays the current setting as a filled bar with the numeric value below the bar. In the above example, the left slider velocity is set to 60 deg/sec.

Changing the Slider Value

There are three ways to change the slider value.

- Click the slider and hold the mouse button down as you move to a new value. Release the mouse button and the slider will be set to the new value.
- Click the slider to select it and use the PageUp and PageDown keys to change the value by large steps. +/-10 in Full Range, +/- 0.25 in Low Range.
- Click the slider to select it and use the ArrowUp and ArrowDown keys to change the value by small steps. +/-1 in Full Range, +/- 1/16 in Low Range.

Setting the Slider Range

Value	Description
Low Range cleared	In the Full Range, the slider displays the full dynamometer range, typically 0 to 500 deg/sec or ft-lbs.
Low Range checked	In the Low Range, the slider displays the low dynamometer range, typically 0 to 1 deg/sec or ft-lbs.

Changing the CW/CCW Values

Value	Description
CW=CCW cleared	The CW and CCW sliders can be independently set.
CW=CCW checked	Changes to the CW or CCW slider are copied to the opposite slider.

Starting the Toolkit

1. From the **Windows Task Bar**, select **Start**, **HUMAC2015**, **Research Toolkit**.
2. Enter the Password "***RESEARCHTK***". The password in not case-sensitive.
3. Click the **Initialize Controller** button. The HUMAC will download the controller program.
4. When the download is complete, the **Toolkit** button will be enabled.
5. Click the **Toolkit** button.

Toolkit Reset

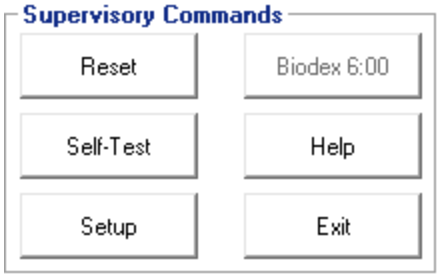


Figure 8-2 Toolkit: Reset

This procedure should be run when the Controller screen is first displayed or if an Error is reported.

Resetting the Machine

1. Remove the patient from the NORM.
2. Click the **Reset** button. Wait 2-3 seconds.
3. Position the input adapter at 6:00 (Straight Down).
4. Click the **Self-Test** button. The system will briefly move the input adapter.
5. If you are on the Biodex System2 or System3, remove the input adapter and click the **Biodex 6:00** button. The system will rotate the dynamometer shaft through the full range, returning to 6:00.

Setting the ROM, Pattern and Side

Setting the ROM Limits

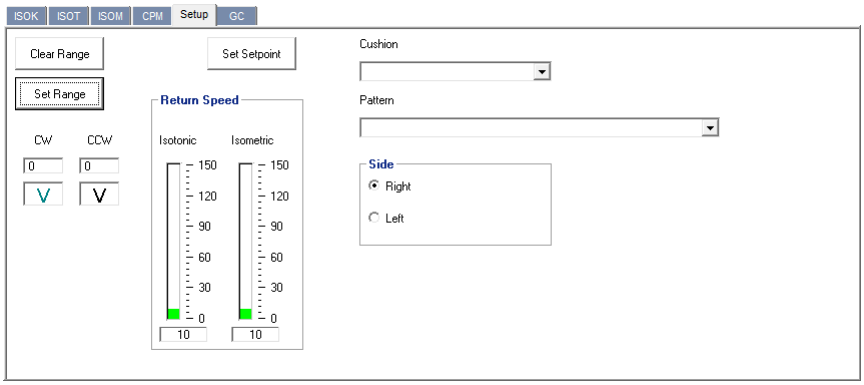


Figure 8-3 Toolkit: ROM Limits, Pattern, Side

Click the **Setup** button.

1. The HUMAC is now in Setup mode and ready to establish a ROM for the patient.
2. Click the **Clear Range** button to clear previous ROM settings.
3. Move the patient through the desired range.
4. Click the **Set Range** button. The HUMAC will set the ROM to the range traveled in Step 4.
5. Set the ROM stops to the values displayed.

Note: *To change the ROM for a new pattern or patient, repeat steps 1-6 under Setting the ROM.*

Isometric Settings

Isometric Angle

1. Set the ROM as described above.
2. Move the input adapter to the desired Isometric angle.
3. Click the **Set Setpoint** button.

Isometric Return speed

The Isometric Return Speed is the speed the input adapter returns to isometric angle if patient exceeds the torque limit and moves away from the angle.

1. In the **Return Speed** area, set the Isometric value to the desired speed in d/s.

Isotonic Settings

Isotonic Start Point:

1. Set the ROM as described above.
2. Move the input adapter to the desired starting Isotonic angle.
3. Click the **Set Setpoint** button.

Isotonic Return Speed

The Isotonic Return Speed is the speed the input adapter returns to isotonic start point after patient releases all force.

1. In the **Return Speed** area, set the Isotonic value to the desired speed in d/s.

Isokinetic Mode

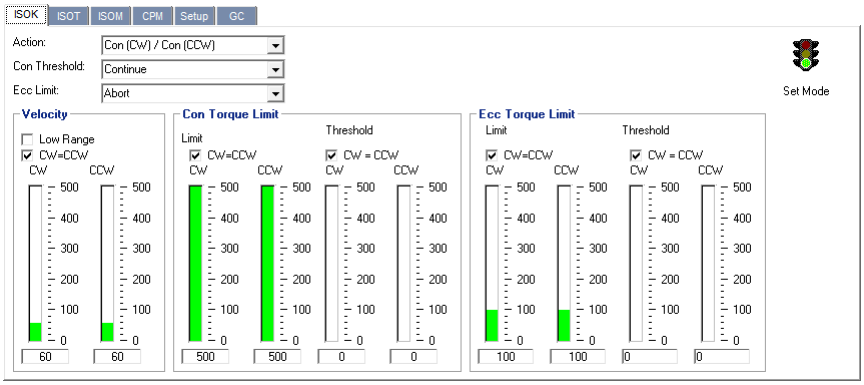


Figure 8-4 Toolkit: Isokinetic Mode

Starting Isokinetic Mode

1. Set the ROM limits.
2. Click the **ISOK** tab.
3. Select the **Action** Con (CW)/Con(CCW) in this example.
4. Set the **Velocity**, **Concentric Torque Limit** and **Eccentric Torque Limits**.
5. Click the **Set Mode** button. The HUMAC will switch to Isokinetic mode.

Value	Description
Action	Set the Dynamometer Action: Con/Con, Con/Ecc, Ecc/Con, Ecc/Ecc
Set Mode	Switch dynamometer mode to Isokinetic Mode.
Velocity	Set the CW and CCW speed in deg/sec
Con Torque Limit	Set the CW and CCW Concentric Torque Limit in ft-lbs.
Con Torque Threshold	Use the sliders to set the CW and CCW Concentric Torque Threshold in ft-lbs. Use the combo box to set the Concentric Torque Threshold mode.
Ecc Torque Limit	Use the sliders to set the CW and CCW Eccentric Torque Limit in ft-lbs. Use the combo box to set the Eccentric Torque Limit mode.
Ecc Torque Threshold	Set the CW and CCW Eccentric Torque Threshold in ft-lbs.

CPM Mode

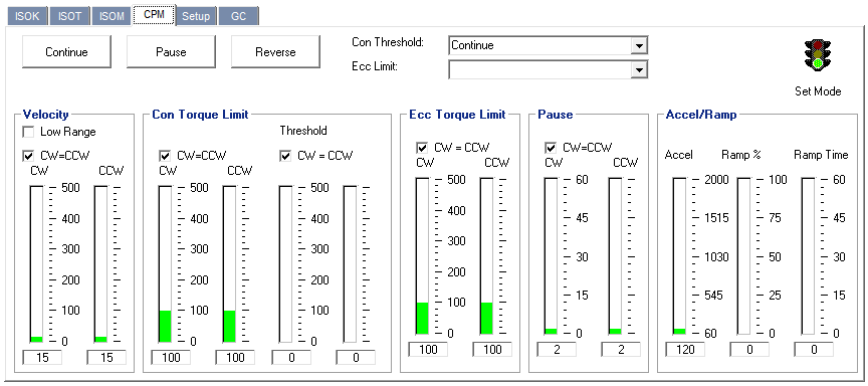


Figure 8-5 Toolkit: CPM

Starting CPM Mode

1. Set the ROM limits.
2. Click the **CPM** tab.
3. Select the **Eccentric Overtorque Mode** (Reverse Direction) in this example.
4. Set the **Velocity**, **Concentric Torque Limit**, **Eccentric Torque Limit**, **Pause** and **Acceleration/Ramp**.
5. Click the **Set Mode** button.
6. Click the **Continue** button. The HUMAC will prepare to switch to CPM mode.
7. Move the patient to the starting location and the HUMAC will begin CPM mode.

Value	Description
Set Mode	Switch dynamometer mode to CPM.
Continue	Begin the CPM motion.
Pause	Pause the CPM motion.
Reverse	Reverse direction.
Velocity	Set the CW and CCW speed in deg/sec
Con Torque Limit	Use the sliders to set the CW and CCW Concentric Torque Threshold in ft-lbs. Use the combo box to set the Concentric Torque Threshold mode.
Ecc Torque Limit	Use the sliders to set the CW and CCW Eccentric Torque Limit in ft-lbs. Use the combo box to set the Eccentric Torque Limit mode.
Accel	Set the CPM Acceleration. This is the rate at which the input adapter accelerates when leaving a ROM stop.
Ramp	Set the CPM Ramping parameters.

Isotonic Mode

Figure 8-6 Toolkit: Isotonic Mode

Starting Isotonic Mode

1. Set the ROM limits.
2. Click the **ISOT** tab.
3. Set the **Torque Limits**.
4. Click the **Set Mode** button. The HUMAC will switch to Isotonic mode.
5.

Value	Description
Set Mode	Switch dynamometer mode to Isotonic.
Torque Limit	Set the Isotonic force in ft-lbs.
Hold/Release	Click Hold to set the Isotonic Starting point. Click Release to reposition the Isotonic Starting point.

Isometric Mode

Figure 8-7 Toolkit: Isometric Mode

Starting Isometric Mode

1. Set the ROM limits.
2. Click the **ISOM** tab.
3. Set the **Torque Limit**.

4. Click the **Set Mode** button. The HUMAC will switch to Isometric mode.

Value	Description
Computer move to patient angle	**Selected:** The computer automatically moves the limb to the Isometric setpoint. **Cleared:** The computer enters isokinetic mode and waits for the patient reaches the setpoint. When the patient reaches the setpoint, the system moves to isometric mode.
Set Mode	Switch dynamometer mode to Isometric Mode.
Torque Limit	Set the CW and CCW Concentric Torque Limit in ft-lbs.
Setpoint	Change the isometric setpoint.

Zero Gravity

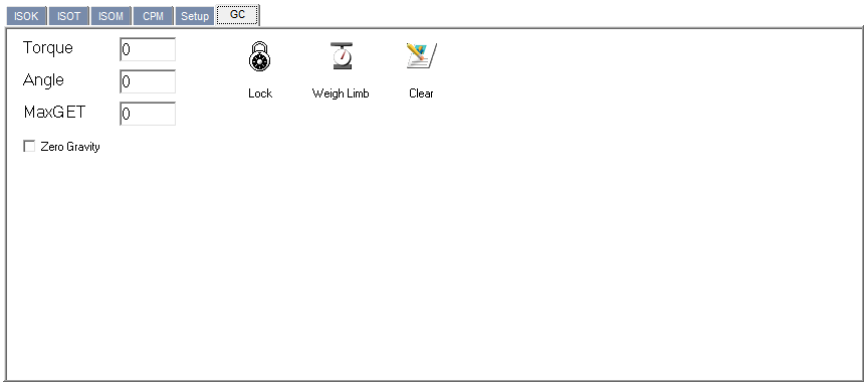


Figure 8-8 Toolkit: Zero Gravity

To enable Zero Gravity:

1. Click the **Enabled** checkbox.
2. Move the patient limb as close to Horizontal as possible without initiating a stretch.
3. Click the **Lock** button to hold the limb in-place.
4. Click the **Weigh Limb** button.
5. Click the **Unlock** button.
6. Zero Gravity will be turned-on when Isokinetic or CPM modes are selected.

Setting the Aux Outputs

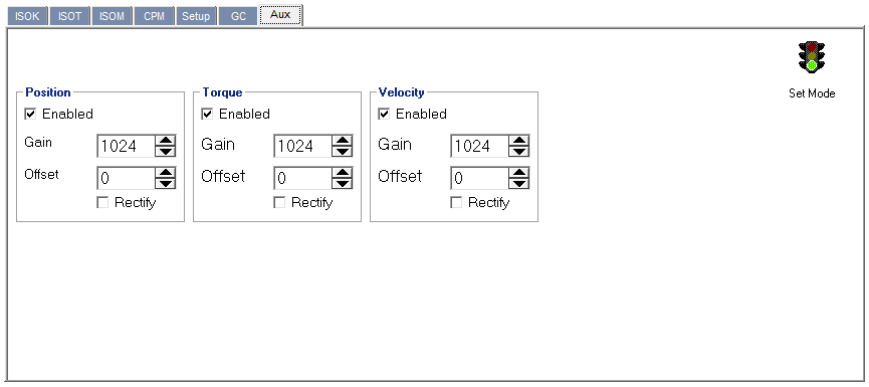


Figure 8-9 Toolkit: Auxiliary Outputs

1. Click the **Aux** tab.
2. Set the **Position**, **Torque** and **Velocity** values.
3. Click the **Set Mode** button.

Toolkit Feedback Display

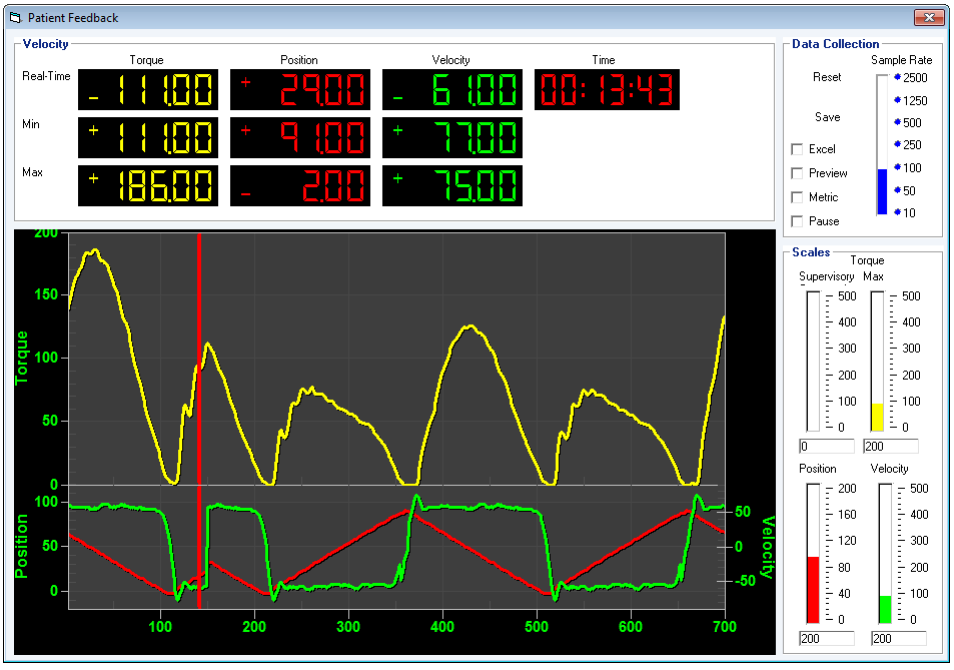


Figure 8-10 Toolkit: Feedback Display

Real-Time Numeric Values

1. The top of the feedback display contains real-time Torque, Position and Velocity values along with the Min and Max values.

Data Collection

Value	Description
Reset	Clear the data collection buffer. Reset the Min/Max values.

Value	Description
Save	Write the data collection buffer to a disk file.
Excel	Cleared: Save the data as a CSV text file. Checked: Save the data in Excel format.
Preview	Open the saved data file.
Metric	**Cleared:** Display the data in US (ft-lbs) units. **Checked:** Display the data in metric (nm) units.
Pause	Pause the data acquisition.

Scales

1. Set the **Real-Time Torque**, **Position** and **Velocity** plot scales.
2. Set the **Sampling Rate** from 10 to 2,500 Hz.

Real-Time Plots

1. The **Real-Time Torque**, **Position** and **Velocity** data is plotted.
2. A vertical cursor shows the current data point.