EVALTECH™

OPERATOR'S MANUAL

Original Instructions

Printed in the U.S.A.

This manual supports the BTE EvalTech™ System

40050079, Rev. F, CO 5674. Published 2023-06-16

Manufacturer

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WARRANTY

We guarantee that the BTE rehabilitation products are free of manufacturer defects in both workmanship and material. We will replace or repair defective parts or equipment for a period of time and in accordance with the conditions set forth below:

This warranty covers the structure and framework for 1 year of normal institutional use. All mechanical components including bearings, bushings, pulleys, and glides are warranted from manufacturer defects in both workmanship and material for a 1-year period. Cords and padding are covered for a 1-year period under normal use.

This limited warranty is in lieu of all warranties, expressed or implied, and all other obligations or liabilities on the part of BTE. We neither assume nor authorize any person to assume any other obligation or liability in connection with the sale of this product.

Under no circumstances shall BTE be liable by virtue of this warranty or otherwise, for damage to any person or property what so ever for any special, indirect, secondary, or consequential damage of any nature however arising out of the use or inability to use this product.

This limited warranty applies only while the BTE product remains in the possession of the original purchaser and has not been subject to accident, misuse, abuse, unauthorized modification, failure to follow instructional use, failure to do proper maintenance, incorrect adjustments, or failure due to cause beyond the manufacturer's control.

DISCLAIMER

The information presented in this manual is given in good faith and is to the best of our knowledge accurate. However, anyone who uses this information in any way does so entirely at his or her own risk. Neither BTE, its officers nor their representatives can accept any responsibility for any damage or injury incurred as a result of information presented here except under the terms of the product warranty.

Your system may not include all components described in this manual. Please contact BTE Customer Service at BTE if you have any questions.

Product Description, Use, and Application Specification

Product: ER
Model: EvalTech

General Description

The EvalTech is a system used to assess physical capacity of specific human functions. The system includes load cells, mechanical adapters for various applications, tool communication hardware, software, attachment frame, and Range of Motion (ROM) devices. Calibration weights and fixtures allowing in-field calibration are also included.

Intended Use

The EvalTech is intended to be used for musculoskeletal testing. Applications include occupational and physical therapy and industrial rehabilitation.

Contraindications for use include conditions where tensile strength of tissues and/or structures is compromised, i.e. healing bone fractures and tendon, ligament, and muscle repairs. Clinical judgment is required to determine whether subject should perform assessments.

Intended Medical Indication

The system is intended to assess strength and ROM.

Intended Patient Population

General Population: Anyone whose muscle strength or range of motion needs to be measured. There are no age, weight, or height restrictions.

Intended Anatomical Applicability

Evaluation of the musculoskeletal system

Intended User Profile

Medical healthcare professionals

Intended Conditions of Use

Office or clinic setting

Frequency of Use

There are no frequency of use restrictions for this device.

Use of Energy Source

An electric power source is required to provide power to the equipment.

Essential Functions

- Provides means to asses push, pull, grip, pinch and lift forces to quantify muscle strength.
- Record setup information and data.
- Save results to a client record database.
- Create reports presenting results and trending.

Essential Performance

The device does not have any essential performance characteristics.

Operating Principle

The EvalTech is a device that supplies a means for assessing strength and range of motion through the use of a hand grip, pinch strength, ROM devices, pull/push devices, and lifting apparatus. The tools include a Universal Task Master (UTM), Column Load Cell (CLC), pinch gauge, hand grip, and a portable load cell. The EvalTech measures isometric push/pull forces applied to the tool by the client and the duration of time force is applied. The data collected allows the program to track a client's capabilities through multiple calculated variables. Reports are generated from the computer program that can be used to evaluate a client's capabilities over single or multiple uses of the EvalTech.

Applied Parts

EvalTech applied parts include base, columnm, all tools, tool attachments, heart rate monitor, and the Portable Dock and Transmitter or BHU. All applied parts are type B.

Performance Characteristics

- Support Column safe workload is 500 lbs
- Hand Grip has the capability to measure push forces in range 1 lb to 200 lbs (± 0.75 lb.)
- Pinch Gauge has the capability to measure push forces in range 1 lb to 45 lbs (± 0.2 lb.)
- Portable Load Cell (PLC) has the capability to measure push and pull forces in range 1 lb to 300 lbs. Tolerances are: ± 0.75 lbs in 1 -100 lbs range and ± 2 lbs in 101-300 lbs range
- Goniometer has the capability to measure 0 to 360 degrees of movement in 1 degree increments (± 3 degrees)
- Inclinometer has the capability to measure 1 to 360 degrees of movement in 1 degree increments (± 1 degree)
- Heart rate system allows for constant and real time monitoring during testing. The systems measures the heart rate in beats per minute and functions within 2 feet from Portable Dock and Transmitter and 30 feet from the Hub.
- Functional Range of Motion (FROM) Panels are available with the system.

Operating Voltages

The EvalTech has 2 main components connected to the supply mains; the computer cart and the column/base assembly. The computer cart is capable of operating at 50/60hz and the voltages listed below which are factory set and noted on the external transformer case.

- 100V~
- 115V~
- 200V~
- 215V~
- 230V~

The column/base assembly is powered by the column URFIO power supply whcih can be connected to the supply mains with 100-240v~ and 50-60Hz.

Power cords corresponding to the equipment settings and supply mains information provided by the customer are included with the system.

Servicing

- No parts shall be serviced or maintained while in use with a patient
- Upon request BTE will provide circuit diagrams, component parts lists, descriptions, calibration instructions, or other information to assist service personnel to repair parts

Connections

Hosting Device	Port	Connected Device
Computer	USB	Keyboard
		Mouse -or- pointing device
		Printer
		USB Powered Speakers
		BTE Wireless Hub
	VGA video output	LCD -or- LED Monitor
BTE Wireless Hub	SMA Connector	Wired connection to base unit
Base Unit	RJ45 Connector	Load cell attachments
	SMA Connector	Wired connection to BTE wireless hub

EXPLANATION OF SYMBOLS AND CERTIFICATION MARKINGS

Manufacturer		Temperature Limit	
Catalogue Number (Product and Model Number)	REF	Humidity Limit	
Serial Number	SN	Atmospheric Pressure Limitation	
Follow instructions for use		General Warning Sign	
Type B Applied Part		Alternating Current	
Direct Current		General Mandatory Action Sign	
Safety Certification	SGS C S 710101	Electromagnetic Field	
Where Applicable	CE		

CAUTION AND WARNING

Marking on the Equipment

Where Applicable

REF ER EvalTech

BTE

SN Serial Number

Permissible Environmental Conditions for Transport and Storage

CAUTION AND WARNING (cont.)

Weights used for lifting tests are marked as follows:

- 20 Lb Weight (Green Label)
- 15 Lb 14Weight (Red Label)
- 10 Lb Weight (White Label)
- 5 Lb Weight (Yellow Label)

Important Information for Safety

Prior to Each Use

Check that the Portable Load Cell (PLC) and Portable Load Cell (PLC) Tools are not damaged.

WARNING

The heart rate system is not intended for use with clients that are in life-threatening circumstances or in condition that precludes performing activities required for physical assessment.

WARNING

Incorrectly locked attachments, UTM or CLC could result in an injury

WARNING

Only ER computer, printer, monitor, and battery charger may be safely attached to the multiple-socket outlet

WARNING

Connect to the multiple-socket outlet only the specified ER equipment

WARNING

Connecting electrical equipment to the multiple-socket outlet effectively leads to creating a medical electrical system and the result can be a reduced level of safety.

WARNING

An additional multiple-socket outlet or extension cord shall not be connected to the ER system.

WARNING

Do not modify this equipment without authorization of the manufacturer.

CAUTION

Portable Load Cell (PLC) and PLC attachments shall not be serviced while in use with a client. Inspections of these components shall be performed prior to use.

WARNING

To avoid the risk of electric shock, the isolation transformer and the column URFIO power supply must only be connected to supply mains with protective earth.

WARNING

Do not position the equipment such that the power cords for the transfomer ancd column URFIO power supply are difficult to disconnect from the supply mains.

CAUTION

The ER shall only be transported unassembled

CAUTION

Anti-virus software is installed on the computer. If the computer is connected to the Internet, the software must be updated regularly to protect the computer against viruses.

ELECTROMAGNETIC FIELD WARNING

The Mio Alpha watch and USB charger contain magnets that could affect pacemakers and implantable cardioverter-defibrillators (ICDs).

The EvalTech can only be used with the power supply provided by BTE.

The multiple-socket outlet located inside the EvalTech computer cart column base is used to connect the system computer, printer, monitor, and battery charger. The multiple-socket outlet shall only be used for supplying power to the intended electrical equipment that is part of the medical electrical system. If other electrical equipment is connected, electrical current drawn by the system could exceed the maximum allowed current tripping the circuit breaker. This could make the equipment non-operational and delay treatment benefits tot he patient.

The responsible organization (e.g. the customer) must refer to the standard IEC 60601-1, third edition, for the requirements that are applicable to a medical electrical system (ME System).

Permissible Environmental Conditions for Transport and Storage

Ambient temperature:	-20°C to +40°C
Relative humidity:	30% to 90%
Atmospheric pressure:	550 hPa to 1060 hPA

Permissible Environmental Operating Conditions

Ambient temperature:	+10°C to +38°C
Relative humidity:	30% to 75%
Atmospheric pressure:	700 hPa to 1060 hPa

Electromagnetic Interference

The Equipment needs to be placed into service according to electromagnetic compliance information provided in the manual Appendix.

Environmental Protection

- Dispose of batteries in accordance with all local, state, and federal laws.
- At the end of the equipment service life, dispose of the device components in accordance with all local, state, and federal laws for electronic recycling.

Interchangeable or Detachable Parts by Service Personnel.

- There are no components that are designated as repairable by service personnel. Components will be replaced if needed in accordance with BTE service policy

Preventative Inspection

Maintenance

Calibration should be performed by the operator every two weeks. No components shall be serviced or maintained while in use with a client.

Equipment Shut Down

Shutdown the computer before turning the transformer off.

IMPORTANT NOTES:

The computer that was shipped with your EvalTech is the brain of the system. Adding other software to this computer will lead to errors in your EvalTech operating system.

DO NOT install any software applications, utilities, or modify the existing software and operating system configurations. Doing so, will void your BTE warranty.

Your EvalTech was shipped with an initial default password enabled. You will not be able to access a patient record without first entering the password.

The initial password is: **BTE**

If you wish to change the password, select **Utilities**, then **Password**.

Information Regarding EC Declaration of Conformity

BTE Technologies maintains the EU Declaration of Conformity. If you have any questions, contact BTE customer service.

OPERATOR'S MANUAL

TABLE OF CONTENTS

SETUP & GENERAL OPERATION

SETUP & GENERAL OPERATION

I. EVALTECH COMPONENTS

The EvalTech system consists of 4 main components: the Column & Base, Computer Cart, Tool Rack with Tools, and FROM Pegboard (Figure 1-1).

Figure 1-1. EvalTech System

The majority of the EvalTech System will arrive on a skid, which the shipping company may disassemble, and the Computer Cart and Tool Rack will arrive in 2 separate boxes.

The shipping company may assemble the base and column in the location you specify. The Computer Cart and Tool Rack should then be placed within a couple feet of either side of the column. The FROM pegboard may be placed anywhere in close proximity to the system, but no more than 20 feet away (Figure 1-2).

All the equipment must be assembled on a level surface; the base may be leveled by using the supplied flat-head screwdriver to adjust any of the seven screws around the top perimeter of the base.

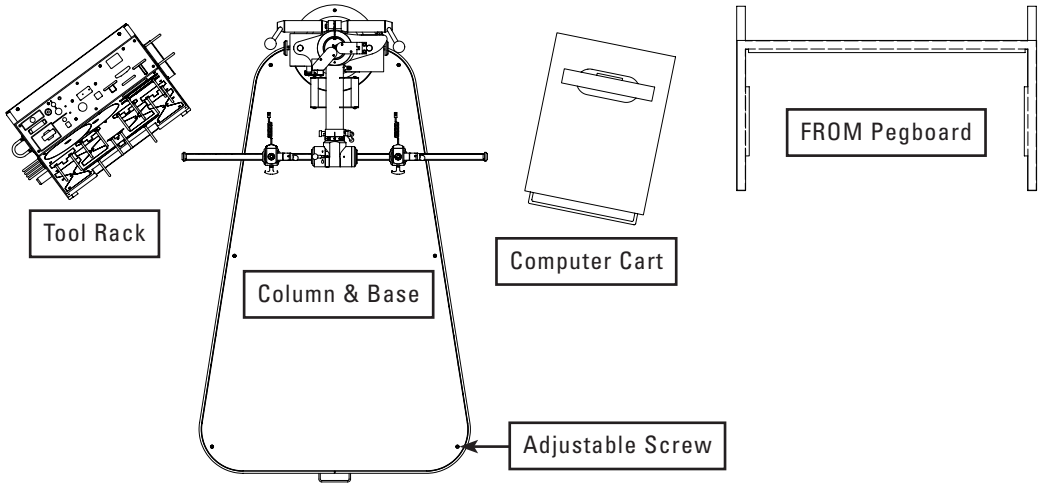


Figure 1-2. Suggested Layout of the EvalTech System

Please inspect all parts for any visible damage from shipping. Notify BTE upon discovery of any damage.

It is recommended that while unpacking the equipment you review your packing slip to ensure you have received all the required parts. Contact Customer Service immediately if anything is missing so that replacements may be provided.

A. COLUMN & BASE

The base of the EvalTech is supplied with a removable handle. To make use of it Rotate the removable handle 180 degrees and screw the unsecured hex bolt into the base. Make sure to tighten the bolts with a 3/4 inch wrench as finger tightening will not be adequate. The removable handle should appear as shown in the following image.

1. ATTACH THE COLUMN TO THE BASE

Warning

At least two people are required to move the column and base for assembly.

Column Handling instructions

Verify that the lower and upper arms are in the following positions:

- The upper arm should be at the bottom of it's range of motion and next to the upper arm stop
- The lower arm is at or below the 19 inch mark

Note that the equipment is shipped with the column arms locked in the described positions.

Verify that the locking lever in the lower and upper arm has been tightened.

Utilize the column arm handles to move and position the column for assembly.

Step 1. Position the EvalTech base where the center of the system is to be installed. If the system is to be installed near a wall, position it at least 18in/46cm away from the wall.

Step 2. Position the column on the base with the 2 arms facing out toward the base (Figure 1-3). the '0' (zero) on the top of the column should be facing forward lined up with the '0' (zero) on the base.

Step 3. Using the 5/16" Allen key, secure the column to the base with the 4 screws

Figure 1-3. Column Attached to Base

2. CONNECT THE POWER SUPPLY TO THE COLUMN

Step 1. Identify the power supply components: 1 power cord, 1 power adapter, and 1 column power cable (Figure 1-4).

The column power cable can be found behind the long white stabilizer bar that runs the length of the column. The round connector on the cord should be a couple of inches above the base.

Step 2. Plug the small round connector on the power adapter cable into the connector on the column power cable (Figure 1-4a).

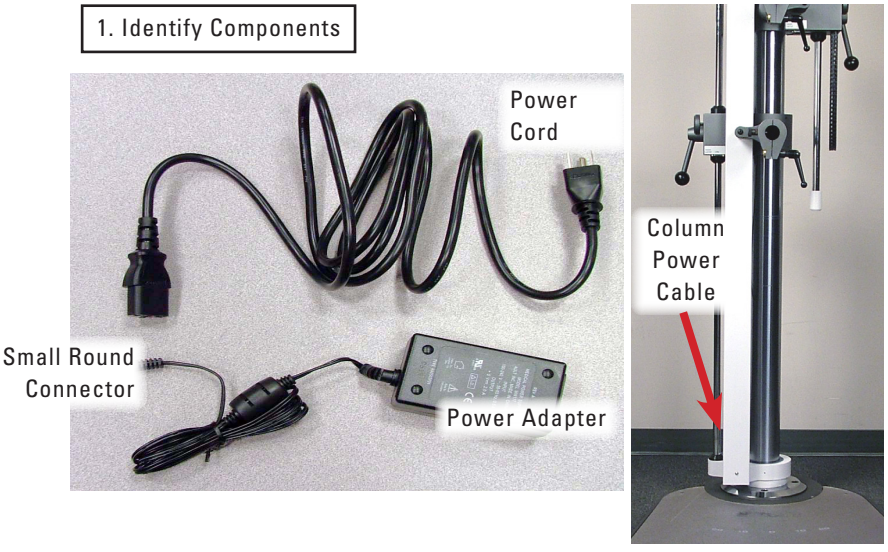


Figure 1-4a. Supply Power to the Column

Step 3. Plug the non-pronged side of the power cord into the adapter (Figure 1-4b). Make sure the cord is pushed all the way into the adapter.

Step 4. Plug the 3-pronged side of the power cord into the wall outlet.

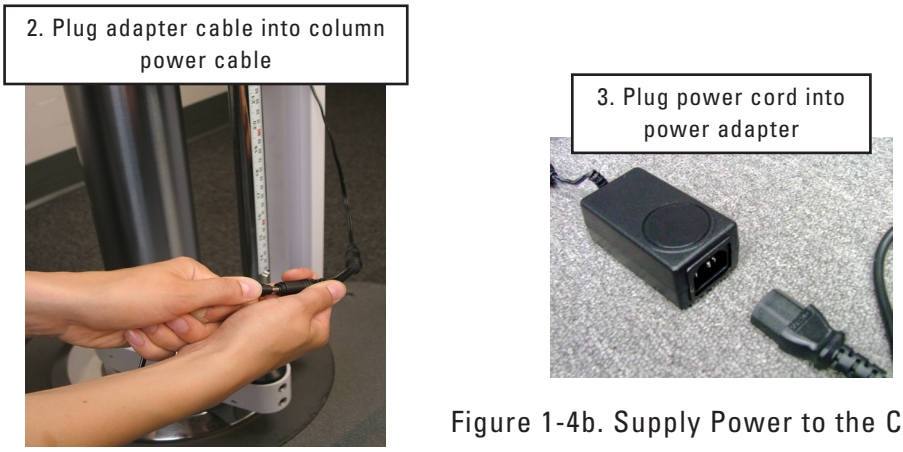


Figure 1-4b. Supply Power to the Column

The use of extension cords is not recommended. If an extension cord can not be avoided, use no less than 14 gauge wire. Keep the cord as short as possible, and use only hospital approved plugs. The extension cord MUST complete the ground from the EvalTech power supply cord to the wall outlet.

B. COMPUTER CART AND EQUIPMENT

The computer equipment consists of a touchscreen monitor w/speakers, printer, CPU, batttery charger, and isolation transformer (Figure 1-5).

Step 1. Remove cart from it's shipping carton

Step 2. Attach the stainless steel handle to the front of the top shelf using the included screws

Step 3. Place the computer (CPU) horizontally on the bottom shelf of the cart

Step 4. Place the printer on the middle stationary shelf above the computer

Step 5. Place the monitor, keyboard, and battery charger on the top shelf. The monitor must be secured to the top shelf with the provided hardware.

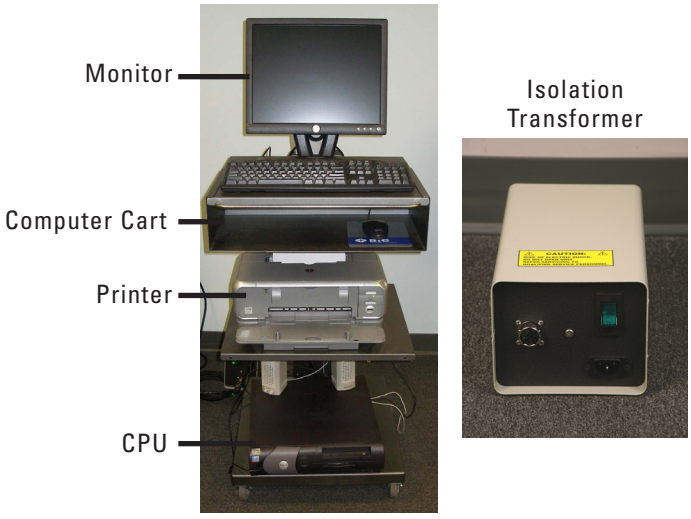


Figure 1-5. Computer Equipment and Cart

Step 6. Slide the adjustable tray under the top shelf. As an option, the keyboard may be placed on the tray.

Step 7. Connect each cable end to it's proper receptacle. The computer cart is shipped pre-wired with the cables in the proper position and ready for use.

Step 8. Connect the long cable extending from the back of the computer cart to it's mating connector on the isolation transformer. Be sure the connection is firmly secured.

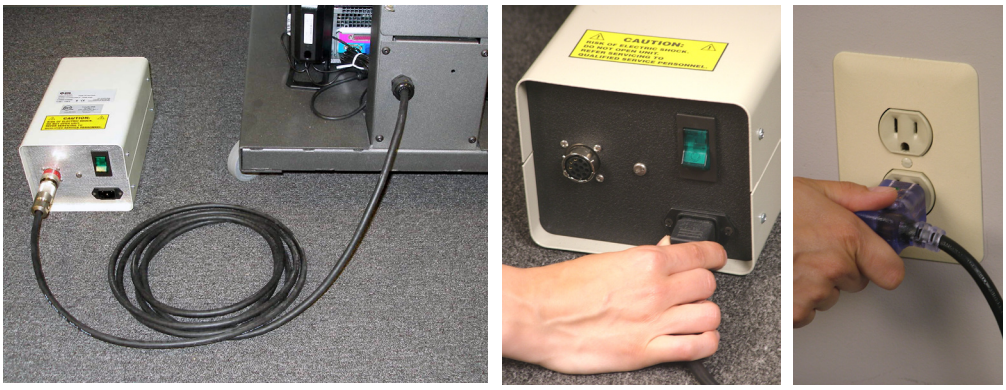


Figure 1-6. Attach Cables to Transformer & Plug into Wall Outlet

Note: The computer equipment is powered by the isolation transformer; none of the equipment will turn on unless the isolation transformer is powered and turned on.

C. TOOL RACK & EVALUATION TOOLS

1. IDENTIFICATION OF EVALUATION TOOLS & ACCESSORIES

Included in the system are several tools that evaluate the client's strength and range of motion. In addition, there are many attachments and accessories that aid in the evaluation (Figure 1-7).

Data Acquisition Devices & Portable Electronic Tools

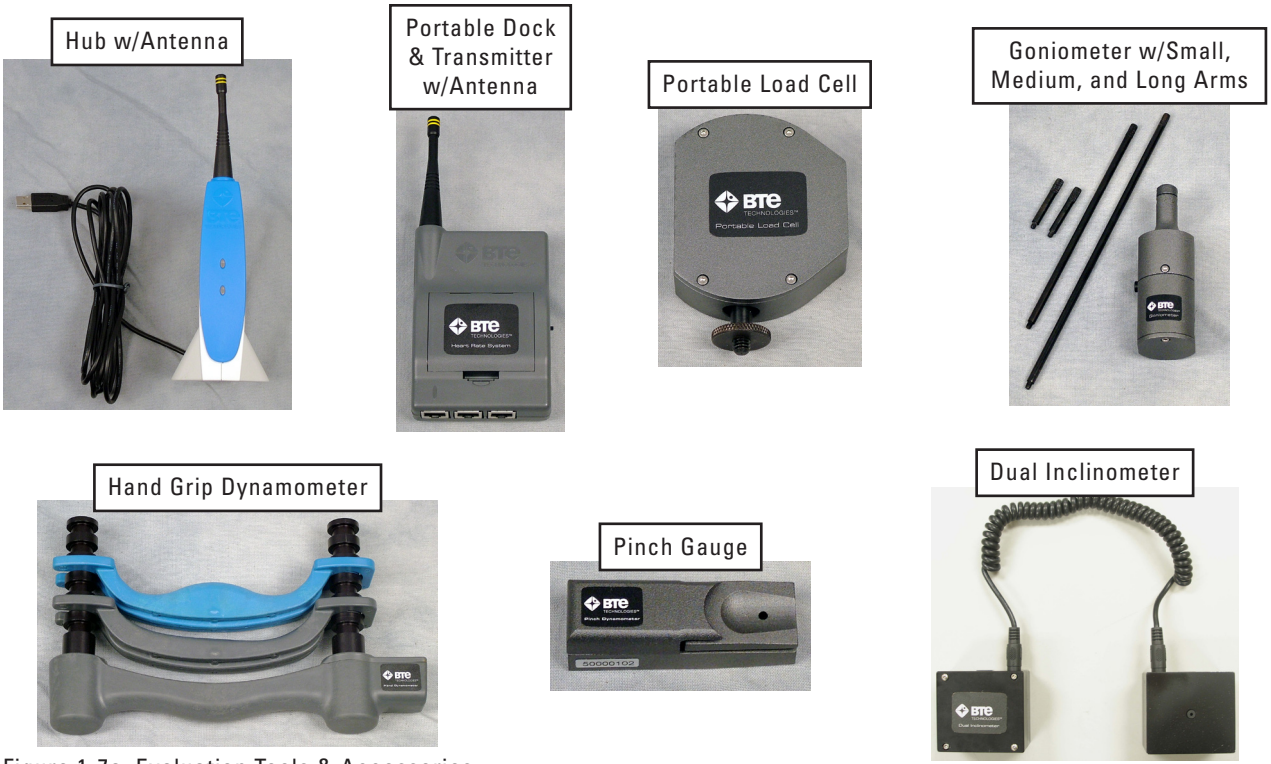


Figure 1-7a. Evaluation Tools & Accessories

Heart Rate System and Portable Dock & Transmitter Accessories

Heart Rate Monitor & Strap

Velcro Straps - Long and Short

RJ45 Cables (3ft & 5 ft)

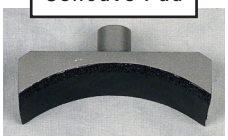
Rechargeable AA Batteries

Battery Charger

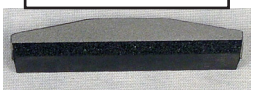
Portable Load Cell Accessories

Interface Screw

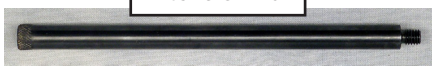
Concave Pad



Rectangular Pad



Extension Bar



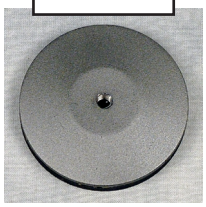
Snap

Narrow Corner

Wide Corner

Small Square Pad

Round Pad



Column-Integrated Electronic Tools

Column Load Cell

Universal Task Master

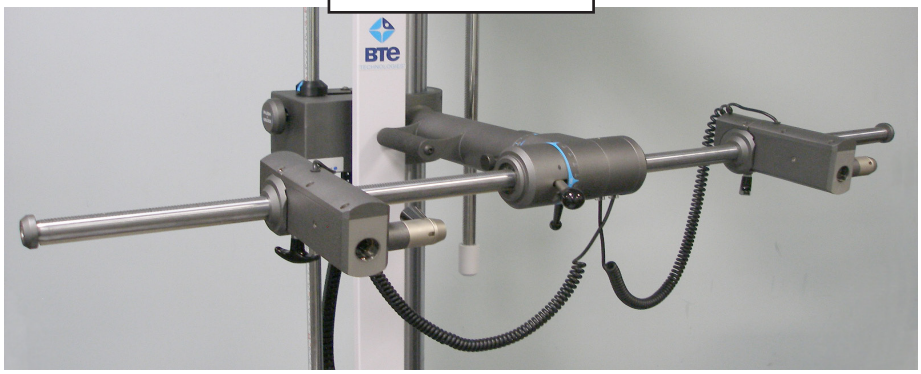


Figure 1-7b. Evaluation Tools & Accessories

CLC, PLC, and UTM Attachments

Single Box Grip (2)

Curved Strength Pad (1)

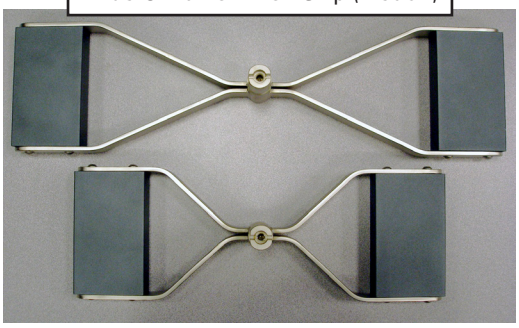
D Handle (2)

Flat Palm Pad (2)

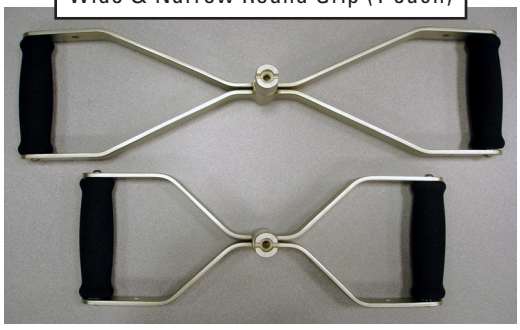
Straight Bar (1)

Unilateral Straight Handle (2)

Wide & Narrow Box Grip (1 each)

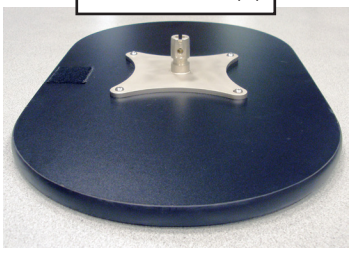


Wide & Narrow Round Grip (1 each)

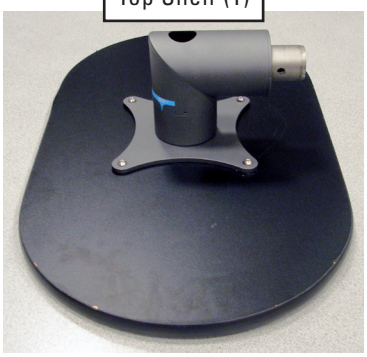


Dynamic Lifting and Carrying Accessories

Bottom Shelf (1)



Top Shelf (1)



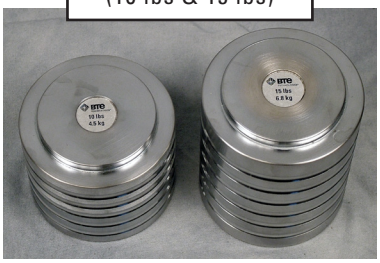
Lifting Crate & Weights

(2) 5lb - Yellow (2) 15lb - Red
(5) 10lb - White (2) 20lb - Green

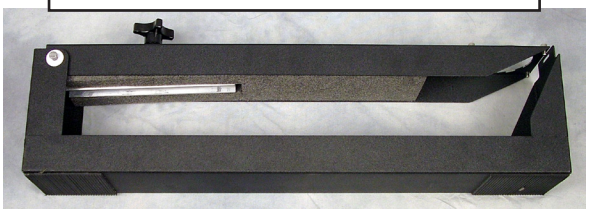
Figure 1-7c. Evaluation Tools & Accessories

Calibration Accessories

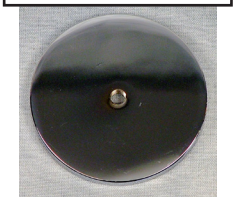
Calibration Weights (10 lbs & 15 lbs)



Hand Grip Dynamometer Calibration Fixture

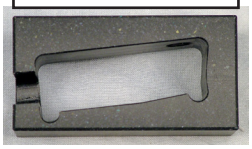


Portable Load Cell Calibration Disk



Pinch Gauge Calibration Fixture

Pinch Gauge Calibration Block



CLC & UTM Calibration Fixture

Support Material

Installation CD

Software Manual

Figure 1-7d. Evaluation Tools & Accessories

2. PLACEMENT OF TOOLS ON TOOL RACK

Each tool and accessory has a dedicated location on the Tool Rack (Figure 1-8).

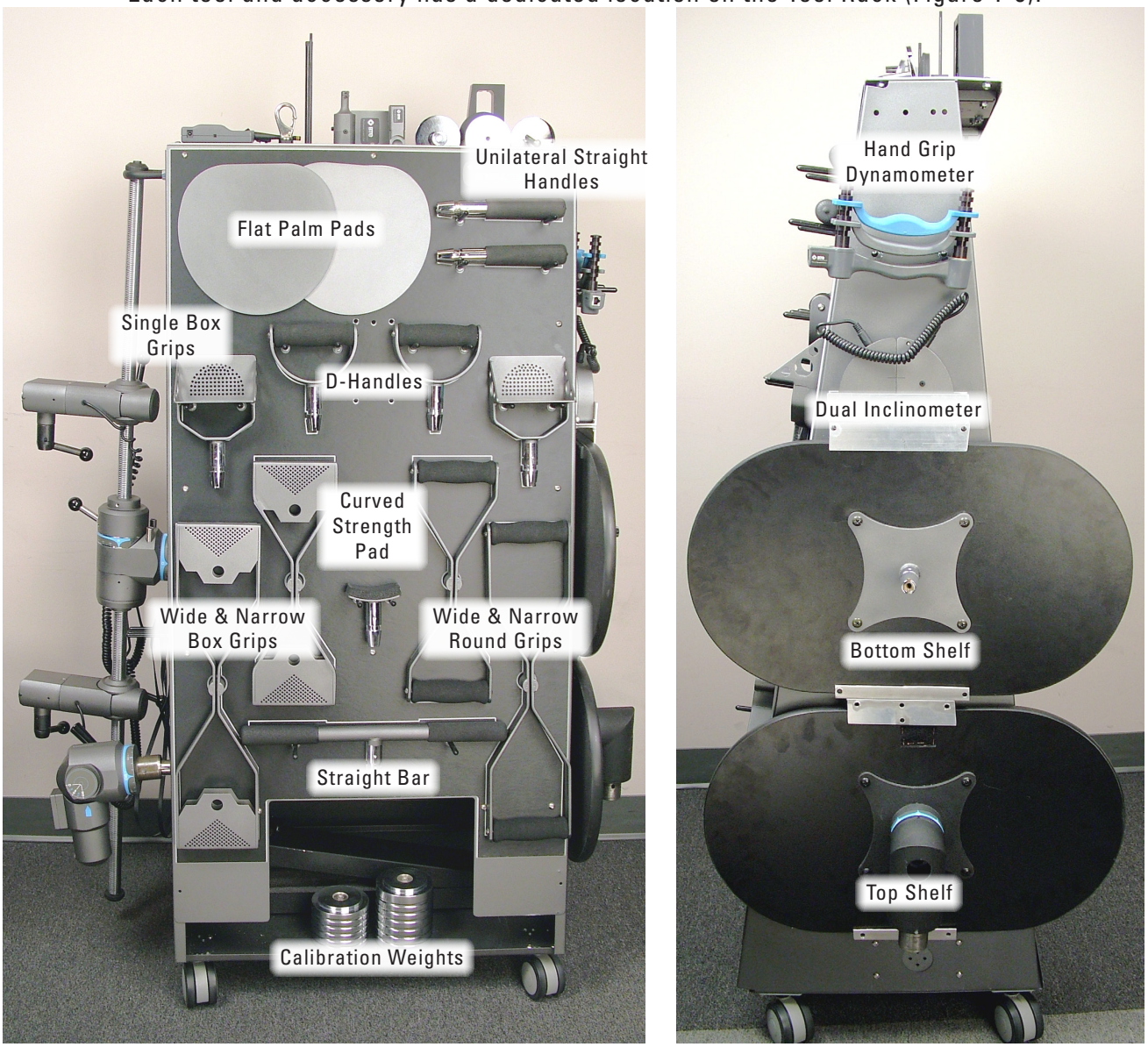
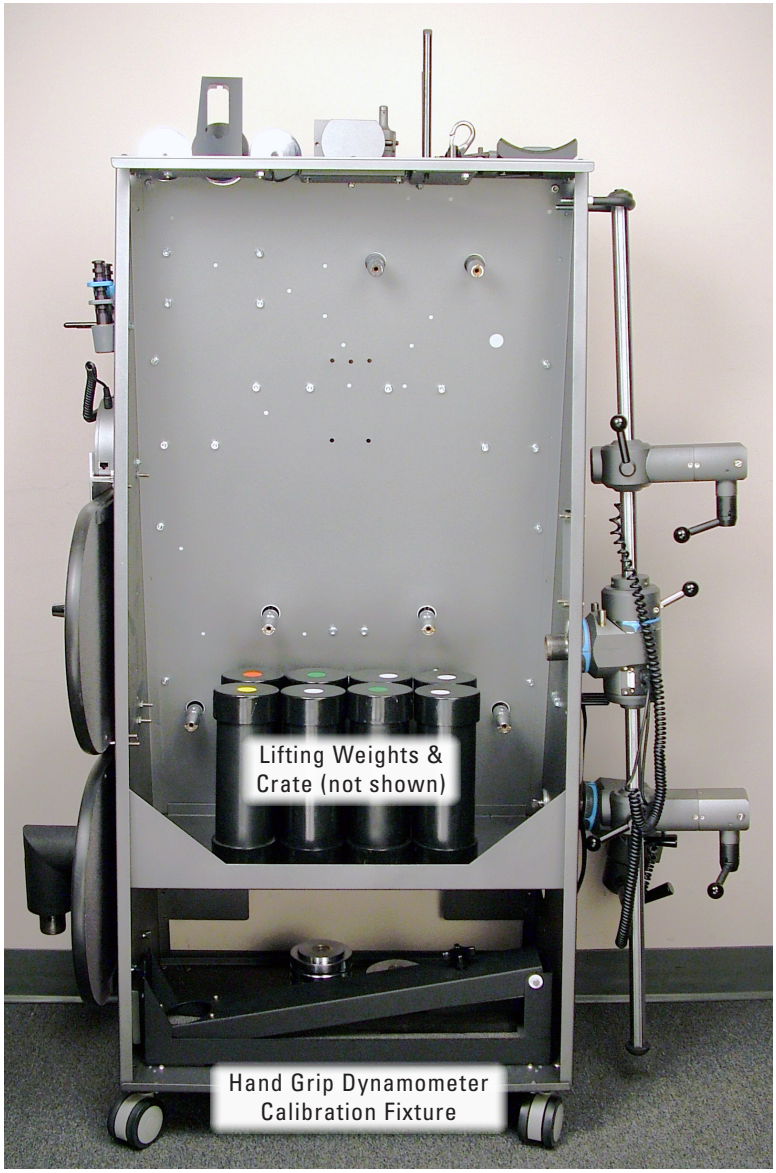


Figure 1-8a. Placement of Tools on Tool Rack - Front & Right Sides



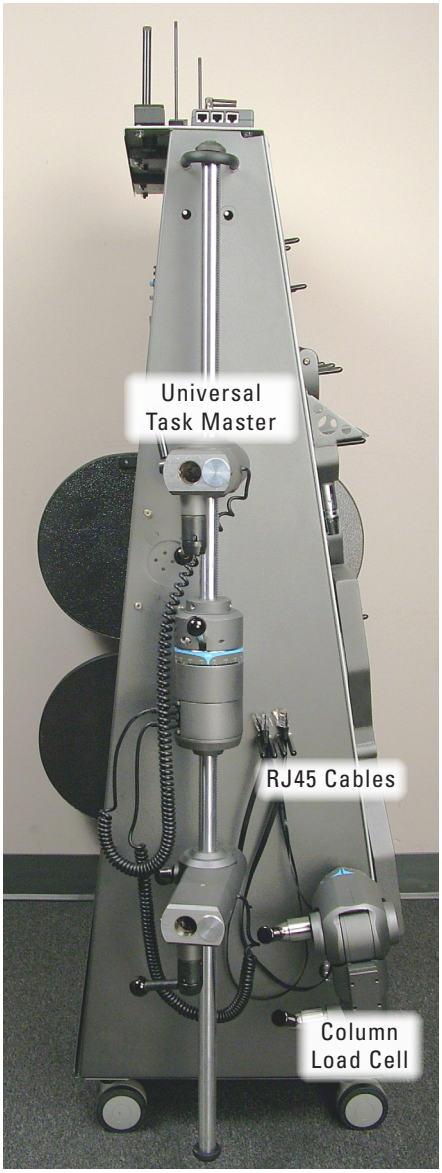


Figure 1-8b. Placement of Tools on Tool Rack - Back & Left Sides

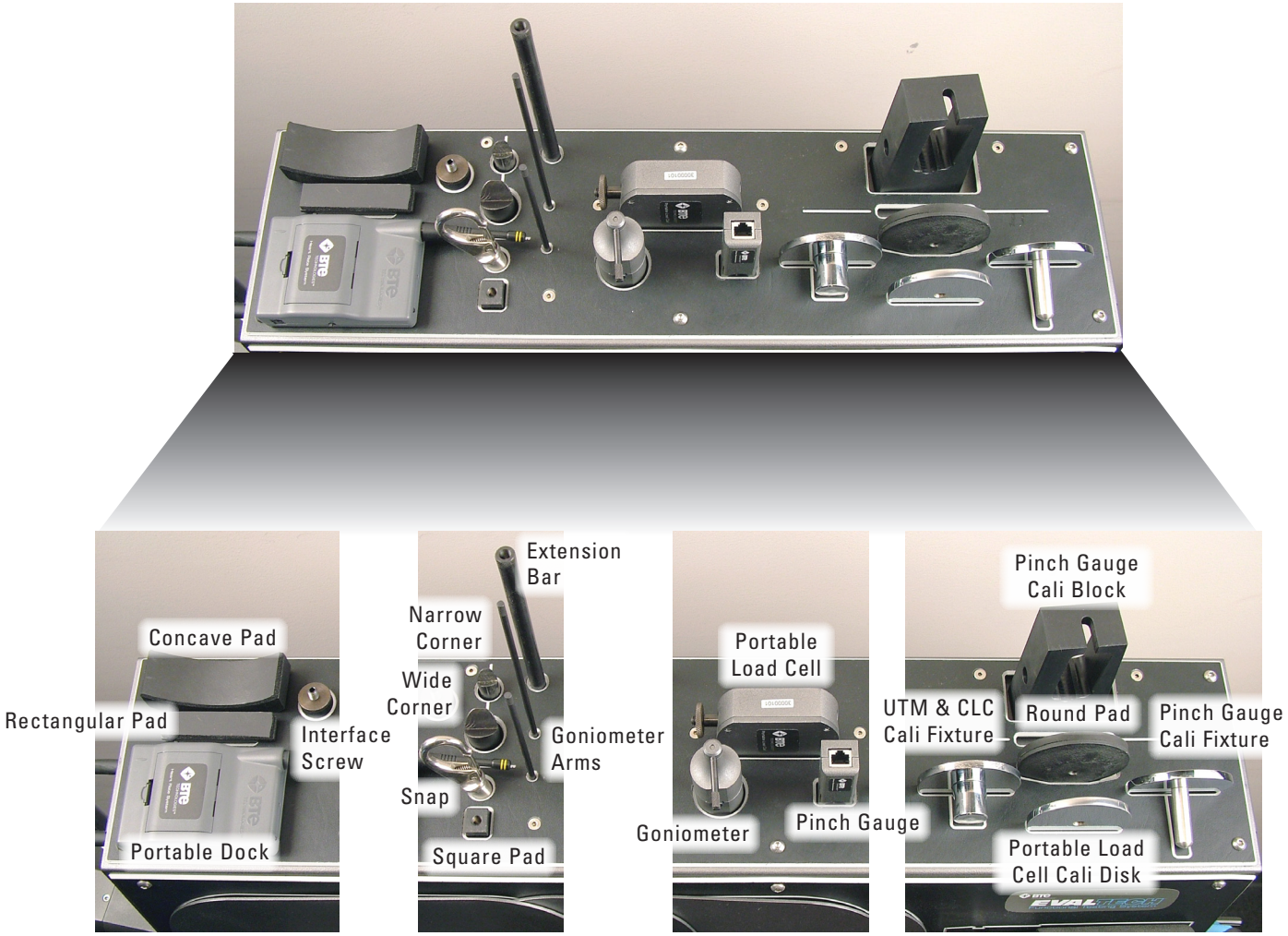


Figure 1-8c. Placement of Tools on Tool Rack - Top

D. FROM PEGBOARD

1. ASSEMBLING THE PANELS AND BRACKETS

Step 1. Locate the top and bottom bracket (Figure 1-9), 6 panels, and 24 1-¼" screws for the FROM assembly. A 5/32" Allen wrench is provided for the FROM setup.

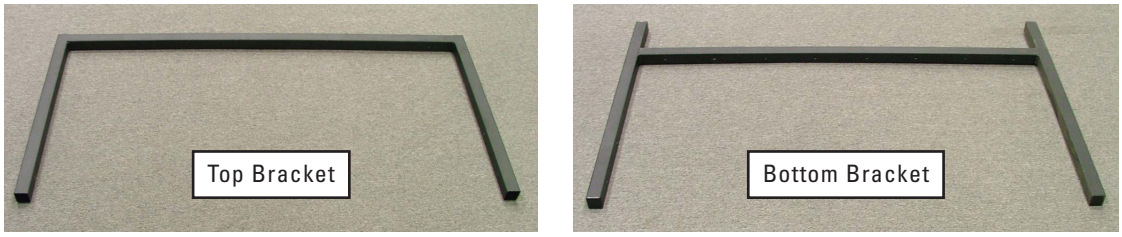


Figure 1-9. FROM Top & Bottom Brackets

Step 2. Arrange the FROM panels on the floor in the following sequence (from left to right): 6, 1, 2, 3, 4, and 5. Place the top and bottom brackets above and below the middle four panels so they may be attached first. You may want to move panel 6 and 5 aside for the time being. First attach the middle four panels to the top bracket and then to the bottom bracket (Figure 1-10).

Figure 1-10. FROM Panels 1-4

Step 3. Next, attach Panel 6 by placing one screw at the top of the panel and then one at the bottom. Finish securing the panels in place by attaching the remaining screws. Repeat this for Panel 5 (Figure 1-11).

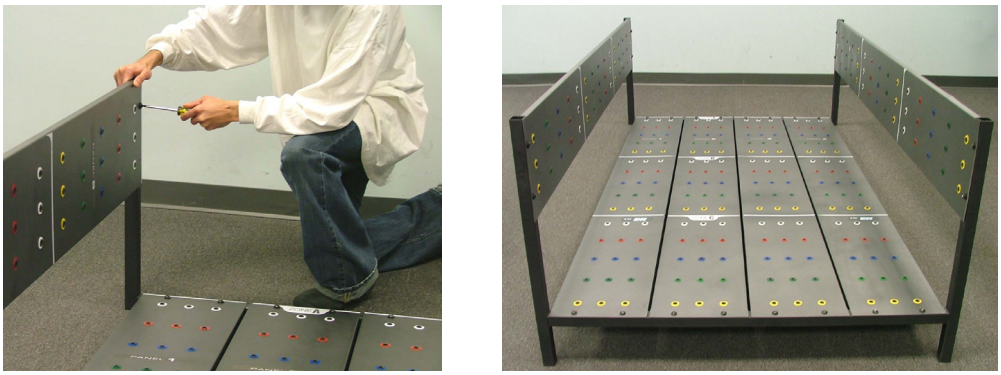


Figure 1-11. Attaching FROM Panel 6 and Completed Assembly

Step 4. Tilt the FROM assembly into an upright position (Figure 1-12). The FROM pegboard may now be positioned near the EvalTech system.

Figure 1-12. FROM in the Upright Position

2. ATTACHING THE SUPPORT KIT

Included with the FROM panels and brackets is a support kit that helps maintain rigidity of the FROM during testing.

Step 1. Identify the components of the support kit (Figure 1-13):

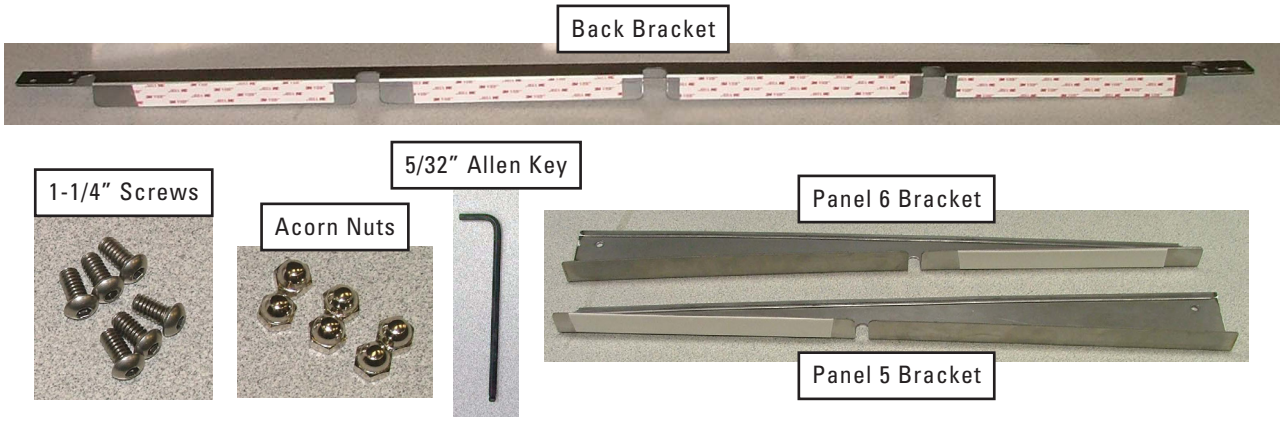


Figure 1-13. Components of the FROM Support Kit

Step 2. Remove the protective coating from the back bracket, Panel 6 bracket, and Panel 5 bracket (Figure 1-14).

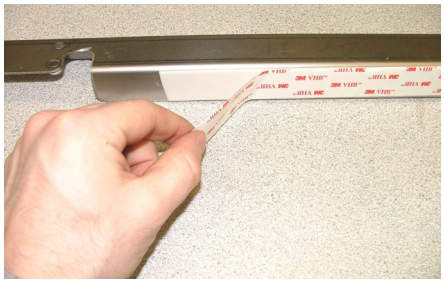


Figure 1-14. Remove the Protective Coating

Be careful not to touch the adhesive or set it on a surface that you do not wish to attach it to; the adhesive is very strong and can be damaged by excessive touch or by removing it from an undesired location.

Step 3. Locate the blue row in Zone B on the FROM panels (Figure 1-15). Clean this area *on the back* of all 6 panels with glass cleaner.

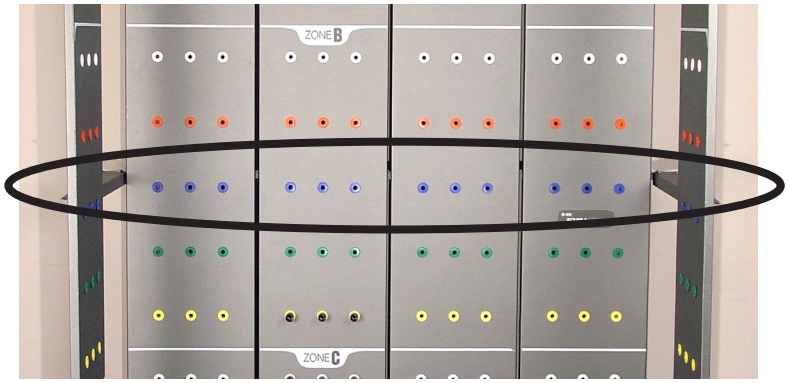


Figure 1-15. Blue Row of Zone B on the FROM panels

Step 4. Rest the back support bracket on top of the back of the blue row of bushings. Roll the back bracket up and forward such that the adhesive touches the FROM panels. The "U" shape of the bracket should be facing the floor (Figure 1-16).

Figure 1-16. Position the Back Bracket and Adhere it to the FROM

Step 5. Firmly push the back bracket into Panels 1-4 while supporting the front side of the panels (Figure 1-17).

Figure 1-17. Secure the Back Bracket to Panels 1-4

Step 6. Repeat *only Steps 3 & 4* for the Panel 6 support bracket (do not firmly push the bracket against the panel - this will be done in a later step). Make sure the end of the Panel 6 support bracket is positioned underneath the end of the back bracket (Figure 1-18).

Step 7. Insert one of the provided screws into one of the holes on the back bracket and through the corresponding hole on the Panel 6 bracket. Loosely fasten the screw in place with one of the provided nuts (Figure 1-18).

Figure 1-18. Position the Panel 6 Bracket and Secure It to the Back Bracket

Step 8. While holding the front of Panel 6, firmly push the Panel 6 bracket against the panel to ensure the adhesive bonds properly (Figure 1-19).

Step 9. Insert two more screws into the back bracket and Panel 6 bracket and secure them each with a nut (Figure 1-19).

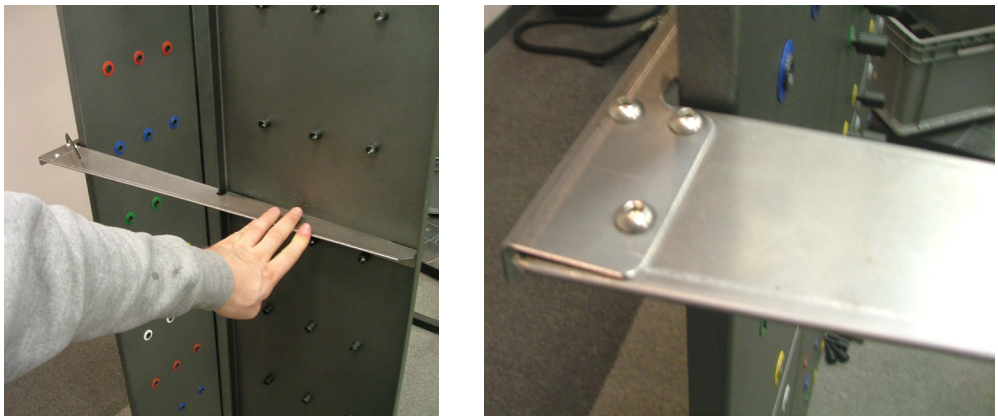


Figure 1-19. Adhering the Panel 6 Bracket and Securing All 3 Screws & Nuts

Step 10. Tighten all 3 screws with the 5/32" Allen key.

Step 11. Repeat Steps 6-10 for the Panel 5 support bracket.

II. GENERAL OPERATION OF THE SYSTEM

DO NOT CHANGE OR MODIFY ANY COMPONENTS

Any changes or modifications, especially to the wireless components, not expressly approved by BTE could void the user's authority to operate the equipment.

A. SETUP

Step 1. Attach one of the antennas to the Hub and plug the Hub USB cable into the computer (Figure 1-20). Be sure to connect the Hub to the designated USB port on the CPU.

Figure 1-20. Attach Antenna and Plug Cable into Computer

Step 2. Place the Hub on the top shelf of the computer cart behind the monitor.

Step 3. Attach the other antenna to the Portable Dock & Transmitter and insert the batteries (Figure 1-21).

Note that the batteries are charged before shipping; however, rechargeable batteries will self-discharge over time. It is recommended that you recharge the batteries before using the system for an extended length of time.

Figure 1-21. Attach Antenna and Insert Batteries

IMPORTANT

DO NOT ATTACH any power supply to the Portable Dock & Transmitter.

ACCEPTABLE ANTENNA(S)

This device has been designed to operate with the antenna(s) listed below and having a maximum gain of 2.7 dBi. Antennas not included in this list or having a gain greater than 2.7 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Acceptable antenna(s) include:

1. Linx Technologies 916MHz 1/4 Wave Whip Antenna (ANT-916-CW-QW)

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

B. CONNECTING A TOOL TO THE PORTABLE DOCK & TRANSMITTER

Three 3 ft and three 5 ft RJ45 cables are included with the system (Figure 1-22). These are the only cables that should be used to connect a tool to the Dock.

Figure 1-22. 3ft and 5ft RJ45 Cables

Step 1. Turn on the Dock and verify the green LED, which is to the right of the antenna, is lit (Figure 1-23).

Step 2. Plug one end of the RJ45 cable into any of the ports on the Dock (Figure 1-23).

Step 3. Plug the other end of the RJ45 cable into the desired tool (Figure 1-23).

Figure 1-23. Connect a Tool to the Dock

A maximum of 3 tools may be connected to the Dock at one time (Figure 1-24).

Figure 1-24. Dock May Accommodate 3 Tools

Note that each tool requires power from the Portable Dock - the more tools that are plugged in, the faster the batteries will drain.

C. IDENTIFYING TOOL SERIAL NUMBERS

Each tool is assigned a unique serial number, which is how the calibration data is stored in the software.The serial number can be found on the label near the RJ45 jack on each tool and on the back of the Portable Dock & Transmitter (Figure 1-25).

Figure 1-25. Serial Number Labels

D. MANAGING TOOLS

The Tool Management feature can be accessed in the software by going to the Administration menu and selecting Manage Tools. Refer to Chapter 02c-V [Administration Menu - Manage Tools] of the EvalTech Software Operator's manual for more information. The screen includes a snapshot of all the tools which are plugged into a powered Portable Dock (Figure 1-26). Note that the Heart Rate icon will be green whenever the Portable Dock & Transmitter is turned on. In addition, the Column Load Cell will be green whenever the Column is powered.

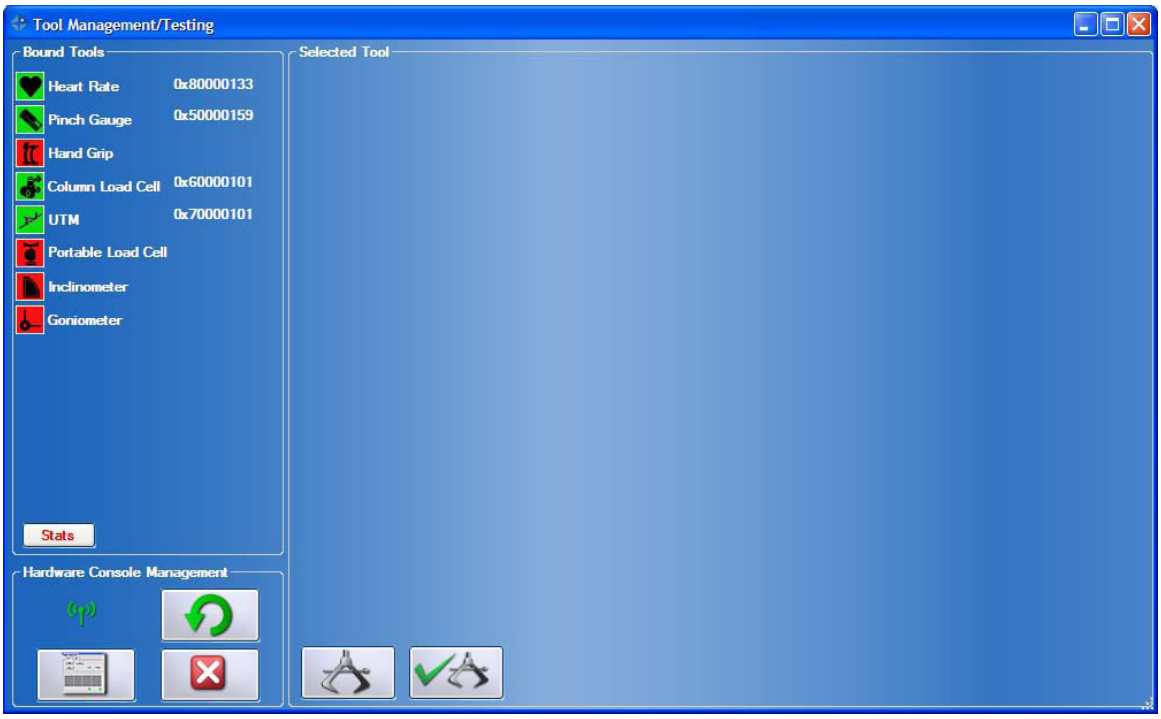


Figure 1-26. Tool Management Screen - Available Tools

In addition, the screen may display the input values whenever a tool name is selected (Figure 1-27). The tool icon must be green in order for the input values to be displayed.

E. UTILIZING THE WIRELESS SYSTEM WHILE TESTING

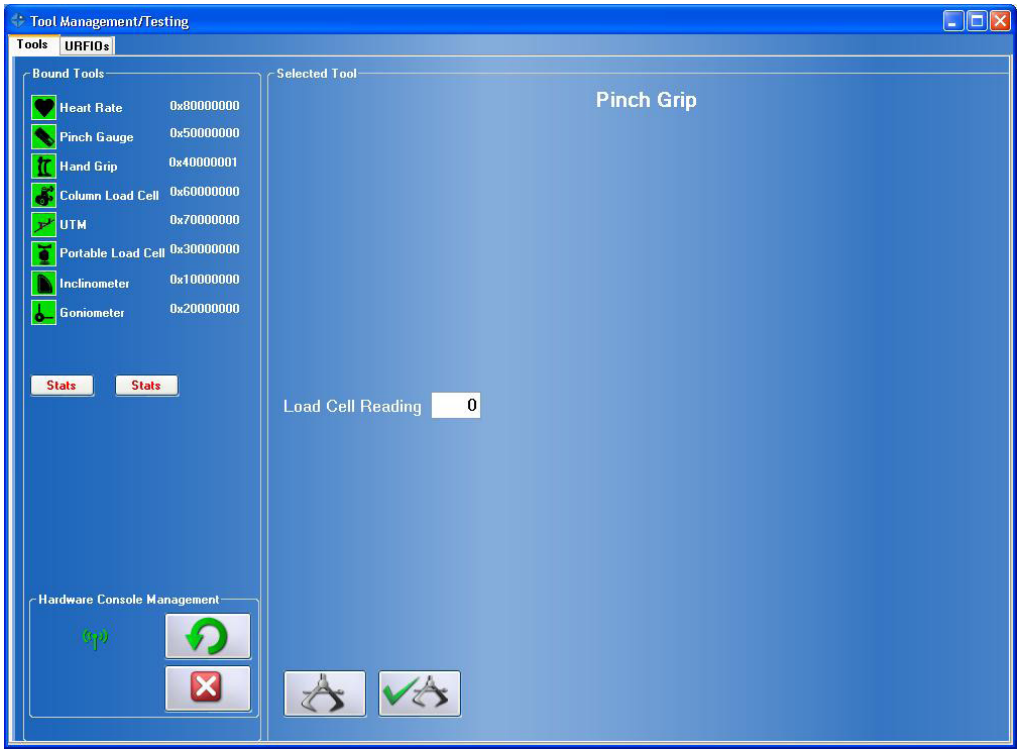


Figure 1-27. Tool Input Values

Take the following into consideration while testing:

1. The Portable Dock & Transmitter must be turned on and the tool must be connected prior to starting a test. The software will not recognize the tool if it is connected after the test has started or if the Dock is turned on after the test has started.
2. A tool must be calibrated prior to testing with it.

F. BATTERIES

The provided rechargeable batteries are charged before shipping; however, rechargeable batteries will self-discharge over time. It is recommended that you recharge the batteries before using the system for an extended length of time. **Only NiMH type batteries can be charged in charger provided with the device**

When fully charged, the batteries should power the Portable Dock for up to 5 hours of continuous testing. This will vary depending on how much battery capacity is available, how many tools are plugged in at once, and which tools are being used (e.g. the Dual Inclinometer and Goniometer use more battery power than the Hand Grip, Pinch Gauge, and Portable Load Cell).

The amount of charging time depends on the remaining capacity of the battery in addition to the charge rate set on the charger. Refer to the battery charger manual for information on the estimated charge time. Whenever possible, only charge the batteries after they have been drained. Short-charging batteries can degrade them over time.

III. MAINTENANCE & CARE

Since rechargeable batteries degrade over time and after extended use, they should be replaced every year.

A. COMPUTER & MONITOR CARE

Since computers are sensitive to extremes of temperature, do not place equipment close to a direct source of heat or cold (for example, in direct sunlight, next to a radiator, or next to an air conditioner).

Do not install any additional software onto the controlling computer. The BTE EvalTech system is in constant communication with the computer, so a "clean", dedicated computer system is crucial to the integrity of this communication system.

If your computer was purchased through BTE and unapproved software has been installed, the computer will not be covered under the warranty.

1. ANTI-VIRUS SOFTWARE

The BTE warranty is void if the product malfunctions as a result of software virus.

Anti-virus software is installed on the computer. If the computer is connected to the internet, the software must be updated regularly to protect the computer against viruses. In addition, the software must be renewed each year.

If the anti-virus software is not approved by your IT department, contact BTE before making any changes.

2. CHECK COMPUTER CABLES

Check that all cables are securely connected to the computer. Just about every cable connector is made in such a way that it will only attach in its appropriate location. If the cables are not secured properly, there may be an interruption of the data transmission, resulting in error messages.

Also verify that the USB cables are plugged into the ports designated on the green tag attached to the computer. Several of the devices may not work properly if they are not in the correct USB port.

3. COMPUTER MAINTENANCE

- Using proper Windows shut-down procedures, shut down the computer every night to keep it running smoothly during testing.
- Periodically defragment the computer. Go to Start - Programs - Accessories - System Tools - Disk Defragmenter; note that this process may take several hours.

4. TOUCH SCREEN MONITOR

- Moisten a soft towel with a mild alcohol-based cleaner (e.g. Windex) and wipe off the screen.
- Do not spray any liquid onto the back of the touch screen monitor.
- Do not use bleach on the touch screen; it will damage the surface.

B. TOOLS AND ATTACHMENTS

- Regularly wipe down the tools and attachments with an alcohol-based solvent.
- Periodically inspect the tools and attachments for any unusual wear or damage.

C. COLUMN

- Wipe down the painted column components with an alcohol-based solvent.
- The column cable should be inspected on a monthly basis for any unusual wear or damage:
    1. Move both column arms down to the bottom of their ranges. The counterweight should be at the top of the column.
    2. Inspect the entire length of the cable for stripping of the nylon coating and verify the cable is not twisted at the top.
- Lightly lubricate the column on a yearly basis or as needed with a petroleum-based lubricant. 3-in-1 multipurpose oil is recommended; do not use WD40.

D. PORTABLE DOCK AND HEART RATE SYSTEM

- Replace the rechargeable batteries every 6 months if used frequently and every year if used occasionally.
- Replace the Polar Heart Rate chest strap every 2 years or 2500 hours of use. Contact BTE at 410-850-0333 or 800-331-8845 for a replacement.

E. CABLES

- Periodically inspect the entire length of the cables used to attach to the tools to the Portable Dock. Replace any that are damaged.

F. BATTERIES

Only NiMH type batteries can be charged in charger provided with the device

G. COMMUNICATION CHANNEL ADJUSTMENT

The tools and the column communicate wirelessly to the computer. In some situations electrical noise in the environment can cause interference with comunication. If you experience tool communicaiton loss the frequency of the tools and columns can be changed. Please contact BTE to assist with this.

IV. STRONGLY RECOMMENDED ADDITIONAL PURCHASES

In addition to the equipment shipped to you from BTE, the purchase of the following items from a local supplier is strongly recommended for adequate protection of your client data:

- CD-RWs (re-writable compact discs), USB flash drives, or a USB external hard drive for backing up and archiving copies of client data
- Disinfectant wipes to clean the commonly used surfaces on the tools and accessories

TABLE OF CONTENTS

HEART RATE SYSTEMS

SECTION 2a - CHEST STRAP HEART RATE SYSTEM

SECTION 2B - BLUETOOTH 4.0 HEART RATE SYSTEM

HEART RATE SYSTEMS

There are two two heart rate system options for the EvalTech; a chest strap system and bluetooth system utilizing a wrist-watch. The software accomdates both systems, but only one can be used for data collection at a time. Refer to the EvalTech Software Operator's Manual for information on choosing which system to use.

SECTION 2a - CHEST STRAP HEART RATE SYSTEM

I. INTRODUCTION

Unlike other heart rate systems, the BTE Heart Rate System allows for constant monitoring during the tests while remaining fully integrated with the computer. In addition, since it is a radio frequency system, a line-of-sight signal is not required. Therefore, the client is free to move around without having to worry about the signal being blocked. Note that the Transmitter has been tested to perform up to 30 feet from the Hub.

This Heart Rate System is comprised of the Hub, Portable Dock & Transmitter, and Polar Heart Rate Monitor with elastic strap. Additional items include two elastic Velcro straps, AA rechargeable batteries, and a AA battery charger (Figure 2-1).

Figure 2-1. Heart Rate System

II. SETTING UP THE HEART RATE SYSTEM

Step 1. With the elastic strap attached, have the client secure the monitor to his or her chest just below the chest muscles and directly against the skin. The Polar logo should be centered on the chest and in an upright position (Figure 2-2).

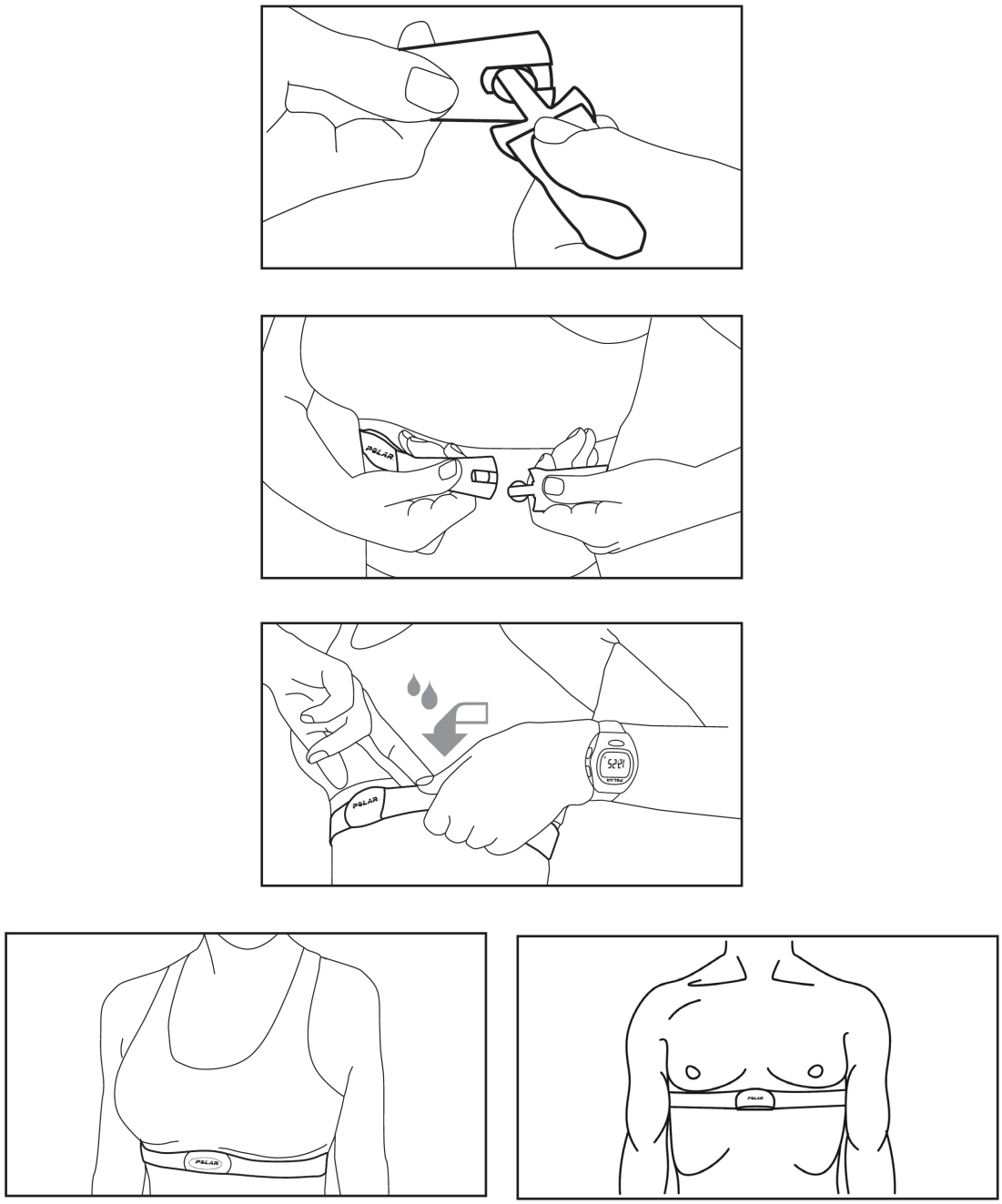


Figure 2-2. Polar Heart Rate Moniter Attached to Client

Tips for obtaining optimal results with the Polar Chest Strap:

1) Use water or electrode conductor gel between the client's skin and the strap

2) Place ***one*** ply of a damp paper towel between the client's skin and the strap

3) DO NOT USE ultrasound gel; it creates a layer of film that blocks the conductivity

Step 2. If you haven't done so already, attach the antenna to the Portable Dock & Transmitter.

Step 3. Make sure the batteries are in the Transmitter and turn the Transmitter on using the switch on the side farthest from the antenna (Figure 2-3). Be sure the batteries are charged; otherwise, the system will give inconsistent results.

Step 4. Have the client place the Transmitter on the left back of his or her pants at belt-line level or on the upper left arm with a Velcro strap. These are the optimal positions since they prevent the Transmitter from obstructing movement during the tests (Figure 2-3). Ensure that the Transmitter will be less than 2 feet from the Polar Monitor during all activities.

Figure 2-3. Transmitter Power Switch and Attached to Back of Client or Left Arm

Note: the upper left arm is the ideal location for consistent heart rate readings, especially during lift tests.

III. UTILIZING THE HEART RATE SYSTEM

Within the software, the heart rate (in beats per minute) may be actively viewed in the Tool Management screen, Cardiovascular Intake screen, and any applicable Test screen (Figure 2-4). Refer to the EvalTech Software Operator's Manual for information on accessing the screens.

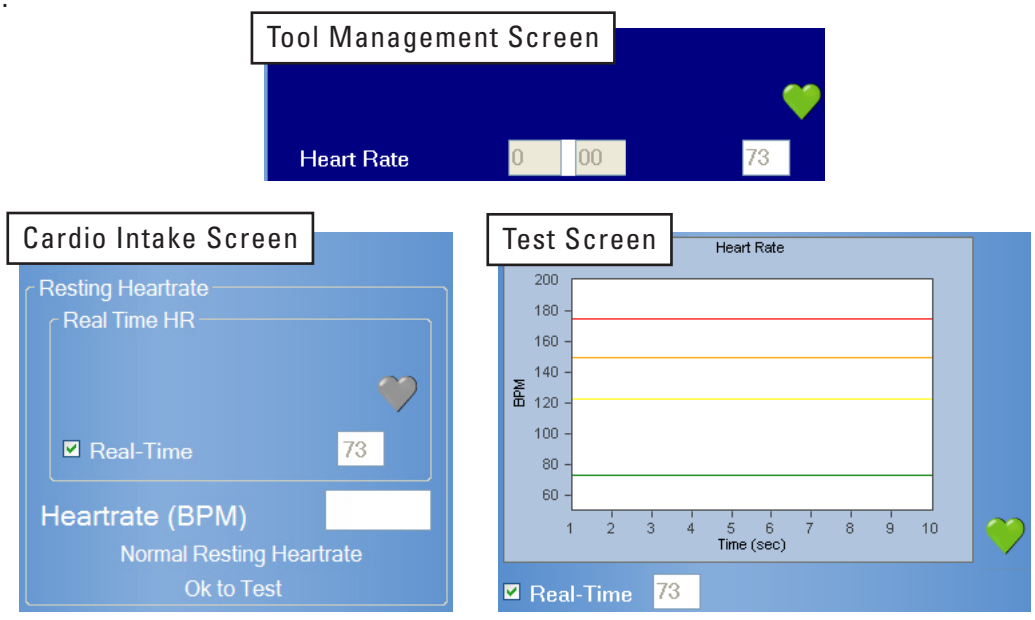


Figure 2-4. Heart Rate Displayed in Various Screens

When you are ready to capture a client's heart rate, make sure the Transmitter is turned on. Once the Hub senses a heart rate, the capture screen will display the beats per minute. Be aware that it may take a couple of seconds for the software to average the heartbeat and give an accurate number.

Please note that the heart rate system does not operate like most Polar systems in that it does not store values; therefore, the readings are more accurate and up to date. However, as a result, if the heart rate is fluctuating too much, the monitor may not be able to pick up a constant value.

Remember that many physiological characteristics (e.g. obesity, skin conductivity, and body hair composition) play a role in obtaining a heart rate and differ from individual to individual. Therefore, you may have to make some modifications in order to obtain the best results.

IV. ELASTIC STRAP

A medium elastic strap is provided with the system. Additional sizes may be purchased from Polar at www.shoppolar.com.

V. MAINTENANCE & CARE

- Store the Polar Heart Rate Monitor in a cool and dry place. Do not store it in a damp environment, in non-breathable material (such as a plastic bag or a sports bag) or with conductive material such as a wet towel. Sweat and moisture can keep the transmitter electrodes wet and the transmitter activated, shortening battery life.
- Keep the Polar Heart Rate Monitor clean. Clean it with a mild soap and water solution. Dry it carefully with a soft towel. Never use alcohol or any abrasive material such as steel wool or cleaning chemicals.
- The operating temperatures are -10 °C to +50 °C / +14 °F to +122 °F.
- Do not bend or stretch the Polar Heart Rate Monitor. This may damage the electrodes.
- Do not dry the Polar Heart Rate Monitor in any other way than with a towel. Mishandling may damage the electrodes.
- Replace the rechargeable batteries every 6 months if used frequently and every year if used occasionally.
- Replace the Polar Heart Rate chest strap every 2 years or 2500 hours of use. Contact BTE at 410-850-0333 or 800-331-8845 for a replacement.

VI. TROUBLESHOOTING

A. UNABLE TO CAPTURE HEART RATE

1. VERIFY THE FOLLOWING

- The batteries in the Portable Dock & Transmitter are charged and less than a year old
- The antenna is properly secured to the Portable Dock & Transmitter and Hub
- The Hub is plugged in and the Portable Dock & Transmitter is powered On
- The channel number on the grey FCC labels on the Hub and the Transmitter are the same (Figure 2-5)

Figure 2-5. Verify Channel Numbers Match

- The Polar Monitor (chest strap) is making a direct and secure contact with the client's skin
- The client's undergarments are not interfering with the placement of the Polar Monitor
- The Transmitter is attached to the client such that it is **less than 2 feet** from the Polar Monitor
- There is no interference between the Hub and Transmitter (see Chapter 12)
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable
- The Transmitter has not been dropped or hit hard - if so, then turn the power off for ~5 seconds and then back on

2. ATTEMPT THE FOLLOWING

- Try a different combination of batteries - if one of the batteries has gone bad, then the Portable Dock will not work properly.
- Refer to the next section to verify the Polar Heart Rate Monitor is properly positioned and secured.
- Attach a Velcro strap around the patient's upper left arm, and secure the Portable Dock to the strap (Figure 2-3).
- If you are in a test, tool management, or calibration screen, exit the screen for ~5

seconds, make sure the Hub is plugged in, turn the Transmitter off and then on, and then re-enter the screen.

B. ABNORMAL HEART RATE VALUES

There can be several reasons for abnormal or irregular readings during testing. Due to the same reasons, heart rate may stay at the same value for a long time or the heart rate stays at zero (0). The following is information provided by Polar. Visit www.polarusa.com for more support information.

1. POOR CONTACT BETWEEN THE SKIN AND THE ELECTRODES OF THE HR MONITOR

For accurate heart rate measurement, the contact between skin and the electrodes should be as good as possible. Polar monitors measure the ECG signal from the chest, where it is the strongest. The weak heart-generated signals need to be accurately measured before the calculation of the heart rate. It is therefore important to ensure that the contact between the skin and the electrodes is as good as possible. Here are some tips how to ensure good contact:

- Moisten the grooved electrode areas on the back of the HR monitor. At the beginning of the testing session the client's skin may be dry and the moisture will help ensure better contact. When the client starts to sweat the contact will improve because the salt in the sweat conducts the electrical signals very well. Saliva is a good conductor as well.
- Tighten the elastic strap of the monitor. If the monitor is loose, the movement of the electrodes disturbs the detection of the ECG signal. If the standard strap does not fit satisfactorily, larger and smaller elastic straps are available as accessories.
- The type of the ECG signal slightly varies from person to person. The form of the ECG signal can depend on form of the chest, the anatomical location and position of the heart, position of the electrodes and the amount of body fat. If the ECG signal is weak, disturbances can more easily spoil the signal.

Find the best contact by turning the monitor left or right, or place it lower or higher. There have been cases where the monitor detects the heart rate better when it is turned upside down so that the Polar logo is upside down and facing out, or even when attached on the person's back with the Polar logo upside down and facing out.

- A hairy chest may also weaken the contact. Try to find the best possible position for monitor.
- In demanding cases, use conductive electrode lotion or gel to improve the contact. After using them, it is very important to wash the monitor carefully.

2. WEAR AND TEAR OF THE MONITOR

Proper care of the monitor after use ensures longer service life for the monitor.

- Wash the monitor regularly after use. It should be washed with a mild soap and water solution. Dry it carefully with a soft towel after washing.
- If the electrodes appear discoloured, the monitor needs to be washed. Do not use any alcohol or a solvent based detergent.
- Never store the monitor when it is wet. Sweat and moisture can keep the electrodes wet and the monitor activated, which shortens the battery life.
- Store the monitor in a cool and dry place. Make sure that the electrodes do not contact anything damp, such as sport towel or wet elastic strap. Do not store a wet monitor in any kind of non-breathing material, such as a plastic bag or a sports bag.
- Keep the monitor out of extreme cold and heat. The operating temperature is -10 ºC to 50 ºC/ 14 ºF to 122 ºF. Do not expose it to direct sunlight for extended periods, such as leaving it in a car.
- Do not bend or stretch the monitor. This may damage the electrodes.

3. ELECTROMAGNETIC DISTURBANCES

- Electromagnetic disturbances may occur near high voltage power lines, traffic lights, mp3 players, the overhead lines of electric railways, electric bus lines or tram lines, televisions, car motors, bike computers, some motor driven exercise equipment, cellular phones or when you walk through electric security gates. Check the surroundings and move away from the source of interference, or remove the source of the disturbance.
- Exercise equipment with electronic or electrical components such as LED displays, motors and electrical brakes may cause interfering stray signals. To solve these problems, try the following:

  1. Have the client move the monitor around until they find an area in which it displays no stray reading. Interference is often worst directly in front of the display panel of the equipment, while the left or right side of the display is relatively free of disturbance.
  2. Put the monitor back on your chest and keep the running computer in this interference-free area as much as possible.

     If the monitor still does not work with the exercise equipment, it may be electrically too noisy for wireless heart rate measurement.

4. DISTANCE BETWEEN THE MONITOR AND PORTABLE DOCK & TRANSMITTER IS TOO GREAT

The maximum transmission range between the monitor and the unit is 1 meter (3 ft). If the distance is greater, the Portable Dock may not get all the signals sent from the monitor.

5. SIGNALS FROM OTHER POLAR MONITORS WITHIN 1 METER TRANSMISSION RANGE

In cases where there are more than one monitor nearer than 3 ft (1 m), the Portable Dock can pick up the signal from all monitors within the range. This can result abnormal high readings. To avoid signal crosstalk, keep a 6-9 ft (2-3 m) distance from

the other monitors.

6. STATIC ELECTRICITY, TECHNICAL SPORTSWEAR, AND SPECIAL CONDITIONS

If the humidity of the air is low a fluttering shirt may rub the monitor and generate static electricity. This causes additional signals, especially if the contact between skin and monitor is poor. To avoid this:

- Moisten the electrodes before use, or use the conductive lotion or gel
- Use a cotton shirt instead of a synthetic shirt
- Use a tighter shirt to avoid fluttering of the material
- Use the monitor on a wet shirt
- Wet the shirt

7. BATTERY OF THE MONITOR IS GETTING EMPTY

The estimated average battery life of the monitor is 2500 hours of use. If the battery of the monitor is running low, the transmission range decreases and may cause errors similar to the ones listed above. If the battery is low, the monitor must be replaced.

SECTION 2b - BLUETOOTH 4.0 HEART RATE SYSTEM

I. INTRODUCTION

The Bluetooth 4.0 Heart Rate System is comprised of the Mio Alpha Heart Rate Monitor and USB Bluetooth 4.0 low energy radio adapter. Additional item includes the USB charging adapter that comes with the Mio Alpha.

The watch uses two green LEDs and an electro-optical cell which are integrated into the back plate of the watch. The LEDs shine light into the skin, which enables the electro-optical cell to detect the pulsing volume of blood flow.

Figure 2-5. Bluetooth 4.0 Heart Rate System

ELECTROMAGNETIC FIELD WARNING

The Mio Alpha watch and USB charger contain magnets that could affect pacemakers and implantable cardioverter-defibrillators (ICDs).

A. SETTING UP THE BLUETOOTH 4.0 HEART RATE SYSTEM

If not done already, insert the Bluetooth USB adapter into an available USB port on the front of the computer.

Step 1. Fasten Mio ALPHA tightly on your arm above, not on, the wrist bone.

Note: Wear it higher on the forearm you have a small wrist.

Step 2. Press and hold the HR button until the watch beeps and the display says FIND.

Step 3. Hold your arm fairly still until the watch beeps again and displays heart rate

Notes: 1) It takes a few seconds for heart rate to register.
2) With proper fit, there should be no visible light between the watch and skin. Make necessary adjustments in fit.

B. CHARGING THE HEART RATE MONITOR BATTERY

Battery life of the watch varies from 8-10 hours of continuous heart rate collection. Always turn discontinue off when not collecting Heart Rate data to preserve battery life. The battery in the watch can be recharged with the included USB charger.

Step 1. Make sure that the four connection pads on the back of the watch are dry. If not, dry them with a towel.

Step 2. Insert the USB charger into one of the USB ports of the computer.

Step 3. Attach the Watch to the USB Charger. This is a magnetic fit which will help to two pieces fit.

Step 4. Once charging the LED will indicate that the battery is charging and the blue LED will flash.

Step 5. When the battery is finished charging the display will say FULL.

Note: If you put the watch in heart rate collection mode and the battery charge is below 1/3, the display will say LOW BATTERY. You can still use the heart rate monitor. If the watch says NO BATTERY, you must recharge before using the watch again.

II. MAINTENANCE AND CARE

- Recharge the battery at least once every 6 months.
- Do not expose the watch to high temperatures.
- Use the watch in the temperature range of 5°C to 45°C (41°F to 113°F).
- Store the watch in the temperature range of 0°C to 25°C (32°F to 77°F).
- Do not disassemble, puncture, or incinerate the watch or battery.
- Clean the sensor area and connection pads with mild soap and water as needed.
- Do not expose your watch to strong chemicals such as gasoline, cleaning solvents, acetone, alcohol, or insect repellents. Chemicals can damage the watch's seal, case, and finish.
- Wipe the watch with a damp cloth as needed. Use mild soap to remove oil or dirt
- Do not scratch the sensor area. Protect it from damage.

III. TROUBLESHOOTING

A. UNABLE TO GET THE WATCH INTO FIND MODE WHEN PRESSING THE HR BUTTON

- When pressing HR button on watch ensure that the button is pressed from the center. Pressing from one of the sides may cause this problem.

B. HEART RATE READING SEEMS INACCURATE

(e.g. Heart Rate is dropping or remaining stable during exercise)

- Ensure the watch is on tight. The watch should be snug so that if the face is pulled away from the wrist the LED light does not show. There should be no gaps between the underside of the watch and the wrist

C. UNABLE TO FIND HEART RATE ON WATCH / WATCH DISPLAYS "--"

- Verify that the watch is not placed on the wrist bone.
- You may need to tighten MIO Alpha's strap and/or move the watch further up the forearm.
- When pressing HR button on watch that the button is pressed from the center. Pressing from the sides of the HR button is used to toggle settings.

D. WATCH IS SHOWING HEART RATE – EVALTECH SOFTWARE IS NOT

- Go to Administration Menu -> Manage Tools
- Verify that under Heart Rate Use Bluetooth Watch is selected. If it is set to Use Chest Strap – Change to Use Bluetooth Watch.

E. WATCH BEEPING DURING USE

- This will have no impact on data collection in EvalTech. This may occur if the persons heart rate is exceeding the preset factory defaults of "Training zones" on the watch – or if settings have been changed via the Set Toggle button on left side of the watch. Refer to the Mio Alpha User Guide if you wish to change settings to avoid any confusion.
- Avoid contact with the Set/Toggle button.

F. WATCH SCREEN IS NOT DISPLAYING HR AND IS SHOWING THE TIMER OR TIME.

- The Set Toggle button the left hand side was hit to toggle to timer or the time. Press the Set toggle button until Heart Rate is shown again. This will not interfere with data collection.
- Avoid contact with the Set/Toggle button.

G. ERROR INITIALIZING BLUETOOTH USB! IF USB IS PLUGGED IN PLEASE REINSERT USB KEY.

- Press OK; Disconnect the USB adapter from the computer and plug back in.
- Go to Administration Menu -> Manage Tools
- Verify that under Heart Rate Use Bluetooth Watch is selected. If it is set to Use Chest Strap – Change to Use Bluetooth Watch.

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DUAL INCLINOMETER

DUAL INCLINOMETER

I. INTRODUCTION

The Dual Inclinometer is used to evaluate range of motion while allowing for sections to be tested in isolation. This is accomplished by a sensor in each Inclinometer side calculating the rotational displacement and subtracting or adding the two values to arrive at a true range of motion value.

The Dual Inclinometer is comprised of two sensors: the master and the remote. The master side is identified by the button switch on the front side. In addition, the master side is connected to the Portable Dock & Transmitter unit via an RJ45 cable. A link cable then connects the remote to the master (Figure 3-1). Depending on the testing situation, you may choose to use a single Inclinometer side or both Inclinometer sides.

There are two versions of the Dual Inclinometer (Figure 3-1). Both versions operate in the same manner.

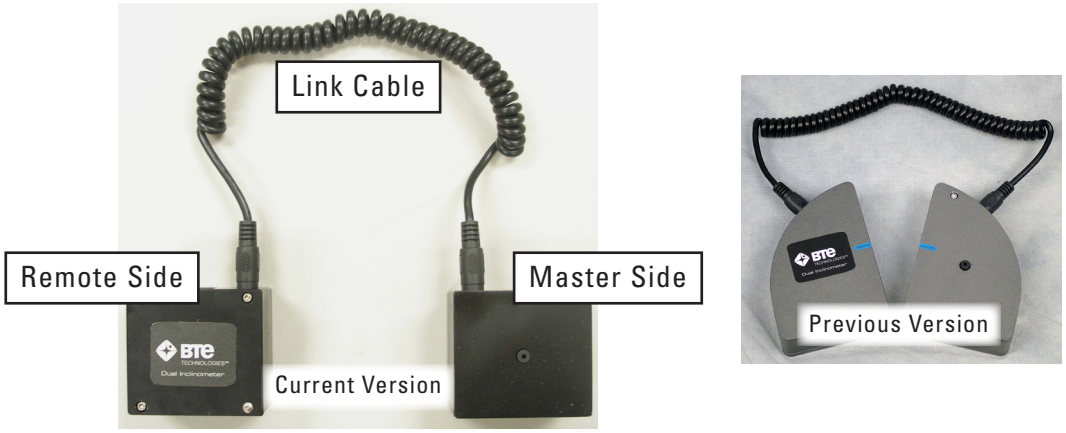

Figure 3-1. Dual Inclinometer - Current and Older Versions

Note that whenever you are testing with the Dual Inclinometer, the sides must always be positioned in the same plane (as shown in the previous figure). The sensors are not able to accurately measure the change in angle if the sides are not properly facing each other.

II. UTILIZING THE DUAL INCLINOMETER

A. CONNECTING TO THE SYSTEM

Always connect the master side to the Dock via the RJ45 jack. Refer to Chapter 01-II-B [Setup & General Operation - General Operation of the System] of this manual for a pictorial example. *Do not attempt to connect the Dual Inclinometer to the column arms - it will not work.*

Remember to verify the tool is plugged in and the Dock is turned on and receiving power before starting a test.

B. COLLECTING DATA

Once the client is in the required initial or final position, press the black button on the front of the master side to obtain the angle.

C. UTILIZING ONE INCLINOMETER SIDE

If you wish to use only one Inclinometer side, then you must use the master side. Simply remove the coiled link cable from the master side and begin testing. Refer to the Cervical Rotation section of this chapter for a pictorial example.

D. UTILIZING BOTH INCLINOMETER SIDES

If you wish to use both Inclinometer sides for the testing, make sure the coiled link cable is properly secured to the master side and the remote side.

III. ADMINISTERING SPINAL RANGE OF MOTION TESTS

Note: All Range of Motion references were obtained from the AMA *Guides to the Evaluation of Permanent Impairment,* Fifth Edition.

The Dual Inclinometer is most useful in its ability to measure spinal range of motion. The most common evaluations are related to the cervical spine, thoracic spine, lumbrosacral spine, sacral hip flexion/extension, gross combined hip and spinal flexion/extension, and straight leg raise.

In order to administer an effective range of motion evaluation, you must make certain the same landmarks are used every time a client is tested.

Table 1 identifies the testing locations and their respective landmarks.

Table 1. Range of Motion Testing Landmarks

Testing Location	Superior Landmark	Inferior Landmark
Cervical Spine	Occiput	T1
Thoracic Spine	T1	T12
Lumbrosacral Spine	T12	Sacral Midpoint
Sacral Hip Flexion/Extension	Sacral Midpoint	Lateral Thigh
Gross Combined Hip & Spinal Flexion/Extension	T1	Sacral Midpoint
Straight Leg Raise	N/A	Anterior Lower Leg

Before beginning an evaluation, it is important to have the client wear appropriate clothing that exposes or provides easy access to the landmarks. You may wish to stock such items as cloth or paper client gowns for this reason.

Guidelines to locating the landmarks:

- **Occiput** – Locate the Occipital protuberance and place the lowest portion of the Inclinometer directly above it.
- **T1** – This is usually the larger of the two protruding spinous processes at the base of the cervical spine near the height of the shoulders. It is easily identified when the client flexes their cervical spine.
- **T12** – Follow the lower ribs posteriorly to the spinous process.
- **Sacral Midpoint** – Follow the iliac crests posteriorly to the PSIS, medially into the sacral sulcus and then medially to the midline. While maintaining one hand at the midline at this level, locate the sacrococcygeal joint. Now locate the midpoint between these two landmarks.

- **Lateral Thigh** – Locate the Greater Tuberosity and place the tip of the Inclinometer just inferior.
- **Anterior Lower Leg** –Locate the Tibial Tubercle and follow the anterior ridge of the tibia inferiorly approximately two-thirds down the lower leg.

For isolated joint movement, use a single Inclinometer side by placing it distally in the plane of movement of the joint being assessed.

For compound joint movement, use both Inclinometer sides by placing one side distally and one side proximally to the joint being assessed. Be sure no other joints are involved in the compound movement and make certain to align the sides in the plane of movement.

Note that these are only guidelines and were developed for the majority of cases. However, there may be clients who have anomalies from birth or injury that may cause these landmark guidelines to be difficult to use. In these cases, document the anomaly and the landmark location so that it may be duplicated in the future.

IV. PRE-DEFINED TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

A. CERVICAL RANGE OF MOTION

1. FLEXION

Step 1. Align the Inclinometer sides in the sagittal plane and place one of the sides on the top of the head (Figure 3-2).

Step 2. Place the other side on T1 (Figure 3-2).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally flex the head (Figure 3-2).

Step 5. Take the final reading by pressing the black button.

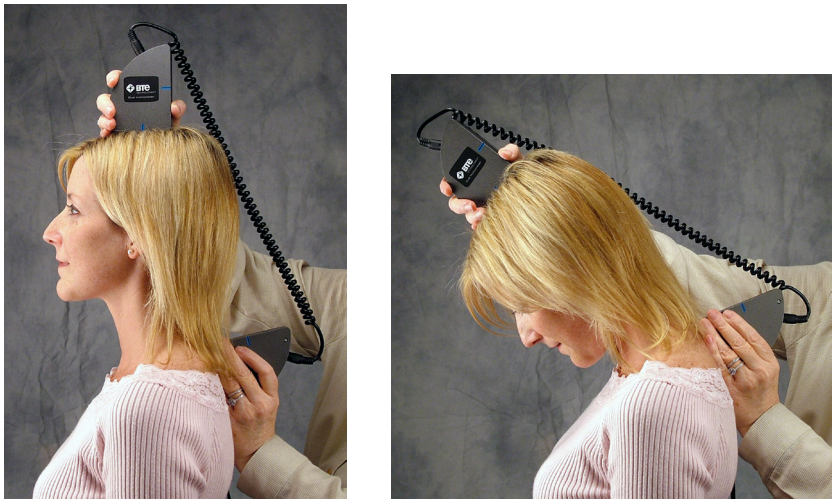

Figure 3-2. Initial & Final Cervical ROM Flexion

2. EXTENSION

Step 1. Align the Inclinometer sides in the sagittal plane and place one of the sides on the top of the head (Figure 3-3).

Step 2. Place the other side on T1 (Figure 3-3).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally extend the head (Figure 3-3).

Step 5. Take the final reading by pressing the black button.

Figure 3-3. Initial & Final Cervical ROM Extension

3. LATERAL FLEXION

Step 1. Align the Inclinometer sides in the coronal plane and place one of the sides on the top of the head (Figure 3-4).

Step 2. Place the other side on T1 (Figure 3-4).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally laterally flex the head to one side (Figure 3-4).

Step 5. Take the final reading by pressing the black button.

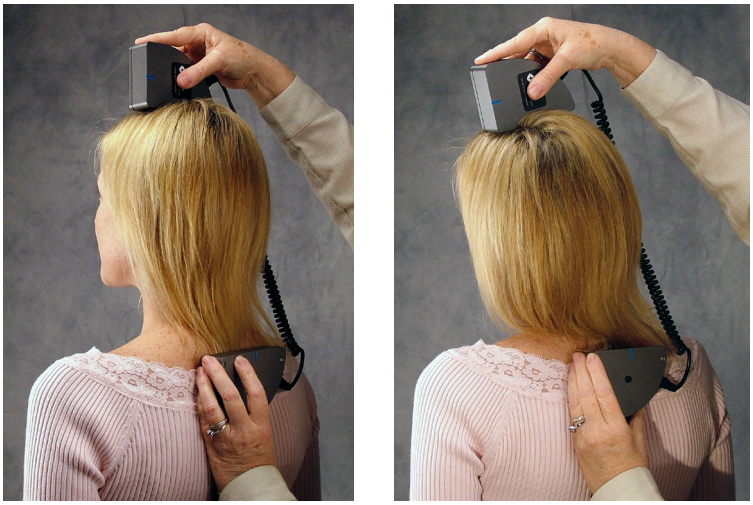

Figure 3-4. Initial & Final Cervical ROM Lateral Flexion

4. ROTATION

Use a single Inclinometer side for cervical rotation testing.

Step 1. Have the client lie in a supine position (this will stabilize the client's shoulders). The shoulders should be exposed in order to allow the evaluator to note any excessive shoulder rotation.

Step 2. Align the Inclinometer side in the transverse plane and place it at the superior portion of the head (Figure 3-5).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally rotate the head to one side (Figure 3-5).

Step 5. Take the final reading by pressing the black button.

Figure 3-5. Initial & Final Cervical ROM Rotation

B. THORACIC RANGE OF MOTION

Since evaluating the thoracic spine is quite dependent on the individual's posture, it is best to have the client use a military type stance. This will help to minimize the client's kyphosis.

1. FLEXION

Step 1. Align the Inclinometer sides in the sagittal plane and place one of the sides on T1 (Figure 3-6).

Step 2. Place the other side at T12 (Figure 3-6).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally flex the thoracic spine (Figure 3-6).

Step 5. Take the final reading by pressing the black button.

Figure 3-6. Initial & Final Thoracic ROM Flexion

2. MINIMAL KYPHOSIS

Step 1. Align the Inclinometer sides in the sagittal plane. Take the initial reading by zeroing the Inclinometers against a true vertical surface such as a wall.

Step 2. Place one of the Inclinometer sides on T1 spinous process.

Step 3. Place the other side at T12 spinous process.

Step 4. Take the final reading by pressing the black button.

3. ROTATION

Step 1. With the client in a standing position, instruct them to flex forward until the thoracic spine is in as horizontal a position as possible (Figure 3-7).

Step 2. Align the Inclinometer sides in the axial and vertical planes and place one of the sides on T1 (Figure 3-7).

Step 3. Place the other side at T12 (Figure 3-7).

Step 4. Take the initial reading by pressing the black button.

Step 5. Have the client maximally rotate the thoracic spine to one side (Figure 3-7).

Step 6. Take the final reading by pressing the black button.

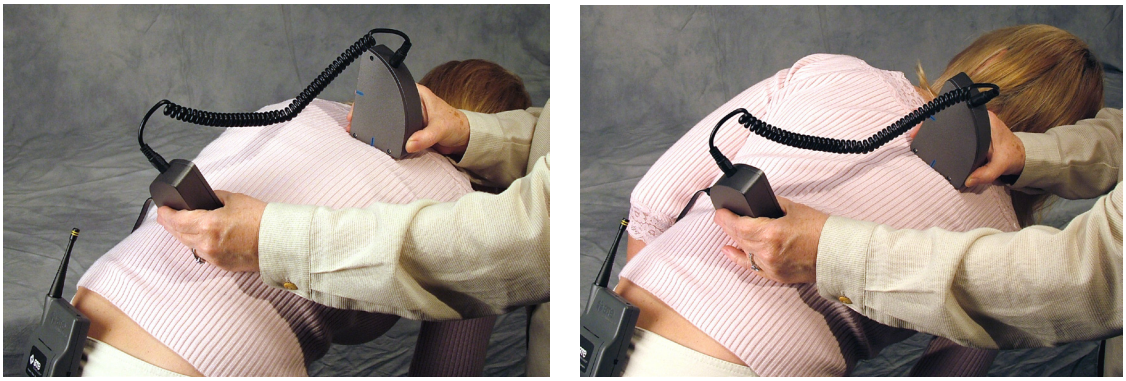

Figure 3-7. Initial & Final Thoracic ROM Rotation

C. LUMBROSACRAL RANGE OF MOTION

1. FLEXION

Step 1. Align the Inclinometer sides in the sagittal plane and place one of the sides on T12 (Figure 3-8).

Step 2. Place the other side at S1 (Figure 3-8).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally flex the lumbar spine (Figure 3-8).

Step 5. Take the final reading by pressing the black button.

Figure 3-8. Initial & Final Lumbar ROM Flexion

2. EXTENSION

Step 1. Align the Inclinometer sides in the sagittal plane and place one of the sides on T12 (Figure 3-9).

Step 2. Place the other side at S1 (Figure 3-9).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally extend the lumbar spine (Figure 3-9).

Step 5. Take the final reading by pressing the black button.

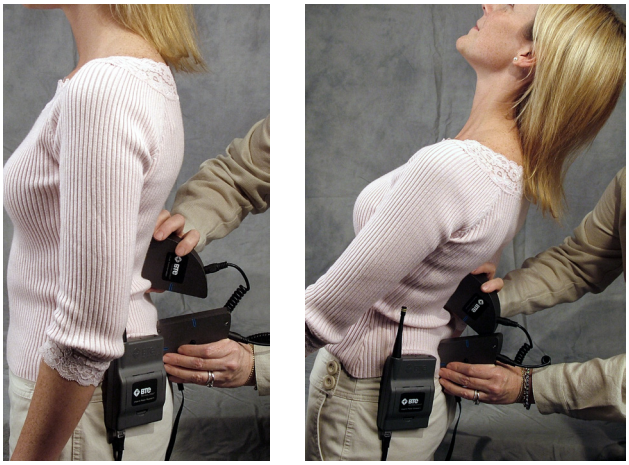

Figure 3-9. Initial & Final Lumbar ROM Extension

3. LATERAL FLEXION

Step 1. Align the Inclinometer sides in the coronal plane and place one of the sides on T12 (Figure 3-10).

Step 2. Place the other side at the sacral midpoint (Figure 3-10).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client maximally laterally flex the lumbar spine to one side (Figure 3-10).

Step 5. Take the final reading by pressing the black button.

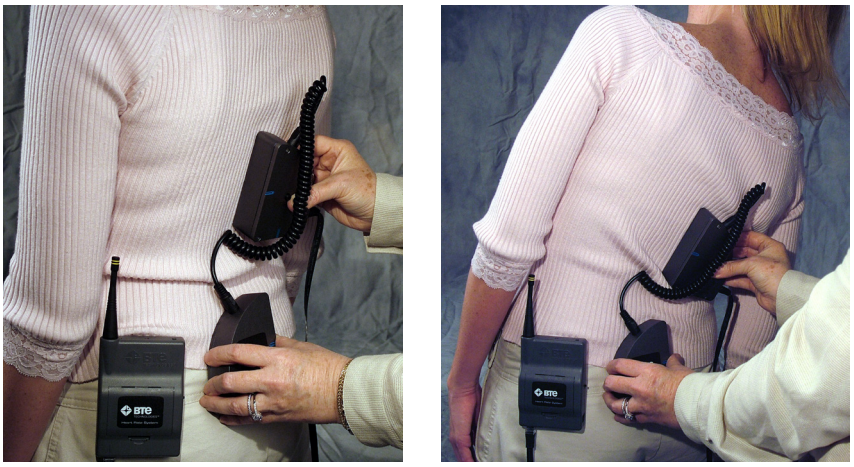

Figure 3-10. Initial & Final Lumbar ROM Lateral Flexion

4. STRAIGHT LEG RAISE

Use a single Inclinometer side for straight leg raise testing.

Step 1. Have the client lie in a supine position.

Step 2. Align the Inclinometer side in the sagittal plane and place it along the anterior lower third of the tibia (Figure 3-11).

Step 3. Take the initial reading by pressing the black button.

Step 4. Have the client perform a straight leg raise (Figure 3-11).

Step 5. Take the final reading at the end of the range by pressing the black button.

Figure 3-11. Initial & Final Straight Leg Raise

The straight leg raise on the tightest side should be within 10 degrees of the total hip motion (i.e. hip flexion + hip extension).

V. DETERMINING THE DEGREE OF ANKYLOSIS

When the degree of ankylosis needs to be documented, the steps listed above must be slightly adjusted:

Step 1. Take the first reading against a wall or on a tabletop.

Step 2. Place the client in as close to a neutral position as possible.

Step 3. Place the two Inclinometer sides at the appropriate landmarks.

Step 4. Take the second reading. This is the degree of ankylosis.

VI. PERFORMING EXTREMITY RANGE OF MOTION EVALUATIONS

While the Goniometer is the ideal tool for performing range of motion evaluations on extremity joints, the single or dual Inclinometer sides may also be used.

VII. TROUBLESHOOTING

A. TOOL NOT READING ANY VALUE OR NOT RECOGNIZED

There are multiple reasons why the Dual Inclinometer may not be reading any value or is not recognized. Verify and attempt the following:

1. VERIFY THE FOLLOWING

- The batteries in the Portable Dock & Transmitter are charged and less than a year old
- The antennas are properly secured to the Portable Dock & Transmitter and Hub
- The Hub is plugged in to the computer and the Dock is powered On
- There is no interference between the Hub and Dock (refer to Chapter 12)
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable
- The Dock has not been dropped or hit hard - if so, then turn the power off for ~5 seconds and then back on
- The Dual Inclinometer, Portable Dock, and cable are not damaged, dirty at the connections, or have loose components

2. ATTEMPT THE FOLLOWING

- Turn off the Portable Dock, attach a new cable to the Dual Inclinometer and Portable Dock, and then turn the Dock back on.
- Turn off the Portable Dock, plug the cable into another port on the Dock, and then turn it back on.
- Turn off the Portable Dock, insert freshly charged batteries, and then turn it back on.
- Try a different combination of batteries - if one of the batteries has gone bad, then the Portable Dock will not work properly.

B. REMOTE SIDE NOT READING ANY VALUE

Unplug and replug the link cable from *both* the Remote Side and the Master Side.

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GONIOMETER

GONIOMETER

I. INTRODUCTION

The Goniometer is used to evaluate extremity range of motion. The tool uses a sensor to calculate the amount of displacement in degrees and arrive at a true range of motion value.

Included with the Goniometer are three different types of arms: 2 small arms, 1 medium arm, and 1 long arm (Figure 4-1). Through the use of the various lengths of arms, you can evaluate the range of motion of smaller joints, such as in the hand and foot, as well as larger joints, such as the knee, hip, and shoulder.

Figure 4-1. Goniometer and Arms

Note that the American Medical Association states that whenever an impairment evaluation is performed, a goniometer must be used for evaluating the range of motion of extremities.

II. UTILIZING THE GONIOMETER

A. CONNECTING TO THE SYSTEM

Always connect the Goniometer to the Portable Dock & Transmitter via the RJ45 jack and cable. Refer to Chapter 01-II-B [Setup & General Operation - General Operation of the System] of this manual for a pictorial example. *Do not attempt to connect the Goniometer to the column arms - it will not work.*

Remember to verify the tool is plugged in and the Dock is turned on and receiving power before starting a test.

B. COLLECTING DATA

Once the client is in the required initial or final position, press the black button on the side opposite the RJ45 jack to obtain the angle.

C. ATTACHING ARMS

The arms are screwed into the top of the Goniometer so they may be easily removed and attached. Use any combination of the small, medium, and long arms to aid in measuring the extremity's range of motion.

III. PRE-DEFINED TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

The following extremities may be tested with the Goniometer:

- Ankle
- Elbow
- Finger
- Forearm
- Hip
- Knee
- Shoulder
- Thumb
- Toe
- Wrist

Note that the names of the pre-defined tests begin with the name of the extremity that is being analyzed.

In assessing motion, the examiner should first observe what an individual can and cannot do by asking them to move each joint of the extremity, from the shoulder down, through its full range of motion. Both extremities should be compared. Individual joints can then be evaluated separately. In determining the range of motion of individual joints, the examiner must evaluate both the active and passive motion.

A. ADMINISTERING RANGE OF MOTION TESTS

Note: All Range of Motion references were obtained from the AMA *Guides to the Evaluation of Permanent Impairment,* Fifth Edition.

Step 1. For small extremity ROM tests (e.g. finger and toe), attach the small arms. For large extremity ROM tests (e.g. elbow and knee), attach the medium and long arms.

Step 2. Instruct the client to place his/her extremity in the initial position (Figure 4-2).

Step 3. Position the center of the top of the Goniometer in line with the joint and the Goniometer arms along the extremity being measured (Figure 4-2).

Step 4. Take the initial reading by pressing the black button.

Step 5. Instruct the client to place his/her extremity in the final position and rotate the Goniometer arms as needed (Figure 4-2).

Step 6. Take the final reading by pressing the black button.

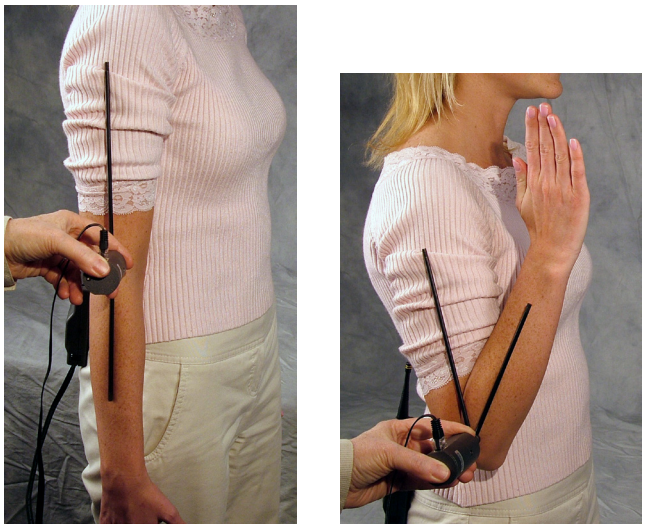

Figure 4-2. Example of Initial & Final Goniometer ROM Positions

B. DETERMINING THE DEGREE OF ANKYLOSIS

When the degree of ankylosis needs to be documented, the testing procedure must be slightly adjusted:

Step 1. Align the Goniometer arms and place them on a wall or tabletop. Take the first reading by pressing the black button.

Step 2. Place the client in as close to a neutral position as possible.

Step 3. Place the Goniometer arms at the appropriate landmarks.

Step 4. Take the second reading by pressing the black button. This is the degree of ankylosis.

IV. TROUBLESHOOTING

A. TOOL NOT READING A CHANGE IN ANGLE

If the top housing of the Goniometer is not properly secured, the Goniometer may not read a change in angle.

Step 1. Attach the long arm to the top of the Goniometer (Figure 4-3).

Step 2. Place the Goniometer in a horizontal position and position the arms parallel to the floor (Figure 4-3).

Step 3. Let go of the top arm - if it falls freely, then the top rotation housing screw needs to be tightened (Figure 4-3).

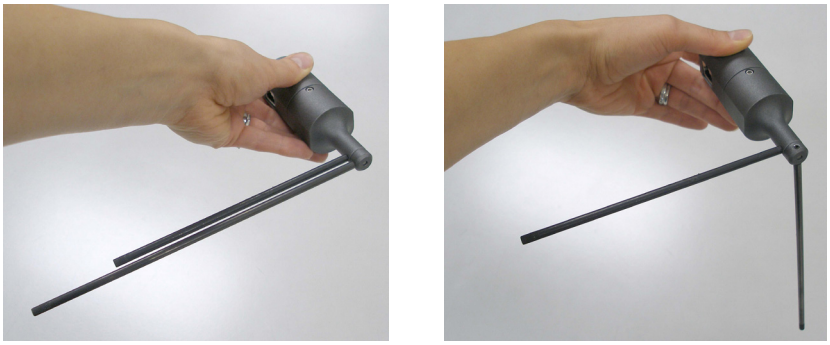

Figure 4-3. Check if Top Housing is Loose

Step 4. Use a 5/64" Allen key, which is supplied with the system (this is the smallest Allen key in the set), to tighten the top set screw (Figure 4-4).

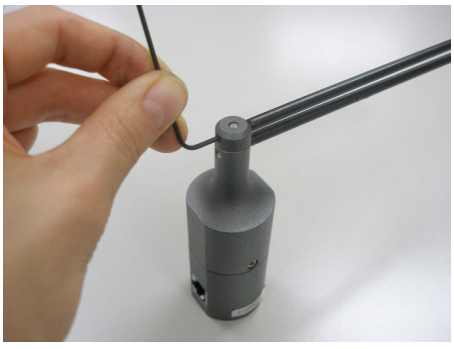

Figure 4-4. Tighten Set Screw

B. TOOL NOT READING ANY VALUE OR NOT RECOGNIZED

There are multiple reasons why the Goniometer may not be reading any value or is not recognized. Verify and attempt the following:

1. VERIFY THE FOLLOWING

- The batteries in the Portable Dock & Transmitter are charged and less than a year old
- The antennas are properly secured to the Portable Dock & Transmitter and Hub
- The Hub is plugged in to the computer and the Dock is powered On
- There is no interference between the Hub and Dock (refer to Chapter 12)
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable
- The Dock has not been dropped or hit hard - if so, then turn the power off for ~5 seconds and then back on
- The Goniometer, Portable Dock, and cable are not damaged, dirty at the connections, or have loose components

2. ATTEMPT THE FOLLOWING

- While the Goniometer is connected to the Portable Dock, turn the Portable Dock off and then back on.
- Turn off the Portable Dock, attach a new cable to the Goniometer and Portable Dock, and then turn the Dock back on.
- Turn off the Portable Dock, plug the cable into another port on the Dock, and then turn it back on.
- Turn off the Portable Dock, insert freshly charged batteries, and then turn it back on.
- Try a different combination of batteries - if one of the batteries has gone bad, then the Portable Dock will not work properly.

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HAND GRIP DYNAMOMETER

HAND GRIP DYNAMOMETER

I. INTRODUCTION

The Hand Grip Dynamometer, also known as the Hand Grip, is used to measure hand grip strength up to 250 lbs/113 kgs. Through the use of multiple attachments and protocols, a client's hand grip strength can be evaluated through several different scenarios.

The Hand Grip comes with 2 different grips: convex (blue) and concave (grey) (Figure 5-1). The concave grip is used for all of the standardized tests and may be used for custom tests. The convex grip is provided to simulate custom applications.

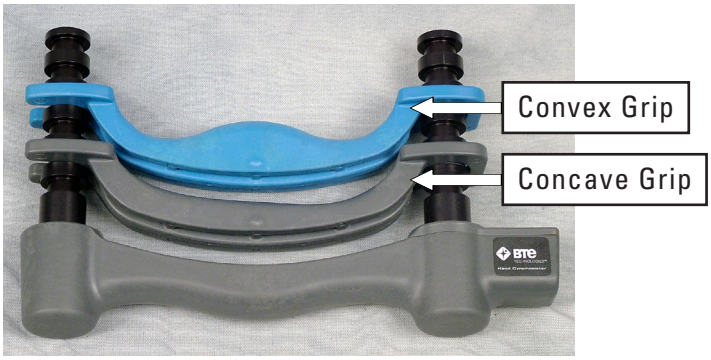


Figure 5-1. Hand Grip Dynamometer

II. UTILIZING THE HAND GRIP DYNAMOMETER

A. CONNECTING TO THE SYSTEM

Always connect the Hand Grip to the Portable Dock & Transmitter via the RJ45 jack. Refer to Chapter 01-II-B [Installation & Setup - General Operation of the System] of this manual for a pictorial example. *Do not attempt to connect the Hand Grip to the column arms - it will not work.*

Remember to verify the tool is plugged in and the Dock is turned on and receiving power before starting a test.

B. HAND GRIP POSITIONS

The Hand Grip was designed such that the detachable grip may be located in 5 different positions (Figure 5-2). Make sure to read each protocol to determine in which position the grip must be.

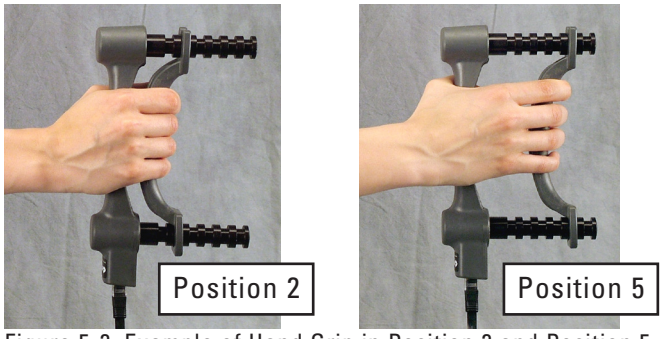


Figure 5-2. Example of Hand Grip in Position 2 and Position 5

Note: Position 1 is closest to the Hand Grip base.

C. HAND GRIP & CLIENT POSITIONING

Verify the grip is properly positioned:

1. The end of the Hand Grip base where the cord attaches should be facing down (Figures 5-3 & 5-4).
2. For the concave grip, the thicker end of the grip, which has the U-shaped end, must be facing up such that the pointer finger comes in contact with it. The convex grip is symmetric, so it may be positioned in either direction.

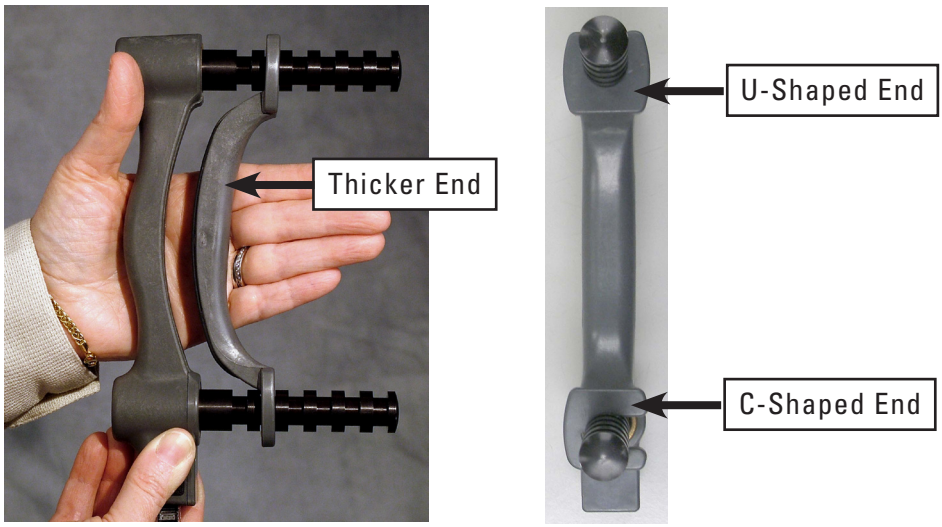


Figure 5-3. Proper Grip Positioning

Prior to testing, the client must be positioned as follows (Figure 5-4):

1. Both feet flat on the floor
2. Upper arm next to body
3. Elbow flexed at 90°
4. Forearm neutral (thumb up)
5. Hand and forearm in slight shoulder internal rotation (toward the center front of the torso)
6. Forearm should not be resting on any surface while gripping

If possible, the client should remove all rings because they may interfere with the performance of the test.

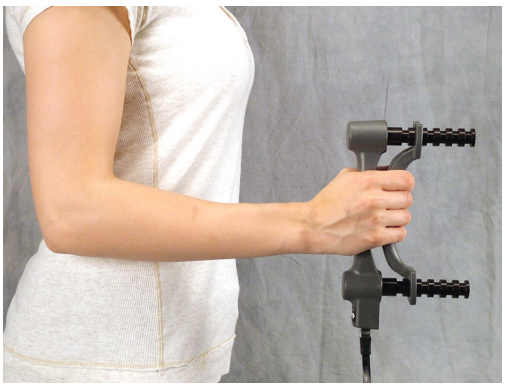


Figure 5-4. Proper Client Positioning

III. PRE-DEFINED TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

A. HAND GRIP - STANDARD

Access this test through the pre-defined test list (refer to Chapter 04a-II-A of the EvalTech Software Operator's Manual).

The Standard Hand Grip Test is optimally used for comparing the client's data to normative data, which is displayed as a solid line (average percentile). This test requires the concave grip to be in position 2 and calls out for the client to maximally grip the tool for 3 seconds on each side for 3 trials each side.

B. HAND GRIP - MAXIMUM VOLUNTARY EFFORT

Access this set of tests through the pre-defined template list (refer to Chapter 04a-II-C of the EvalTech Software Operator's Manual).

The Maximum Voluntary Effort (MVE) Testing Template is optimally used for finding the power position of the client. This template requires the concave grip to be in all 5 positions and calls out for the client to maximally grip the tool for 3 seconds on each side for 3 trials each side.

Generally, the average strength bar graph should represent a bell-shaped curve, thus indicating the client's power position is one of the middle positions. A lack of the bell-shaped curve indicates the client was non-compliant with the strength test. For the COV bar graph, the ideal value should be 15% or below for each side. If the value is higher than 15%, the client did not test consistently across the 3 trials.

C. HAND GRIP - MODIFIED MAXIMUM VOLUNTARY EFFORT

Access this set of tests through the pre-defined template list (refer to Chapter 04a-II-C of the EvalTech Software Operator's Manual).

The Modified Maximum Voluntary Effort (MMVE) Testing Template is the same as the Maximum Voluntary Effort Template except that it differs in the number of trials performed for each position. This template is most helpful when time is a constraint: instead of performing 3 trials for each position and each side, the test only calls out for 1 trial per side in positions 1, 3, 4 & 5, and 3 trials per side in position 2.

D. HAND GRIP - RAPID EXCHANGE

Access this test through the pre-defined test list (refer to Chapter 04a-II-A of the EvalTech Software Operator's Manual).

The Rapid Exchange Test is optimally used for monitoring consistency of the client. The test consists of six 1-second trials per side. If the client has completed the MVE Test, the position of the concave grip should be based on the power position determined from the MVE Test. If the client has not completed the MVE Test, the concave grip should be set to position 2.

When passing the Hand Grip from the client's one hand to the other, hold the Hand Grip at

the base (Figure 5-5). This ensures that the trial won't start prematurely.

Figure 5-5. Hold Hand Grip at Base During Rapid Exchange

IV. CALIBRATION & VERIFICATION

It is recommended calibration is performed on a weekly basis and verification is performed on a daily basis.

A. CALIBRATION EQUIPMENT (FIGURE 5-6)

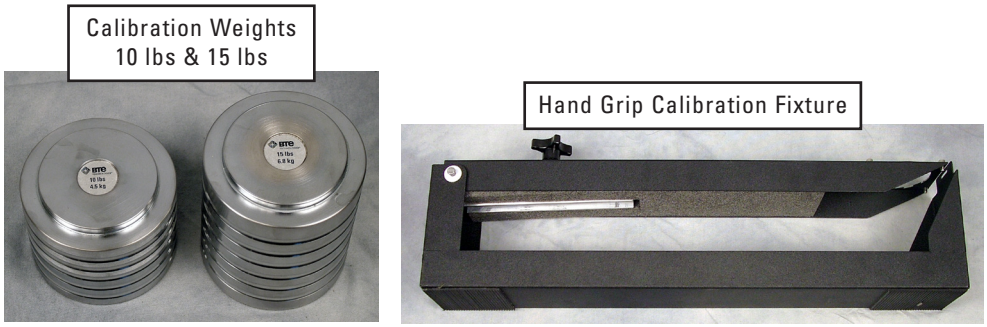


Figure 5-6. Hand Grip Calibration Equipment

B. ACCESSING THE CALIBRATION & VERIFICATION SCREENS

Refer to Chapter 02c-V-C [Administration Menu - Manage Tools - Calibration] of the EvalTech Software Operator's Manual for additional information on the tool management and calibration screens.

The calibration screen may be accessed within the testing screen and within the Tool Management screen.

The verification screen may only be accessed within the Tool Management screen.

1. VIA THE TESTING SCREEN

Click on  , which is typically located in the bottom-center of the screen.

2. VIA THE TOOL MANAGEMENT SCREEN

Step 1. Access the Tool Management screen via one of the following two methods:

a) Within the Test Administration screen, click on  , which is located in the bottom-left corner of the screen.

b) Select the Administration Taskbar Menu and click on Manage Tools.

Step 2. On the left side of the screen, click on Hand Grip. The right side of the screen will show the current input values for the tool.

Step 3a. Click on  in the bottom lower-center to access the calibration screen.

Step 3b. Click on  in the bottom lower-center to access the verification screen.

C. TIPS FOR A SUCCESSFUL CALIBRATION

The following tips are recommended for a successful calibration:

- Ensure that the calibration fixture is placed on a sturdy and level surface during calibration.
- Make sure the calibration fixture lid is not down for the first 2 steps of the calibration.
- After the weight is on the lid, verify the front edge of the lid is visible through the slit, which is at the top front edge of the base (Figure 5-7).

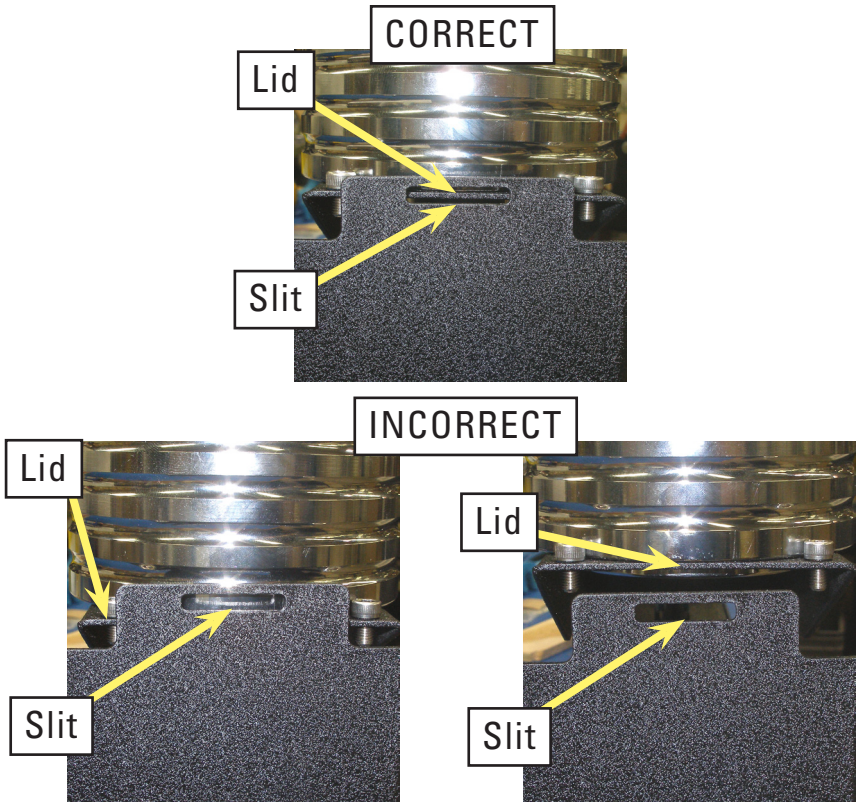


Figure 5-7. Proper Location of Lid after Weight is Applied

If the lid is not visible through the slit, turn the 4-arm knob, which is on the lid above the Hand Grip, in either direction until the lid is visible. This ensures the lid is level with the weight on it and the weight is applied evenly to both rods.

- Lift the lid before placing the 10 lb weight on the fixture. This will allow the Hand Grip to return to a zero weight.
- Push the side of the weight after placing it on the lid but before recording the weight (Figure 5-8). This will slightly shake the Hand Grip and remove any "sticking" in the rods. **Make sure the fixture is not moving when you click the checkmark icon in the software.**

Figure 5-8. Push the Side of the Weight

- If the calibration was not successful, click on  within the calibration screen and repeat the steps, but wait 3 seconds between applying the weight and clicking on the checkmark icon.

D. PERFORMING CALIBRATION

Prior to entering the calibration screen, verify the Hand Grip is connected to the Dock and the Dock is turned on.

The initial calibration screen should look as follows (Figure 5-9):

Figure 5-9. Hand Grip Calibration Screen

Step 1. Remove the detachable grip (i.e. the concave or convex grip) from the Hand Grip and place the Hand Grip in the calibration fixture as shown on the screen.

Step 2. Once the Hand Grip is in place, click on  to set the zero point (Figure 5-10).

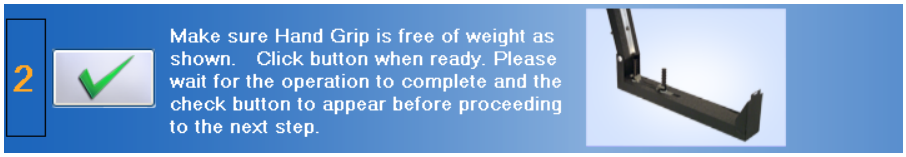


Figure 5-10. Hand Grip - Set the Zero Point

Step 3. Lower the lid of the calibration fixture.

Step 4. Place the 15 lb calibration weight on the calibration fixture. Make sure the lid is

visible through the slit (Figure 5-7).

Step 5. Click on  to set the weight (Figure 5-11).

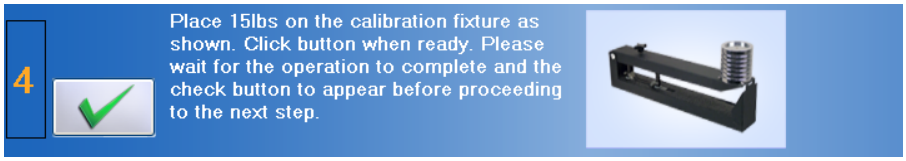


Figure 5-11. Hand Grip - Set the Weight

Step 6. Remove the 15 lb calibration weight and lift the lid up. (Figure 5-10)

Step 7. Place the 10 lb calibration weight on the fixture. Make sure the lid is visible through the slit (Figure 5-7).

Step 7. Click on  to verify the weight (Figure 5-12).

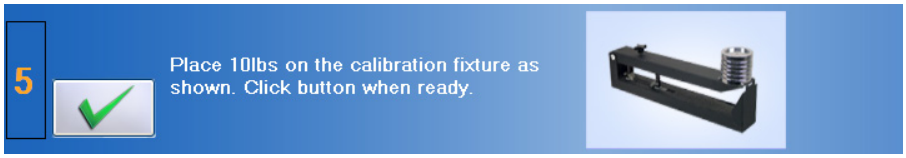


Figure 5-12. Hand Grip - Verify the Weight

If the Hand Grip was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 5-13).

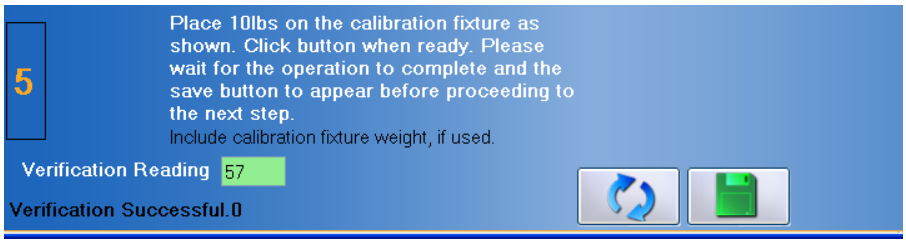


Figure 5-13. Hand Grip - Verification Successful

If the Hand Grip was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 5-14). You may try re-verifying the weight or re-calibrating the tool until the verification is successful. Also refer to the Troubleshooting section within this chapter for help.

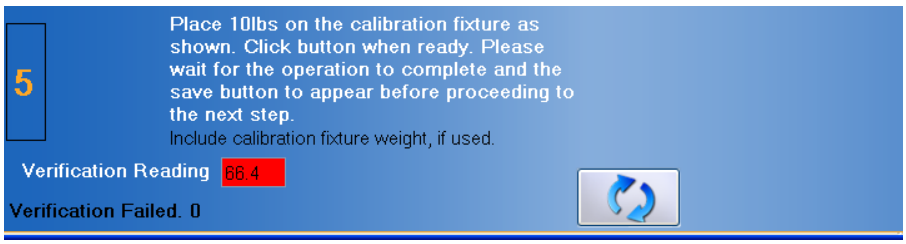


Figure 5-14. Hand Grip - Verification Failed

Step 7. Once the tool has passed verification, click on  to save the data.

E. PERFORMING VERIFICATION

The verification screen allows you to quickly to verify the tool without having to go through the whole calibration. In addition, all verifications performed through the verification screen are included in the tool's calibration report.

Step 1. Place the Hand Grip in the calibration fixture and lower the lid.

Step 2. Place the 10 lb calibration weight on the fixture and click on  to verify the weight (Figure 5-15). Make sure the lid is visible through the slit (Figure 5-7).

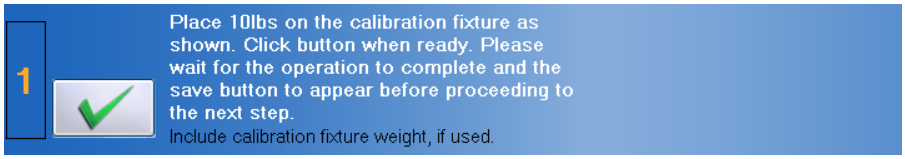


Figure 5-15. Hand Grip - Verify the Weight

If the Hand Grip was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 5-16).

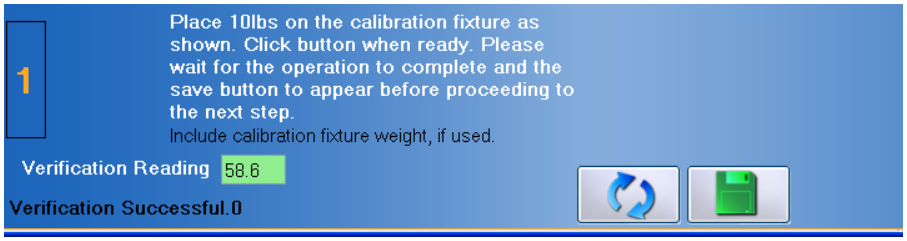


Figure 5-16. Hand Grip - Verification Successful

If the Hand Grip was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 5-15). You may try re-verifying the weight or re-calibrating the tool until the verification is successful. Also refer to the Troubleshooting section within this chapter for help.

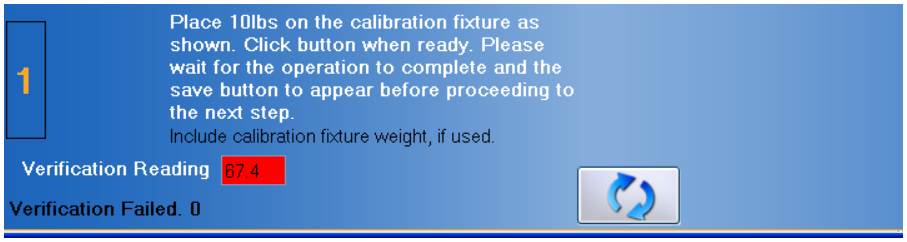


Figure 5-17. Hand Grip - Verification Failed

Step 3. Once the tool has passed verification, click on  to save the data.

V. TROUBLESHOOTING

A. TOOL NOT READING ANY VALUE OR NOT RECOGNIZED

There are multiple reasons why the Hand Grip may not be reading any value or is not recognized. Verify and attempt the following:

1. VERIFY THE FOLLOWING

- The batteries in the Portable Dock & Transmitter are charged and less than a year old
- The antennas are properly secured to the Portable Dock & Transmitter and Hub
- The Hub is plugged in to the computer and the Dock is powered On
- There is no interference between the Hub and Dock (refer to Chapter 12)
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable
- The Dock has not been dropped or hit hard - if so, then turn the power off for ~5 seconds and then back on
- The Hand Grip, Portable Dock, and cable are not damaged, dirty at the connections, or have loose components

2. ATTEMPT THE FOLLOWING

- Turn off the Portable Dock, attach a new cable to the Hand Grip and Portable Dock, and then turn the Dock back on.
- Turn off the Portable Dock, plug the cable into another port on the Dock, and then turn it back on.
- Turn off the Portable Dock, insert freshly charged batteries, and then turn it back on.
- Try a different combination of batteries - if one of the batteries has gone bad, then the Portable Dock will not work properly.

B. UNABLE TO CALIBRATE OR VERIFY

Refer to Section IV-C of this chapter for information.

TABLE OF CONTENTS

PINCH GAUGE

PINCH GAUGE

I. INTRODUCTION

The Pinch Gauge, also known as the Pinch Dynamometer, is used to measure finger strength up to 50 lbs/23 kgs (Figure 6-1).

Figure 6-1. Pinch Gauge

II. UTILIZING THE PINCH GAUGE

A. CONNECTING TO THE SYSTEM

Always connect the Pinch Gauge to the Portable Dock & Transmitter via the RJ45 jack. Refer to Chapter 01-II-B [Setup & General Operation - General Operation of the System] of this manual for a pictorial example. *Do not attempt to connect the Pinch Gauge to the column arms - it will not work.*

Remember to verify the tool is plugged in and the Dock is turned on and receiving power before starting a test.

B. CLIENT POSITIONING

Prior to testing, the client must be positioned as follows:

1. Both feet flat on the floor
2. Upper arm next to body
3. Elbow flexed at 90º
4. Hand and forearm in slight shoulder internal rotation (toward the center front of the torso)
5. Forearm should not be resting on any surface while gripping

III. PRE-DEFINED TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

A. PINCH GAUGE - KEY

The Key Pinch Test is used to measure the strength of the hand in the key (lateral) pinch position. Prior to beginning the test, the client should hold the Pinch Gauge between the thumb and the lateral aspect of the index finger, middle phalanx; the position is intended to simulate the client holding a key (Figure 6-2).

Figure 6-2. Pinch Gauge - Key

B. PINCH GAUGE - TIP

The Tip Pinch Test is used to measure the strength of the hand in the tip-to-tip pinch position. Prior to beginning the test, the client should hold the Pinch Gauge between the tip of the thumb and the tip of the index finger (Figure 6-3).

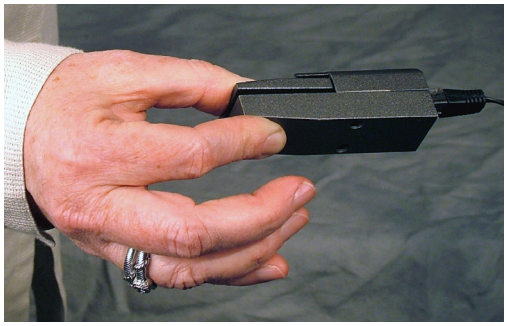


Figure 6-3. Pinch Gauge - Tip

C. PINCH GAUGE - PALMAR

The Palmar Pinch Test is used to measure the strength of the hand in the palmar pinch position. Prior to beginning the test, the client should hold the Pinch Gauge between the tip of the thumb and the tips of the index finger and middle finger (Figure 6-4).

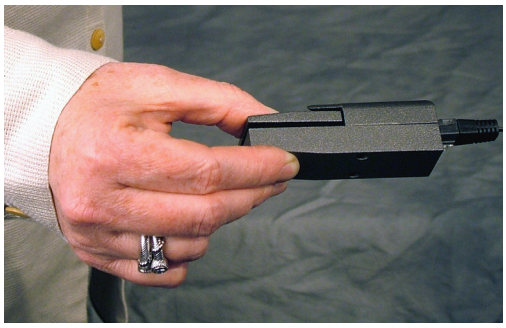


Figure 6-4. Pinch Gauge - Palmar

IV. CALIBRATION & VERIFICATION

It is recommended calibration is performed on a weekly basis and verification is performed on a daily basis.

A. CALIBRATION EQUIPMENT (FIGURE 6-5)

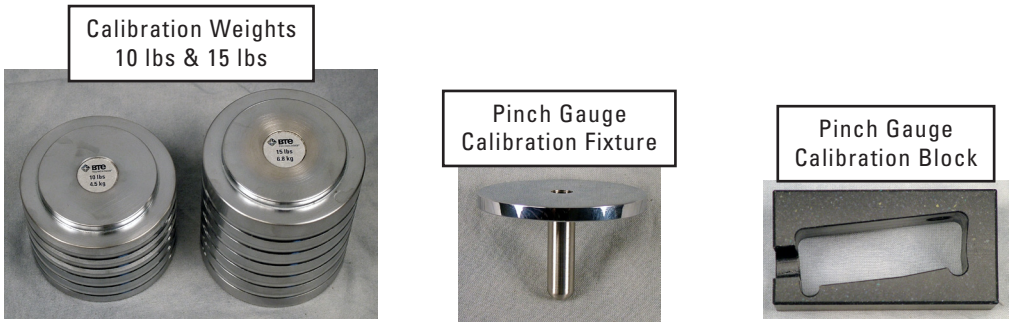


Figure 6-5. Pinch Gauge Calibration Equipment

B. ACCESSING THE CALIBRATION & VERIFICATION SCREENS

Refer to Chapter 02c-V-C [Administration Menu - Manage Tools - Calibration] of the EvalTech Software Operator's Manual for additional information on the tool management and calibration screens.

The calibration screen may be accessed within the testing screen and within the Tool Management screen.

The verification screen may only be accessed within the Tool Management screen.

1. VIA THE TESTING SCREEN

Click on  , which is typically located at the bottom-center of the screen.

2. VIA THE TOOL MANAGEMENT SCREEN

Step 1. Access the Tool Management screen via one of the following two methods:

a) Within the Test Administration screen, click on  , which is located in the bottom-left corner of the screen.

b) Select the Administration Taskbar Menu and click on Manage Tools.

Step 2. On the left side of the screen, click on Pinch Gauge. The right side of the screen will show the current input values for the tool.

Step 3a. Click on  in the bottom lower-center to access the calibration screen.

Step 3b. Click on  in the bottom lower-center to access the verification screen.

C. TIPS FOR A SUCCESSFUL CALIBRATION

The following tips are recommended for a successful calibration:

- Ensure that the calibration block is placed on a sturdy and level surface during calibration.
- During the calibration and verification, gently place the weights on the calibration fixture. This ensures no excessive forces are applied to the load cell.
- Make sure to add the calibration fixture weight to the weight entered in the calibration screen (e.g. 25.6 or 15.6).
- Verify the calibration weight is entered correctly in the text fields.
- Remove the calibration fixture from the block before placing the verification weight on the fixture. This will allow the Pinch Gauge to return to a zero weight.
- If the calibration was not successful, click on  within the calibration screen and repeat the steps, but wait 3 seconds between applying the weight and clicking on the checkmark icon.

D. PERFORMING CALIBRATION

Prior to entering the calibration screen, verify the Pinch Gauge is connected to the Dock and the Dock is turned on.

The initial calibration screen should look as follows (Figure 6-6):

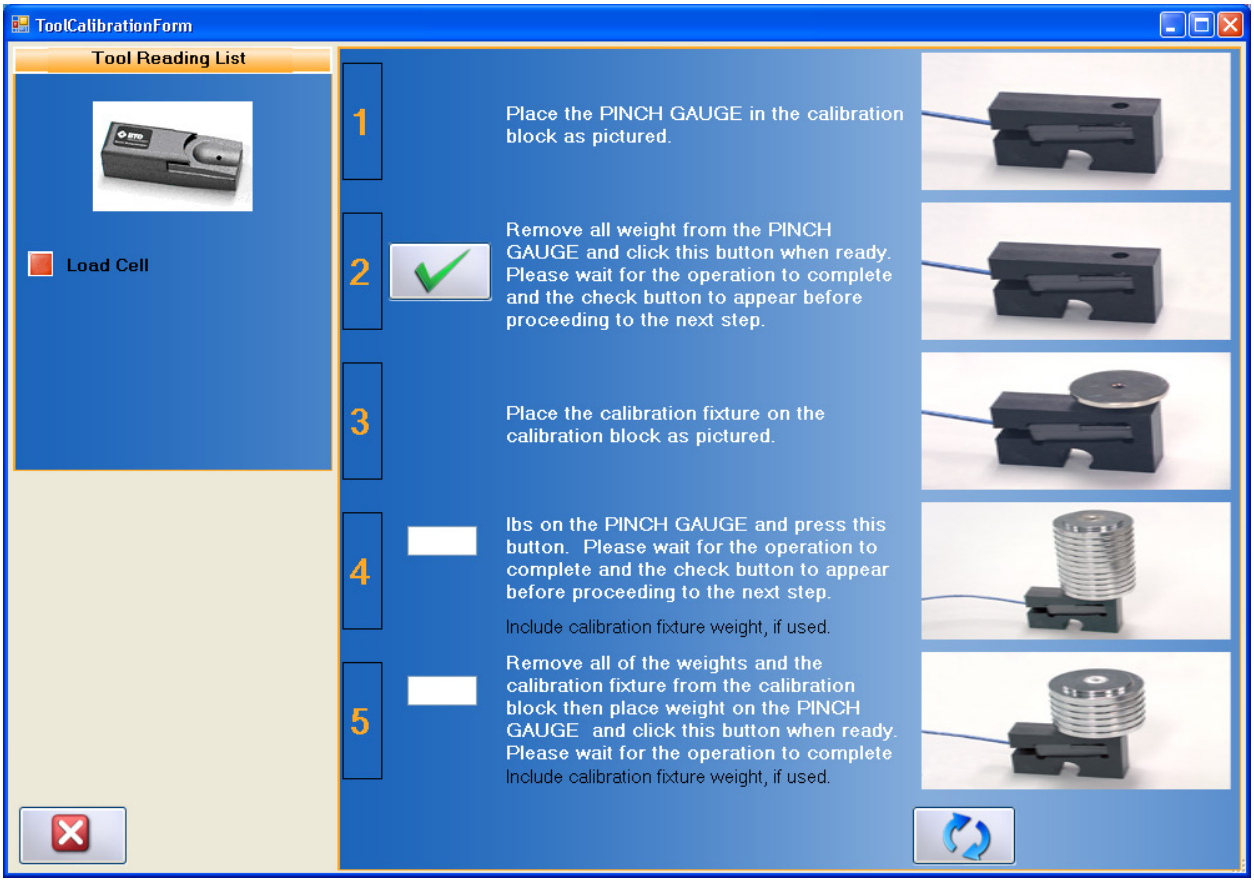


Figure 6-6. Pinch Gauge Calibration Screen

Step 1. Place the Pinch Gauge in the calibration block as shown on the screen.

Step 2. Once the Pinch Gauge is in place, click on  to set the zero point (Figure 6-7).

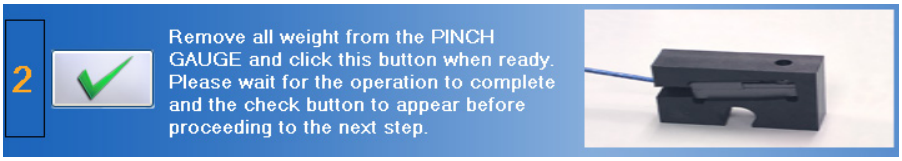


Figure 6-7. Pinch Gauge - Set the Zero Point

Step 3. Insert the calibration fixture into the calibration block.

Step 4. Place both calibration weights on the calibration fixture and type **25.6** (calibration fixture plus calibration weight) in the text field (Figure 6-8).

Step 5. Click on  to set the weight (Figure 6-8).

Figure 6-8. Pinch Gauge - Set the Weight

Step 6. Remove both of the calibration weights and calibration fixture. Re-insert the calibration fixture and then place the 15 lb calibration weight on the fixture. Type **15.6** in the text field (Figure 6-9).

Step 7. Click on  to verify the weight (Figure 6-9).

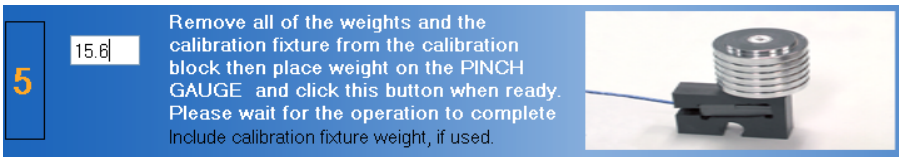


Figure 6-9. Pinch Gauge - Verify the Weight

If the Pinch Gauge was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 6-10).

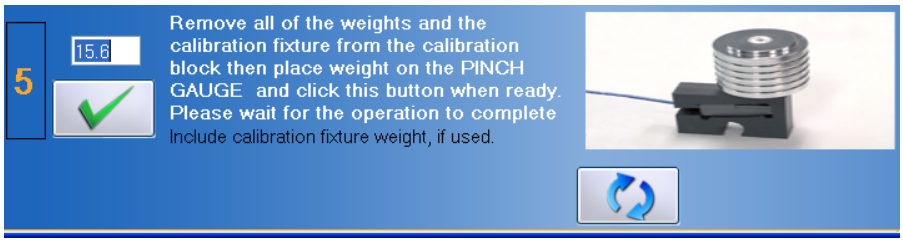


Figure 6-10. Pinch Gauge - Verification Successful

If the Pinch Gauge was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 6-11). You may try re-verifying the weight or re-calibrating the tool until the verification is successful. Also refer to the Troubleshooting section within this chapter for help.

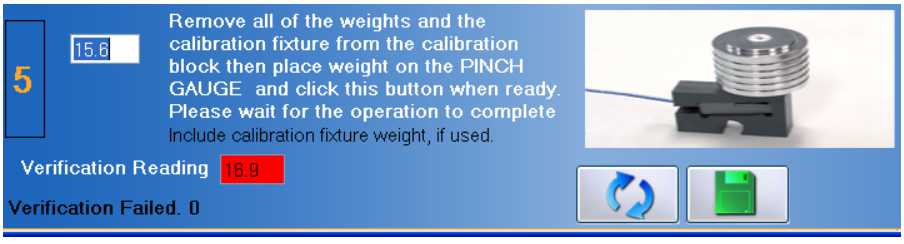
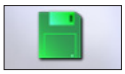


Figure 6-11. Pinch Gauge - Verification Failed

Step 8. Once the tool has passed verification, click on  to save the data.

E. PERFORMING VERIFICATION

The verification screen allows you to quickly to verify the tool without having to go through the whole calibration. In addition, all verifications performed through the verification screen are included in the tool's calibration report.

Note: A tool may not be verified with the same weight that was used during calibration.

Step 1. Place the Pinch Gauge in the calibration block and insert the calibration fixture. Place the 10 lb calibration weight on the calibration fixture and type **10.6** (calibration fixture plus calibration weight) in the text field (Figure 6-12).

Step 2. Click on  to verify the weight (Figure 6-12).

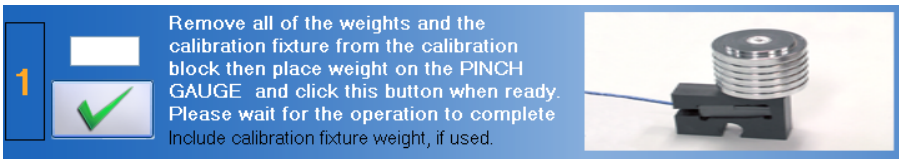


Figure 6-12. Pinch Gauge - Verify the Weight

If the Pinch Gauge was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 6-13).

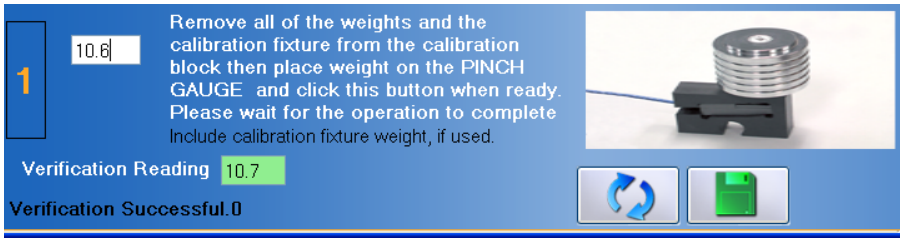


Figure 6-13. Pinch Gauge - Verification Successful

If the Pinch Gauge was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 6-14). You may try re-verifying the weight or re-calibrating the tool until the verification is successful. Also refer to the Troubleshooting section within this chapter for help.

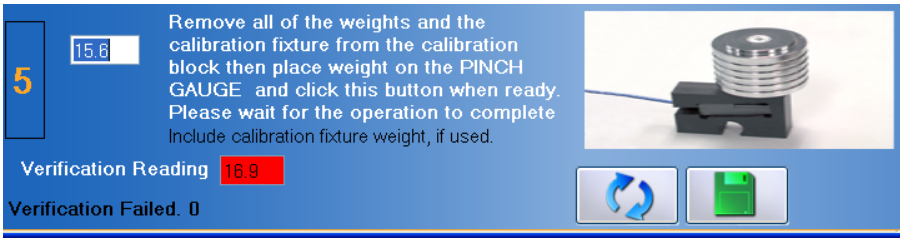


Figure 6-14. Pinch Gauge - Verification Failed

Step 3. Once the tool has passed verification, click on  to save the data.

V. TROUBLESHOOTING

A. TOOL NOT READING ANY VALUE OR NOT RECOGNIZED

There are multiple reasons why the Pinch Gauge may not be reading any value or is not recognized. Verify and attempt the following:

1. VERIFY THE FOLLOWING

- The batteries in the Portable Dock & Transmitter are charged and less than a year old
- The antennas are properly secured to the Portable Dock & Transmitter and Hub
- The Hub is plugged in to the computer and the Dock is powered On
- There is no interference between the Hub and Dock (refer to Chapter 12)
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable
- The Dock has not been dropped or hit hard - if so, then turn the power off for ~5 seconds and then back on
- The Pinch Gauge, Portable Dock, and cable are not damaged, dirty at the connections, or have loose components

2. ATTEMPT THE FOLLOWING

- Turn off the Portable Dock, attach a new cable to the Pinch Gauge and Portable Dock, and then turn the Dock back on.
- Turn off the Portable Dock, plug the cable into another port on the Dock, and then turn it back on.
- Turn off the Portable Dock, insert freshly charged batteries, and then turn it back on.
- Try a different combination of batteries - if one of the batteries has gone bad, then the Portable Dock will not work properly.

B. UNABLE TO CALIBRATE OR VERIFY

Refer to Section IV-C of this chapter for information.

TABLE OF CONTENTS

PORTABLE LOAD CELL

PORTABLE LOAD CELL

I. INTRODUCTION

The Portable Load Cell's primary use is to measure push and pull forces up to 500 lbs/227 kgs. Some of the applications of the Portable Load Cell (aka PLC) are manual muscle testing, evaluating the consistency of a client's self-report of pain, documenting point tenderness, and determining the forces required for specific tasks at the workplace or at home.

All of the attachments (e.g. Box Grip and Straight Bar) can be used with the PLC. In addition, several accessories are provided to help simulate tasks. The figure below shows the most commonly used attachments and accessories (Figure 7-1). Lastly, the 1/2" wrench that is provided with the system can be used to tighten and loosen the nut on the interface screw.

WARNING

Do not exceed pull forces of 250 lbs/113 kgs when using Snap hook.

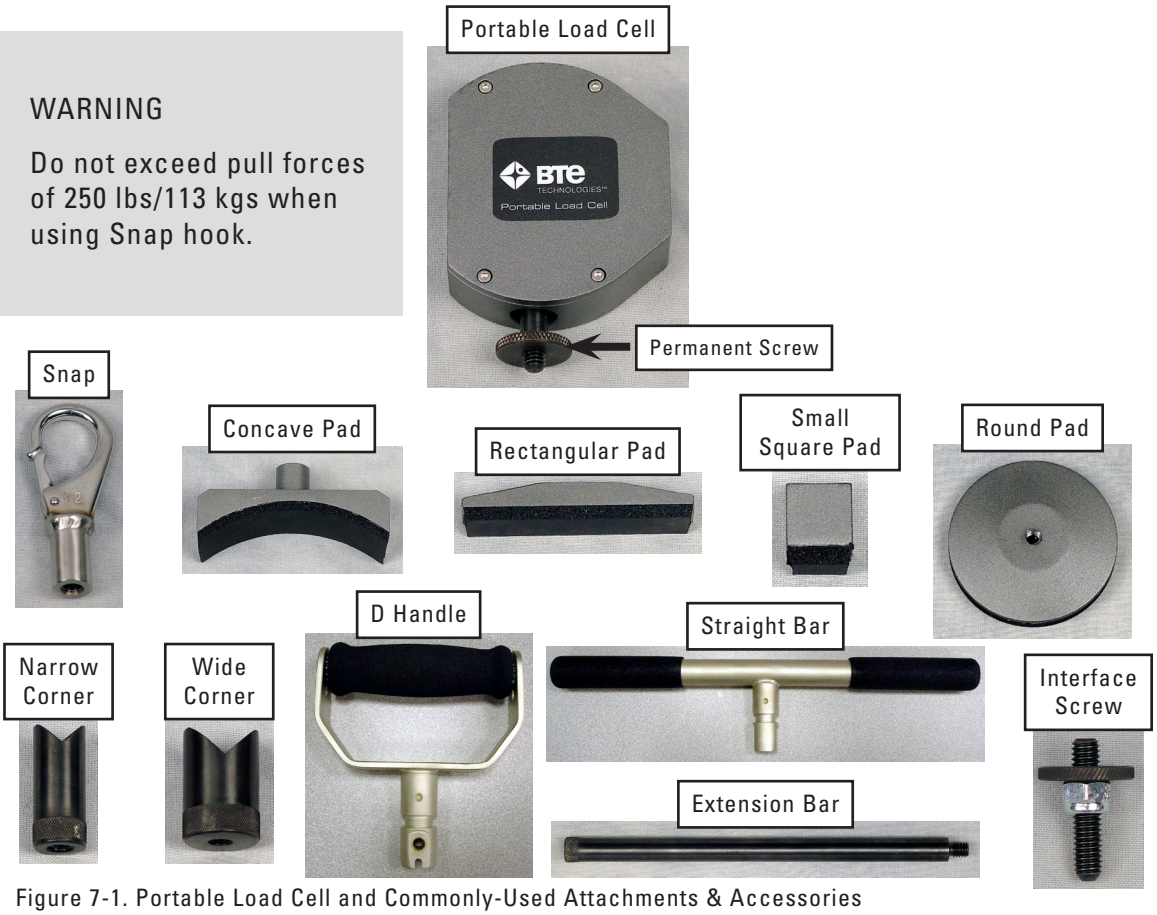


Figure 7-1. Portable Load Cell and Commonly-Used Attachments & Accessories

II. UTILIZING THE PORTABLE LOAD CELL

A. CONNECTING TO THE SYSTEM

Always connect the Portable Load Cell to the Portable Dock & Transmitter via the RJ45 jack. Refer to Chapter 01-II-B [Setup & General Operation - General Operation of the System] of this manual for a pictorial example. *Do not attempt to connect the PLC to the column arms - it will not work.*

Remember to verify the tool is plugged in and the Dock is turned on and receiving power before starting a test.

B. SETTING UP THE PLC

For Manual Muscle Tests, perform the following steps:

1. Attach the Round Pad to the PLC via the Interface Screw (Figure 7-2). If necessary, tighten the knurled nut onto the Round Pad to increase stabilization.
2. Attach the other pad, which the client will push against, on the permanent screw on the PLC (Figure 7-2). If necessary, tighten the knurled nut onto the pad to increase stabilization.
3. Place the Round Pad on the table and once prompted by the software, ask the client to push against the interfacing pad (Figure 7-2).

For all other uses of the Portable Load Cell, attach the accessories as desired.

Figure 7-2. Example of Positioning for Manual Muscle Testing

III. PRE-DEFINED TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

The following extremities are typically tested with the Portable Load Cell:

- Ankle
- Elbow
- Hip
- Knee
- Shoulder

Note that the names of the pre-defined tests contain the name of the extremity that is being analyzed.

IV. CALIBRATION & VERIFICATION

It is recommended calibration is performed on a weekly basis and verification is performed on a daily basis.

A. CALIBRATION EQUIPMENT (FIGURE 7-3)

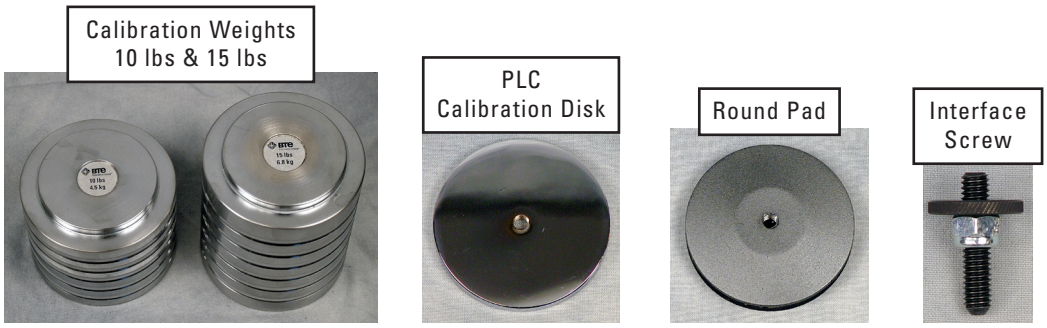


Figure 7-3. Portable Load Cell Calibration Equipment

B. ACCESSING THE CALIBRATION & VERIFICATION SCREENS

Refer to Chapter 02c-V-C [Administration Menu - Manage Tools - Calibration] of the EvalTech Software Operator's Manual for additional information on the tool management and calibration screens.

The calibration screen may be accessed within the testing screen and within the Tool Management screen.

The verification screen may only be accessed within the Tool Management screen.

1. VIA THE TESTING SCREEN

Click on  , which is typically located at the bottom-center of the screen.

2. VIA THE TOOL MANAGEMENT SCREEN

Step 1. Access the Tool Management screen via one of the following two methods:

a) Within the Test Administration screen, click on  , which is located in the bottom-left corner of the screen.

b) Select the Administration Taskbar Menu and click on Manage Tools.

Step 2. On the left side of the screen, click on Portable Load Cell. The right side of the screen will show the current input values for the tool.

Step 3a. Click on  in the bottom lower-center to access the calibration screen.

Step 3b. Click on  in the bottom lower-center to access the verification screen.

C. PERFORMING CALIBRATION

Prior to entering the calibration screen, verify the Portable Load Cell is connected to the Dock and the Dock is turned on.

The initial calibration screen should look as follows (Figure 7-4):

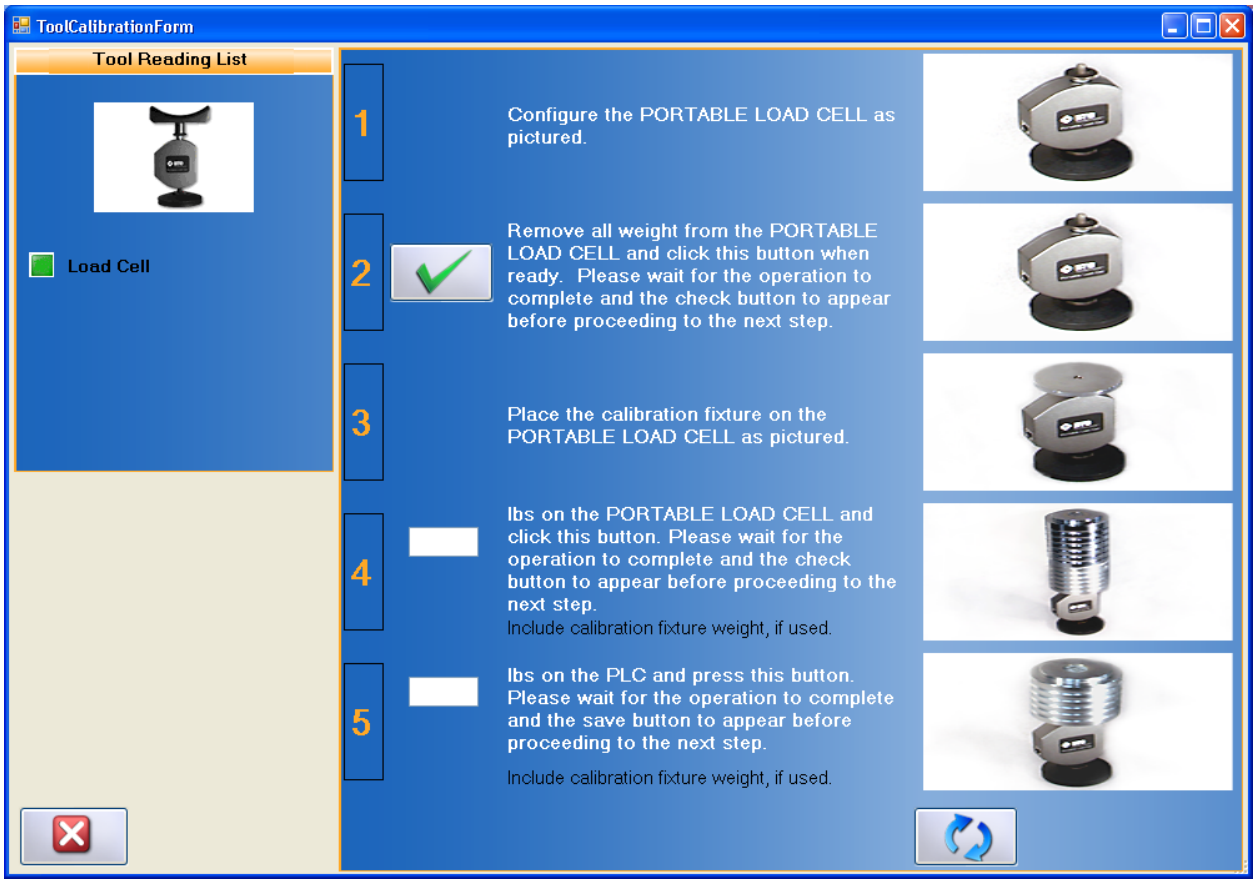


Figure 7-4. Portable Load Cell Calibration Screen

Step 1. Attach the interface screw to the PLC and then attach the Round Pad to the interface screw.

Step 2. Position the Portable Load Cell as shown in the calibration screen and verify the PLC is stable. If necessary, tighten the knurled nut onto the Round Pad to increase stabilization.

Step 3. Click on  to set the zero point (Figure 7-5).

Figure 7-5. Portable Load Cell - Set the Zero Point

Step 4. Attach the calibration disk to the permanent screw on the PLC. Verify the disk is stable and the screw does not extend past the calibration disk. If necessary, tighten the knurled nut onto the disk to increase stabilization.

Step 5. Place both calibration weights on the calibration disk and type **25.5** (calibration disk plus calibration weight) in the text field (Figure 7-6).

Step 6. Click on  to set the weight (Figure 7-6).

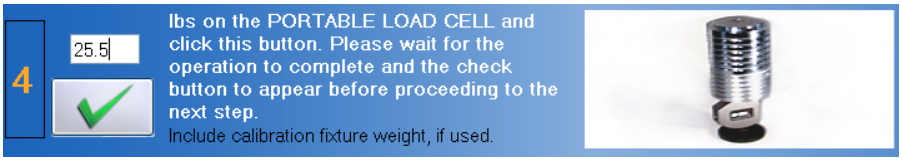


Figure 7-6. Portable Load Cell - Set the Weight

Step 7. Remove both of the calibration weights and then place the 15 lb calibration weight back on the calibration disk. Type **15.5** in the text field (Figure 7-7).

Step 8. Click on  to verify the weight (Figure 7-7).

Figure 7-7. Portable Load Cell - Verify the Weight

If the Portable Load Cell was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 7-8).

Figure 7-8. Portable Load Cell - Verification Successful

If the Portable Load Cell was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 7-9). You may try re-verifying the weight or re-calibrating the tool until the verification is successful.

Figure 7-9. Portable Load Cell - Verification Failed

Step 8. Once the tool has passed verification, click on  to save the data.

D. PERFORMING VERIFICATION

The verification screen allows you to quickly to verify the tool without having to go through the whole calibration. In addition, all verifications performed through the verification screen are included in the tool's calibration report.

Note: A tool may not be verified with the same weight that was used during calibration.

Step 1. If they're not already, attach the Round Pad, Interface Screw, and Calibration Disk as described in Steps 1, 2, and 4 of the previous section.

Step 2. Place the 10 lb calibration weight on the calibration disk and type **10.5** (calibration disk plus calibration weight) in the text field (Figure 7-10).

Step 3. Click on  to verify the weight (Figure 7-10).

Figure 7-10. Portable Load Cell - Verify the Weight

If the Portable Load Cell was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 7-11).

Figure 7-11. Portable Load Cell - Verification Successful

If the Portable Load Cell was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 7-12). You may try re-verifying the weight or re-calibrating the tool until the verification is successful.

Figure 7-12. Portable Load Cell - Verification Failed

Step 4. Once the tool has passed verification, click on  to save the data.

V. TROUBLESHOOTING

A. TOOL NOT READING ANY VALUE OR NOT RECOGNIZED

There are multiple reasons why the Portable Load Cell may not be reading any value or is not recognized. Verify and attempt the following:

1. VERIFY THE FOLLOWING

- The batteries in the Portable Dock & Transmitter are charged and less than a year old
- The antennas are properly secured to the Portable Dock & Transmitter and Hub
- The Hub is plugged in to the computer and the Dock is powered On
- There is no interference between the Hub and Dock (refer to Chapter 12)
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable
- The Dock has not been dropped or hit hard - if so, then turn the power off for ~5 seconds and then back on
- The Portable Load Cell, Portable Dock, and cable are not damaged, dirty at the connections, or have loose components

2. ATTEMPT THE FOLLOWING

- Turn off the Portable Dock, attach a new cable to the PLC and Portable Dock, and then turn the Dock back on.
- Turn off the Portable Dock, plug the cable into another port on the Dock, and then turn it back on.
- Turn off the Portable Dock, insert freshly charged batteries, and then turn it back on.
- Try a different combination of batteries - if one of the batteries has gone bad, then the Portable Dock will not work properly.

B. FORCE NOT RECORDING IN STRENGTH TEST

- Make sure to secure the attachment to the permanent screw (not the interface screw) - the BTE label should be readable by the clinician.
- Verify the actual test situation (i.e. how the client is performing the test) matches the expected test setup (i.e. what is specified under the EvalTech Test Setup).
- Verify all of the settings within the EvalTech Test Setup are correct (e.g. the test is set properly to push or pull).

C. UNABLE TO CALIBRATE OR VERIFY

If you are having trouble completing calibration or verification of the Portable Load Cell, verify and attempt the following:

- Ensure that the PLC is placed on a sturdy and level surface during calibration.
- Make sure to attach the Round Pad to the interface screw and place the Round Pad on the table; the calibration disk should be attached to the permanent screw.
- Make sure the calibration disk is not on the PLC for the first step of the calibration.
- Make sure to add the calibration disk weight to the weight entered in the calibration screen (e.g. 25.5 or 15.5).

- Verify the calibration weight is entered correctly in the text fields.
- Remove the weights from the calibration disk before placing the verification weight on the disk. This will allow the load cell to return to a zero weight.
- Click on  within the calibration screen and repeat the steps, but wait 3 seconds between applying the weight and clicking on the checkmark icon.

TABLE OF CONTENTS

COLUMN & BASE

COLUMN & BASE

I. INTRODUCTION

The main components of the column are the arms - the two pieces that are parallel to the floor and are able to move up and down the column as well as rotate about it (Figure 8-1). You will be interfacing with the arms quite frequently since they are the main junctions for the Column Load Cell and Universal Task Master.

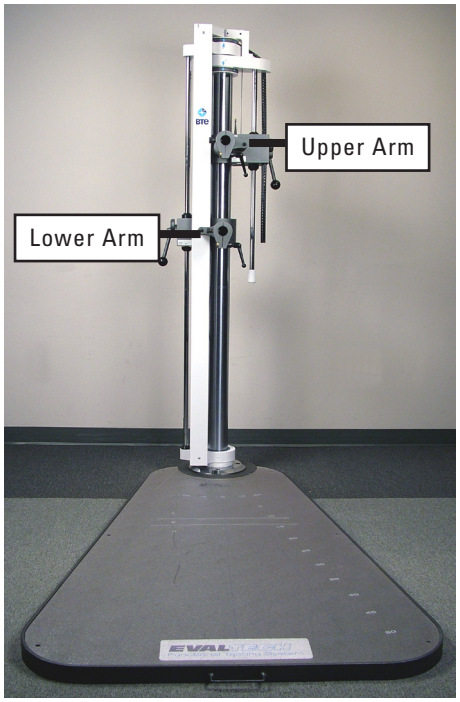


Figure 8-1. EvalTech Column and Base

Another important aspect of the column and base are the many ways you are able to generate tests which are repeatable from one day to the next. This repeatability is achieved through the use of the ruler on each height adjustment bar, the arm angle indicators at the top of the column, and the markings on the base (Figure 8-2). In addition to creating repeatability, the measurement markings allow you to accurately simulate an occupational task.

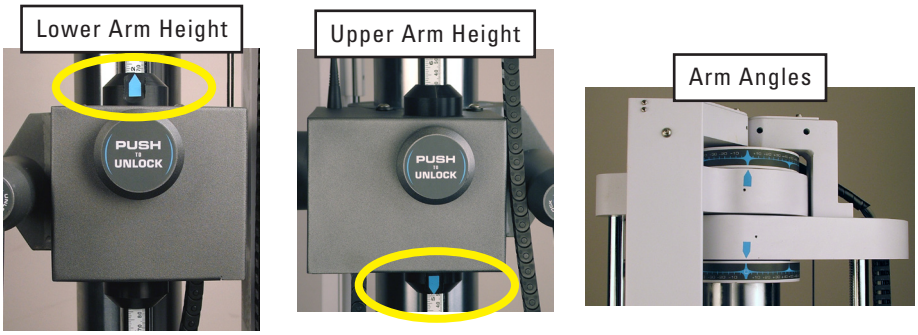


Figure 8-2a. EvalTech Column Measurement Markings

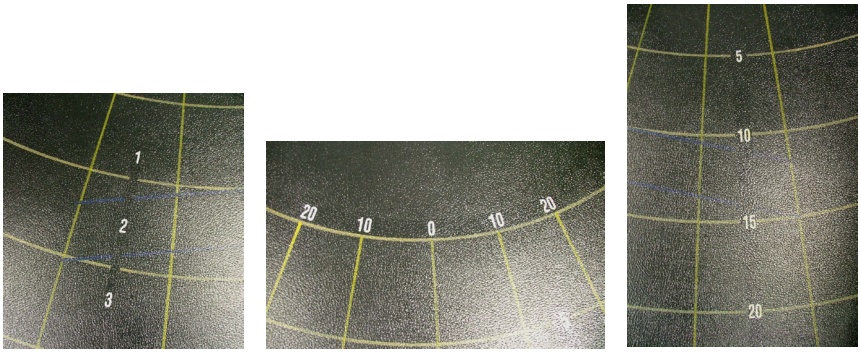


Figure 8-2b. EvalTech Base Measurement Markings

II. UTILIZING THE COLUMN ARMS

A. MANIPULATING THE ARMS ABOUT THE EVALTECH COLUMN

While the EvalTech has many safety features incorporated into it, it is important to have a complete understanding of how to use the system in order to prevent any injuries.

The two arms are connected to each other via a cable and counterweight. When an arm is unlocked and able to move vertically along the column, its natural inclination is to move up due to the counterweight moving down the column. Therefore, when a tool is not attached to the arm and the locking features are released, be aware that the arm will move slightly on its own until an adequate holding force is applied.

1. ROTATING THE ARMS ABOUT THE COLUMN

If you would like to rotate the arm about the column, you must loosen the locking lever, which is located toward the back of the unit (Figure 8-3). One complete counter-clockwise turn of the lever should be enough to allow movement of the arm. Once the lever is loosened, the arm will be able to rotate about the column, but it will not be able to move vertically.

2. MOVING THE ARMS UP AND DOWN THE COLUMN

If you would like to move the arm vertically along the column, you must first loosen the locking lever as described above and then push on the safety knob, which is labeled "Push to Unlock" (Figure 8-3). Pushing this knob releases the arm from its lock and it will be able to move up and down the column through its full range of motion. Note that you must give constant pressure to the safety knob throughout the motion; once the knob is released, the arm will lock into its current location.

After the arm is at the desired location, turn the locking lever clockwise to lock the arm into position. At this point, the arm will not be able to move or rotate. Note that it is very important you make sure the locking lever has been tightened prior to performing a test. This ensures the arm will not rotate during the test and thus reduces the risk of potential injuries.

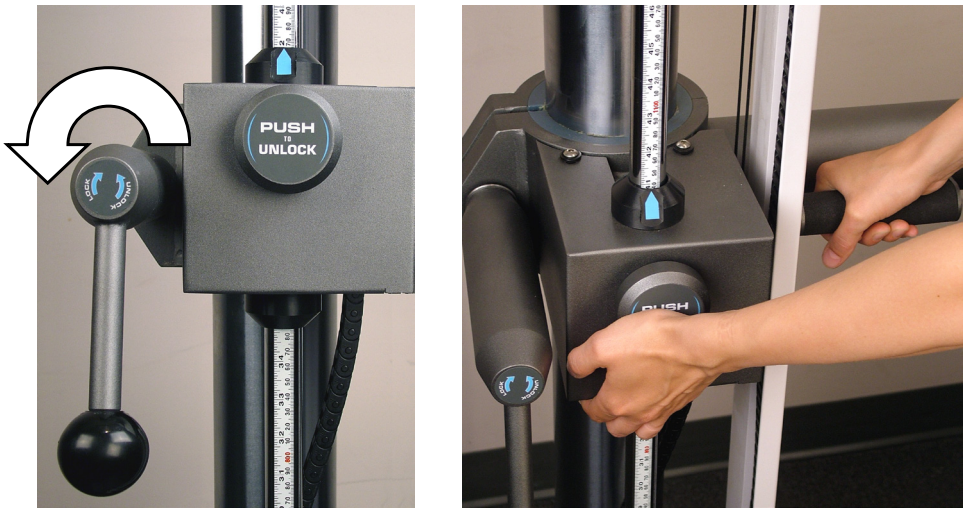


Figure 8-3. Loosen the Locking Lever and Unlock the Arm

B. LOCATING THE ARMS ALONG THE EVALTECH COLUMN

Once you have an understanding of how to manipulate the arms, you can utilize the locating features, which allow you to accurately reproduce a prior test as well as simulate an occupational task. The two locating features for the arms are the rulers alongside the long and short height adjustment bars and the rotation angle indicators at the top of the column (Figure 8-2a).

The rulers on the height adjustment bars indicate the vertical location of the arms with respect to the top of the base. These measurements were originally used for dynamic lift tests and were therefore determined in the following manner:

- The lower arm height refers to the distance from the top of the base to the top of the Bottom Shelf after it has been inserted into the Column Load Cell (in the lower arm).
- The upper arm height refers to the distance from the top of the base to the top of the Top Shelf (in the upper arm).

Note that the arm heights will need to be adjusted if a tool and/or attachment combination other than those listed above are used. The easiest method for determining the appropriate arm height is to first secure the tool (i.e. CLC or UTM) to the appropriate arm, insert the attachment into the tool, and then position the tool as needed. Next, use a measuring tape to measure the distance from the top of the base to the center of the gripping portion of the attachment. Adjust the arm height as needed.

All BTE predefined tests were developed with the height adjustment taken into account. Therefore, any manual adjustments only need to be made for custom tests.

C. INSERTING ATTACHMENTS INTO THE ARMS

Three different attachments are able to be inserted into the upper and lower arms: the Column Load Cell (CLC), Universal Task Master (UTM), and Top Shelf. All three components are inserted and secured in the same manner:

Step 1. Pull the retractable pin, which is located on the left side of the arm, and turn it in either direction a 1/2 turn so the pin is no longer visible down the shaft of the column arm (Figure 8-4).

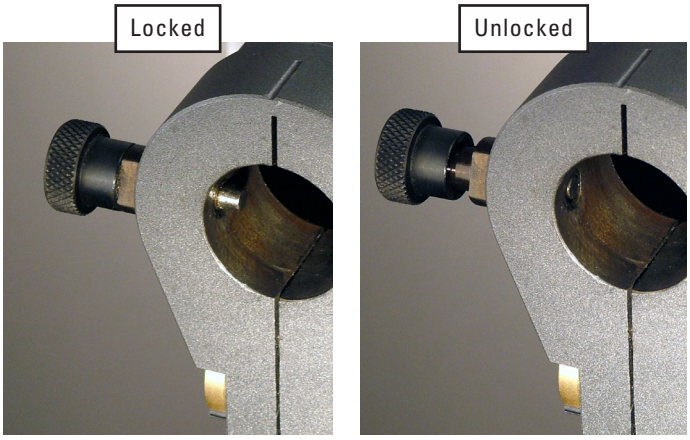


Figure 8-4. Retractable Pin in the Locked and Unlocked Position

Step 2. Turn the column arm locking handle, which is located on the right side of the arm, 1 turn counter-clockwise (Figure 8-5).

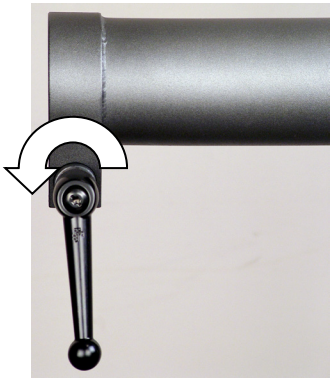


Figure 8-5. Loosen the Column Arm Locking Handle

Note that the column arm locking handle is retractable.

This means the handle portion can be pulled out and rotated without screwing or unscrewing the entire piece.

This may be useful when the Column Load Cell and UTM are inserted into the arm.

Step 3. Note the holes along the steel shaft of the attachment. Line one of the holes up with the retractable pin and insert the attachment into the arm as far as it will go (Figure 8-6).

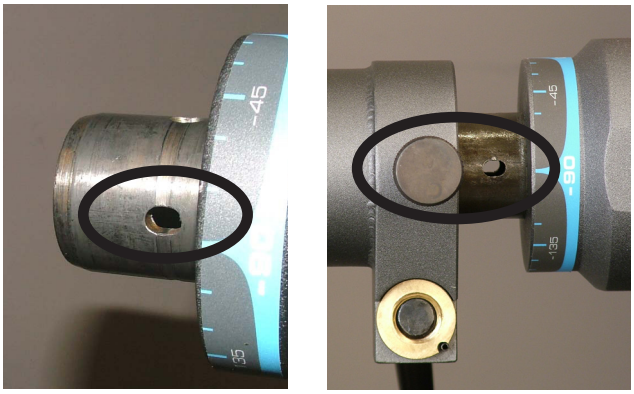


Figure 8-6. Note Hole for the Retractable Pin and Insert the Attachment into the Arm

Step 4. While holding onto the attachment, rotate the retractable pin a 1/2 turn back to its original locked position (Figure 8-7).

Figure 8-7. Turn the Retractable Pin

Step 5. Rotate the attachment back and forth until the retractable pin snaps into the hole on the attachment shaft (Figure 8-8).

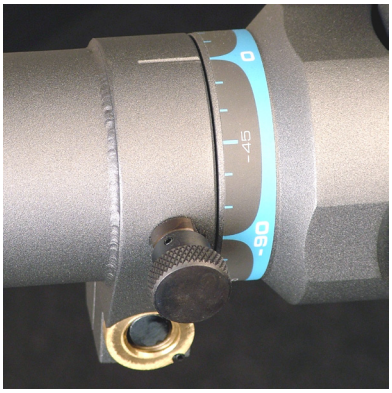


Figure 8-8. Retractable Pin Locked into the Attachment

Step 6. Turn the column arm locking handle clockwise until it is tightened all the way (Figure 8-9).

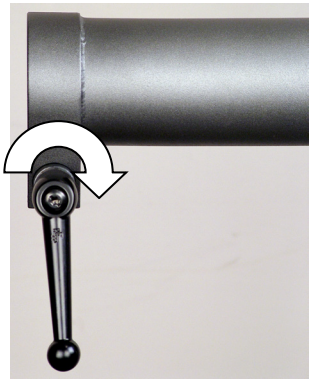


Figure 8-9. Tighten the Column Arm Locking Handle

IMPORTANT

The column arm locking handle must be tightened to ensure the attachment is properly secured. If it isn't tightened enough, the retractable pin may break.

The attachment is now secured in the arm and can be used for testing.

D. REMOVING ATTACHMENTS FROM THE ARMS

The CLC, UTM, and Top Shelf are all removed in the same manner. Refer to the previous section for pictures.

Step 1. Turn the column arm locking handle, which is located on the right side of the arm, 1 turn counter-clockwise (Figure 8-5).

Step 2. While holding onto the attachment, pull the retractable pin, which is located on the left side of the arm, and turn it in either direction a 1/2 (Figure 8-4).

Step 3. The attachment is no longer secure in the arm, so it may be pulled out.

Leave the retractable pin and locking handle in the current unlocked positions for the next time you wish to insert an attachment.

III. INTEGRATION OF THE COLUMN IN THE SOFTWARE

The EvalTech software has the ability to integrate the attributes of the column (e.g. arm heights and angles) into the testing. For information on adding these setup requirements to tests, refer to Chapter 4 of the EvalTech Software Operator's Manual.

Several pre-defined CLC and UTM tests require the arm(s) to be set to a specific height, the arm(s) to be set to a specific angle, or for the client to be positioned at a specific location. Refer to the following sections for information on how these requirements will appear in the software.

- **ARM MUST BE SET TO A SPECIFIC HEIGHT**

  If the arm(s) must be set to a specific height (whether numerical or anthropometric), then a Settings screen will appear prior to the Test Administration screen.

  The required arm heights are shown on the right of the screen in red and read "Set To:" while the actual heights are in orange at the bottom right corner of each scale (Figure 8-10).

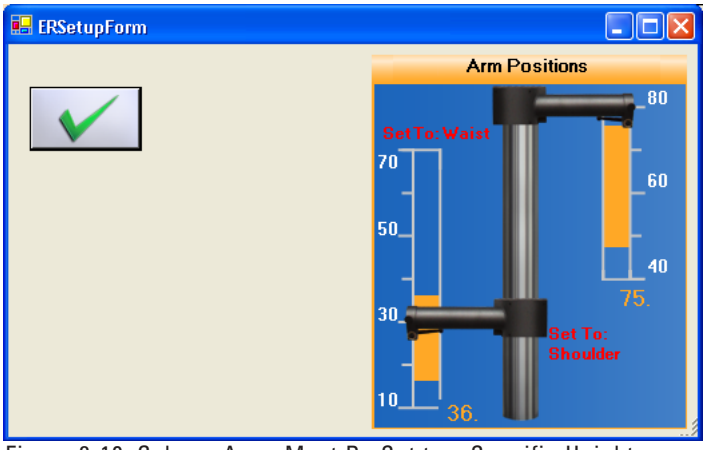


Figure 8-10. Column Arms Must Be Set to a Specific Height

- **ARM MUST BE SET TO A SPECIFIC ANGLE**

  If the arm(s) must be set to a specific angle, then the information will be listed in the Setup Instructions screen (Figure 8-11).

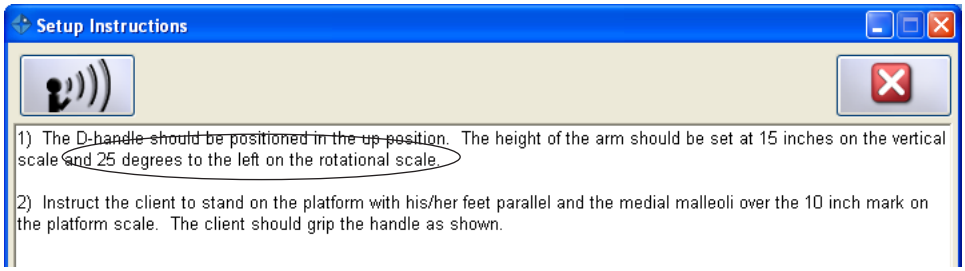


Figure 8-11. Column Arm Must Be Set to a Specific Angle

- **CLIENT MUST BE POSITIONED IN A SPECIFIC LOCATION**

  If the client must be positioned at a specific location on the base, then the information will be listed in the Setup Instructions screen (Figure 8-12).

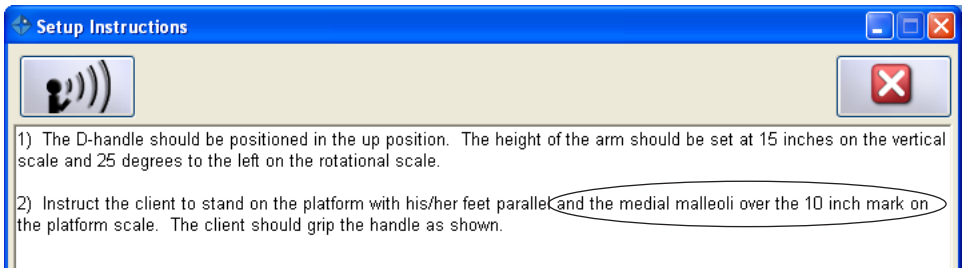


Figure 8-12. Client Must Be Positioned at a Specific Location

IV. CALIBRATION

Note: Only the arm heights may be calibrated in the software; the arm angles are not integrated with the software. The calibration is typically done at the same time as the Column Load Cell, but each arm may also be independently calibrated.

It is recommended calibration is performed on a weekly basis and verification is performed on a daily basis.

A. CALIBRATION EQUIPMENT

No additional calibration equipment is required for the column.

B. ACCESSING THE CALIBRATION SCREEN

Refer to Chapter 02c-V-C [Administration Menu - Manage Tools - Calibration] of the EvalTech Software Operator's Manual for additional information on the tool management and calibration screens.

The calibration screen may be accessed within the testing screen and within the Tool Management screen:

1. VIA THE TESTING SCREEN

Click on  , which is typically located at the bottom-center of the screen.

2. VIA THE TOOL MANAGEMENT SCREEN

Step 1. Access the Tool Management screen via one of the following two methods:

a) Within the Test Administration screen, click on  , which is located in the bottom-left corner of the screen.

b) Select the Administration Taskbar Menu and click on Manage Tools.

Step 2. On the left side of the screen, click on Column Load Cell. The right side of the screen will show the current input values for the tool.

Step 3. Click on  in the bottom lower-center to access the calibration screen.

C. PERFORMING CALIBRATION

The initial calibration screen should look as follows (Figure 8-13):

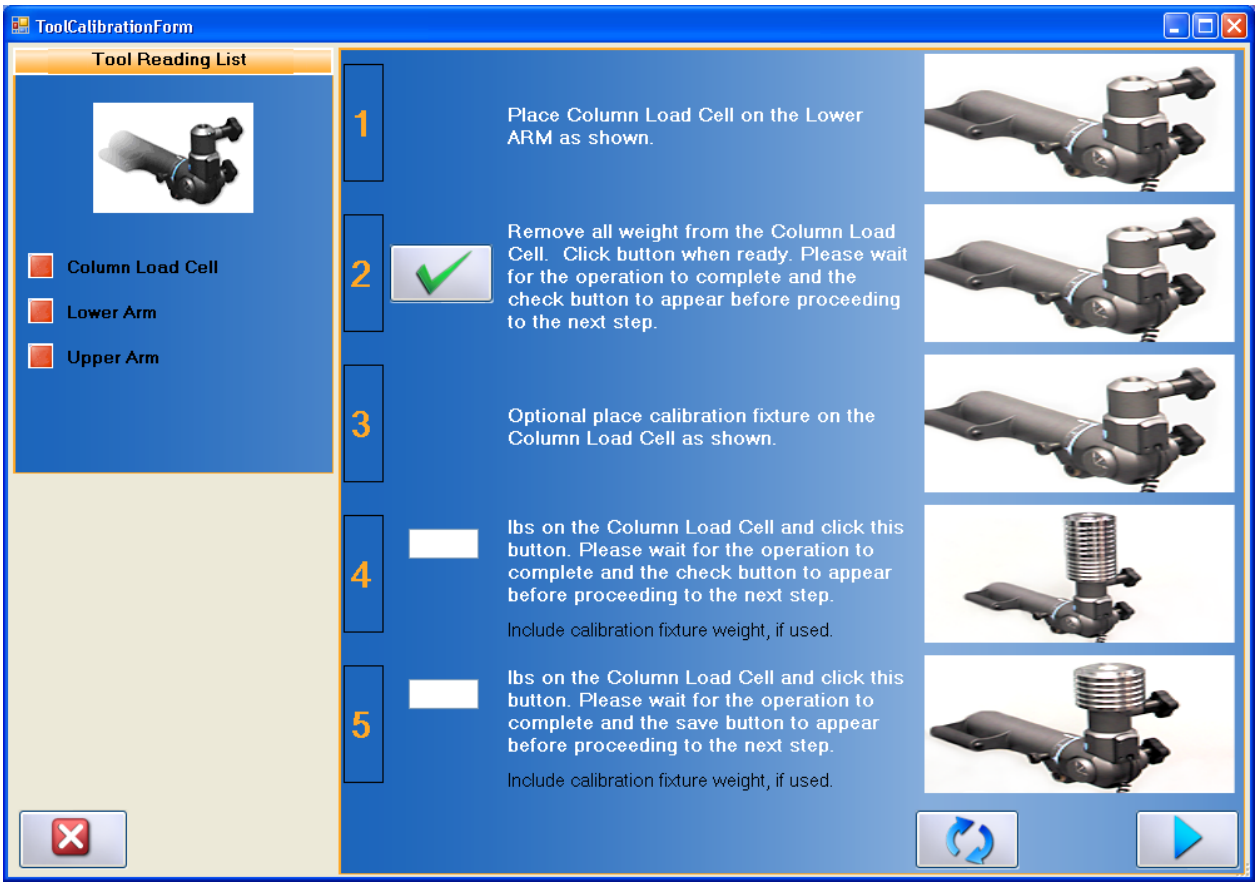


Figure 8-13. Column Load Cell & Column Arms Calibration Screen

To independently calibrate a arm, click on the desired arm name on the left side of the screen (Figure 8-14).

Figure 8-14. If Necessary, Select Column Arm to Calibrate

1. LOWER ARM

Step 1. Move the lower arm to the specified initial height.

Step 2. Click on  to set the initial height (Figure 8-15).

Figure 8-15. Column Lower Arm - Set the Initial Height

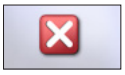
Step 3. Move the lower arm to the specified final height.

Step 4. Click on  to set the final height (Figure 8-16).

Figure 8-16. Column Lower Arm - Set the Final Height

Step 5. Once the initial and final heights have been set, click on  to save the data.

Step 6a. Click on  if you wish to proceed with the upper arm calibration.

Step 6b. Click on  if you wish to exit the screen.

2. UPPER ARM

Step 1. Move the upper arm to the specified initial height.

Step 2. Click on  to set the initial height (Figure 8-17).

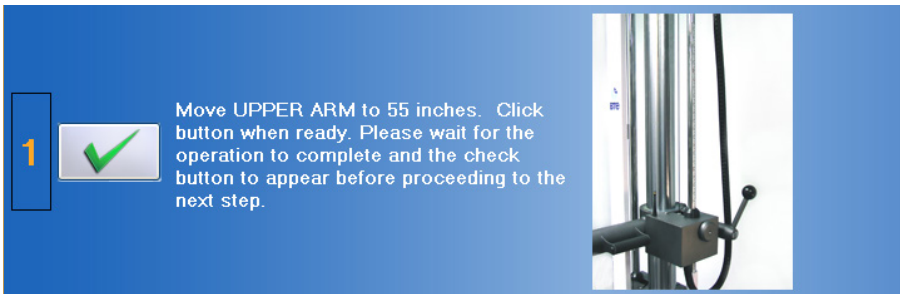


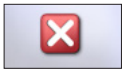
Figure 8-17. Column Upper Arm - Set the Initial Height

Step 3. Move the upper arm to the specified final height.

Step 4. Click on  to set the final height (Figure 8-18).

Figure 8-18. Column Upper Arm - Set the Final Height

Step 5. Once the initial and final heights have been set, click on  to save the data.

Step 6. Click on  to exit the screen.

D. PERFORMING VERIFICATION

There is no screen specifically designed for storing verification data for the arm heights; however, the tool management screen allows you to quickly verify the arms are reading properly (Figure 8-19).

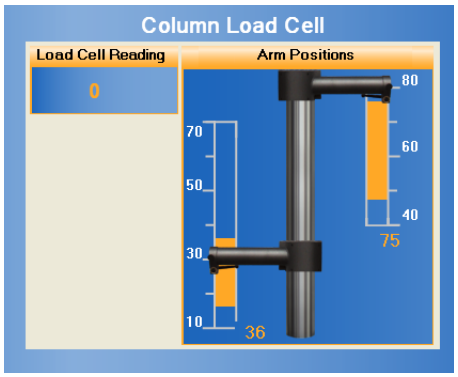


Figure 8-19. Verify Column Arm Input Values

V. TROUBLESHOOTING

A. COLUMN NOT READING ANY VALUE OR NOT RECOGNIZED

1. VERIFY THE COLUMN IS RECEIVING POWER (REFER TO CHAPTER 01-I-A-2 FOR PICTURES)

- Unplug and replug the column power cable, which is behind the long white stabilizer bar, from the short converter cable
- Unplug and replug the short converter cable, which is behind the long white stabilizer bar, from the power adapter cable
- Unplug and replug the long power cable from the power adapter
- Unplug and replug the long power cable from the wall or power strip
- Verify the wall outlet or power strip is providing power

2. VERIFY THE COLUMN IS COMMUNICATING PROPERLY WITH THE HUB

Refer to Chapter 12 for information on preventing interference.

B. DIFFICULT TO ROTATE THE COLUMN ARMS

- Ensure the locking lever is loosened enough
- Verify the column has been lubricated within the past year (refer to Chapter 01-III-C for maintenance and care information)

C. DIFFICULT TO MOVE THE COLUMN ARMS UP OR DOWN

- Ensure the locking lever is loosened enough
- If applicable, remove any attachments (UTM, CLC, or Top Shelf) from the column arm before moving it
- Move the column arm an inch or so in the opposite direction and then attempt to move in the desired direction
- Verify the column has been lubricated within the past year (refer to Chapter 01-III-C for maintenance and care information)

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COLUMN LOAD CELL

COLUMN LOAD CELL

I. INTRODUCTION

The Column Load Cell's primary use is to measure push and pull forces up to 500 lbs/227 kgs; however, through its innovative design, it is able to measure these forces in coordination with several work simulation exercises.

The three main features of the Column Load Cell (Figure 9-1), also known as CLC, include the ability to receive several attachments (e.g. D Handle, Narrow Box Grip, etc.), the ability to rotate in the sagittal plane, and the ability to rotate in the coronal plane. Through these features, a myriad of tasks can be simulated.

Figure 9-1. Column Load Cell

II. UTILIZING THE COLUMN LOAD CELL

A. BASIC OPERATIONS OF THE COLUMN LOAD CELL

1. SECURING THE COLUMN LOAD CELL TO THE COLUMN

Refer to Chapter 08-II-C [EvalTech Column & Base - Inserting Attachment into the Arms] of this manual for information on securing the Column Load Cell to the column.

2. SECURING ATTACHMENTS TO THE COLUMN LOAD CELL

All of the EvalTech attachments may be used with the Column Load Cell. However, the following attachments are most commonly used with the CLC (Figure 9-2):

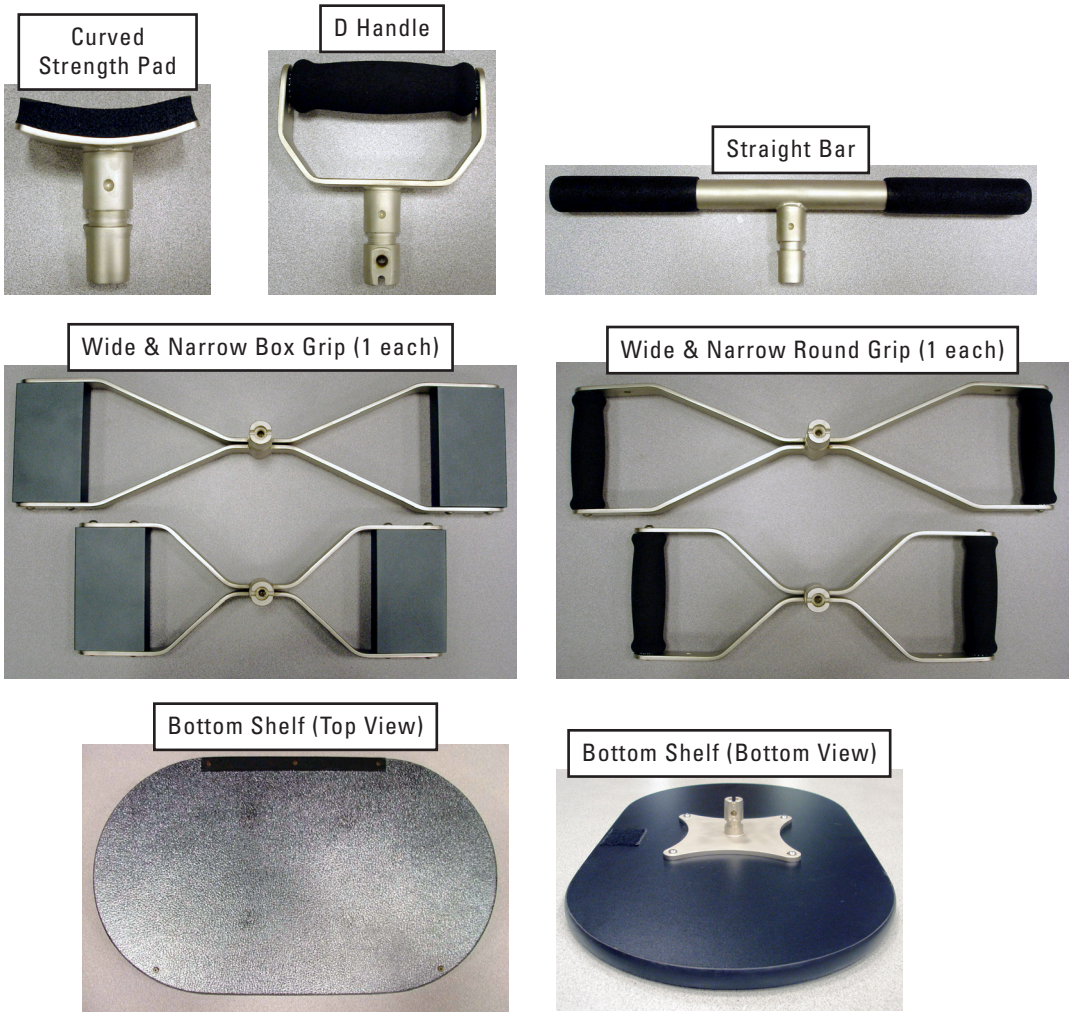


Figure 9-2. Commonly-Used Column Load Cell Attachments

All of the attachments are inserted in the same manner:

Step 1. Locate the top retractable handle, which is on the top right side of the Column Load Cell (Figure 9-3).

Step 2. Rotate the top retractable handle 1 turn counter-clockwise (Figure 9-3).

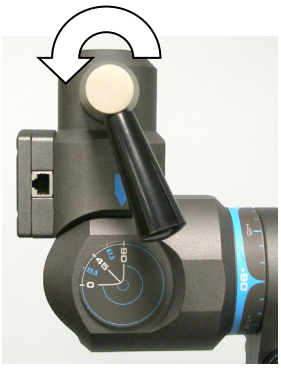


Figure 9-3. Loosen Top Retractable Handle

Step 3. Pull the end of the handle and turn only the end portion a 1/2 turn in either direction; the pin should be resting against the surface of the collar (Figure 9-4).

Figure 9-4. Retractable Handle - Unlock Position

Step 4. Look down the top of the Column Load Cell and verify the retractable handle pin is not visible. If the pin is visible, rotate the collar of the retractable handle counter-clockwise until the pin is not visible (Figure 9-5).

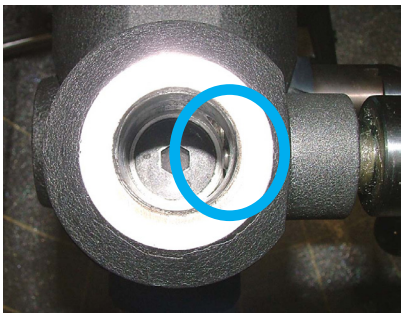


Figure 9-5. Top Retractable Handle Pin Not Visible

Step 5. Locate the hole on the shaft of the attachment you wish to insert (Figure 9-6).

Step 6. Insert the attachment with the flat surface and hole in line with the retractable handle pin (the pin will be going through this hole) (Figure 9-6).

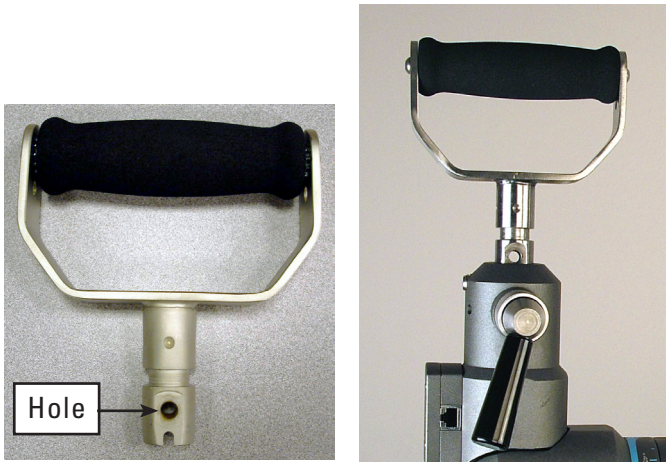


Figure 9-6. Insert the Attachment

Step 7. Pull the end of the retractable handle and turn only the end portion a 1/2 turn in either direction and let go when the pin is lined up with the groove. The end portion should now be flush against the rest of the handle (Figure 9-7).

Figure 9-7. Retractable Handle - Lock Position

Step 8. Rotate the entire retractable handle clockwise until it is hand-tight.

Step 9. Pull on the attachment to verify it is secure in the Column Load Cell and then proceed with testing (Figure 9-8).

Figure 9-8. Handle Secured in CLC

3. ROTATING THE COLUMN LOAD CELL IN THE SAGITTAL PLANE

To better aid in task simulations, the Column Load Cell was designed to rotate in the sagittal plane. The top housing can be positioned from 90° to 0° and every 22.5° in between.

Step 1. Locate the bottom retractable handle, which is on the bottom left side of the Column Load Cell (Figure 9-9).

Step 2. **While holding on to the top housing of the Column Load Cell**, rotate the bottom retractable handle 1 turn counter-clockwise (Figure 9-9).

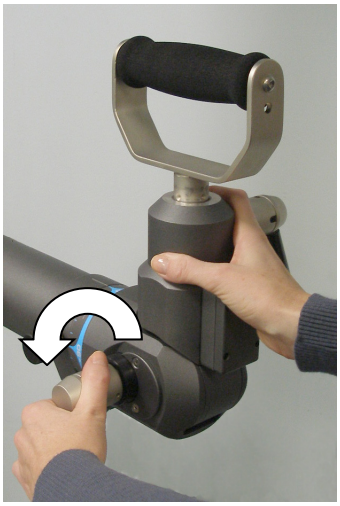


Figure 9-9. Loosen Bottom Retractable Handle

Step 3. Pull the end of the handle and turn only the end portion a 1/2 turn in either direction; the pin should be resting against the surface of the collar. This will release the top portion from its lock, so it is now free to rotate in the sagittal plane (Figure 9-4).

Step 4. Position the top housing at the desired angle (Figure 9-10).

Figure 9-10. CLC Rotated in the Sagittal Plane

Step 5. Pull the end of the retractable handle and turn it a 1/2 turn in either direction and let go when the pin is lined up with the groove. The end portion should now be flush against the rest of the handle (Figure 9-7).

Step 6. Slightly rotate the top housing back and forth until you hear the pin in the retractable handle lock into position. When this occurs, the top housing should not be able to rotate anymore.

Step 7. Rotate the retractable handle clockwise until it is hand-tight.

The Column Load Cell is now secure in its new position and you can proceed with testing.

4. ROTATING THE COLUMN LOAD CELL IN THE CORONAL PLANE

To better aid in task simulations, the Column Load Cell was designed to rotate in the coronal plane. The entire tool can be positioned about the arm every 90°.

Step 1. Turn the column arm locking handle, which is located on the right side of the arm, 1/2 turn counter-clockwise (just enough to loosen the arm) (Figure 9-11).

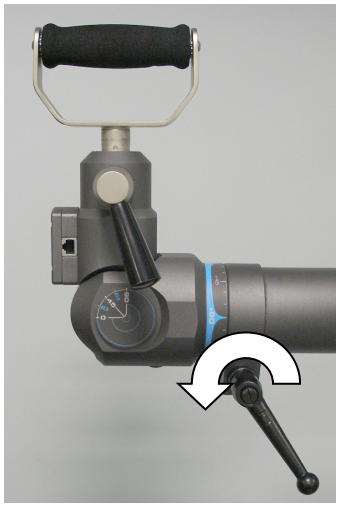


Figure 9-11. Loosen Column Arm Locking Handle

Step 2. While holding onto the Column Load Cell, pull the retractable pin, which is located on the left side of the arm, and turn it in either direction a 1/2 turn so the pin is no longer in the hole on the shaft of the Column Load Cell (Figure 9-12).

Figure 9-12. Unlock Arm Retractable Pin

Step 3. Without pulling the Column Load Cell out of the column arm, rotate it to the desired position (Figure 9-13).

Figure 9-13. Rotate the CLC in the Coronal Plane

Step 4. Rotate the retractable pin a 1/2 turn back to its original position (Figure 9-14).

Figure 9-14. Lock Arm Retractable Pin

Step 5. Slightly rotate the Column Load Cell back and forth until you hear the retractable pin lock into position. When this occurs, the Column Load Cell should not be able to rotate or move (Figure 9-15).

Figure 9-15. CLC Rotated in the Coronal Plane

Step 6. Turn the column arm locking handle clockwise until it is tightened all the way.

The Column Load Cell is now secure in its new position and you can proceed with testing.

B. CONNECTING TO THE SYSTEM

The 3ft RJ45 cable is recommended for connecting the CLC to the column, but the 5ft cable may be used as well.

Always connect an RJ45 cable from the Column Load Cell to the mating RJ45 jack on the column arm (e.g. if the CLC is in the lower arm, then use the RJ45 jack on the lower Column arm) (Figure 9-16). *Do not attempt to connect the CLC to the Portable Dock - it will not work.*

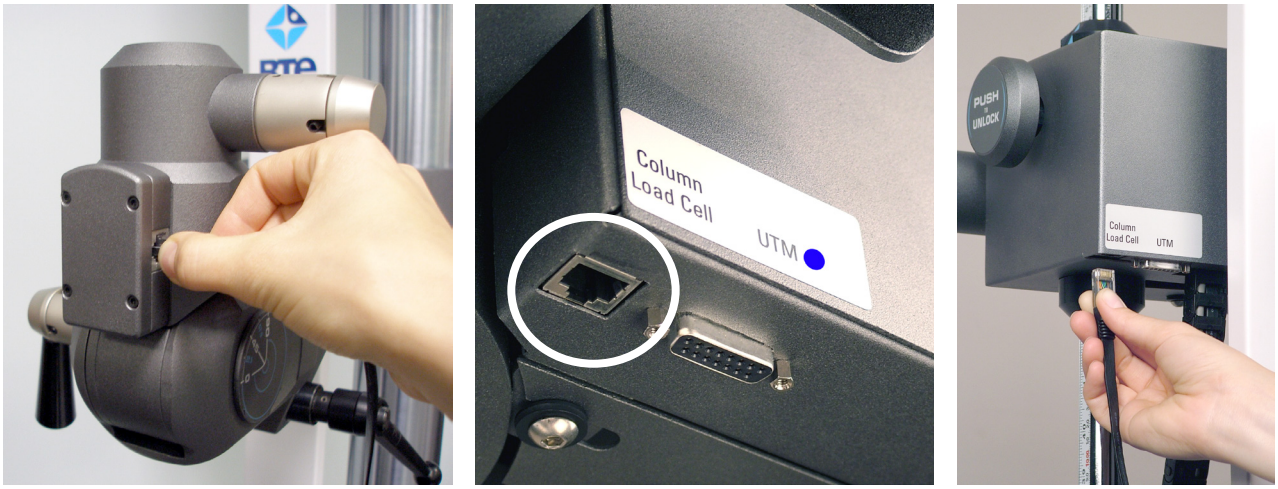


Figure 9-16. Connect the CLC to the Column

IMPORTANT

Always unplug the RJ45 cable from either end prior to removing the Column Load Cell from the column arm. If the cable is not unplugged from one of the ends, stress will be placed on the CLC and column RJ45 jacks, and this may damage the system.

III. PRE-DEFINED ISOMETRIC STRENGTH TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

A. AVAILABLE ISOMETRIC STRENGTH TESTS

For generic isometric strength testing, the following extremities are typically tested with the Column Load Cell:

- Ankle
- Elbow
- Hip
- Knee
- Shoulder
- Wrist

Note that the names of the pre-defined tests contain the name of the extremity that is being analyzed.

The Column Load Cell is also used for the Horizontal Validity and NIOSH tests.

B. ADMINISTERING ISOMETRIC STRENGTH TESTS

Step 1. In the Test Initialization screen, click on  to access the Setup Instructions, which includes detailed information on setting up the column arms and CLC.

Step 2. Click on  to initialize the test.

Step 3. Refer to the Settings screen, which appears prior to the Test Administration screen, for additional test setup requirements (Figure 9-17).

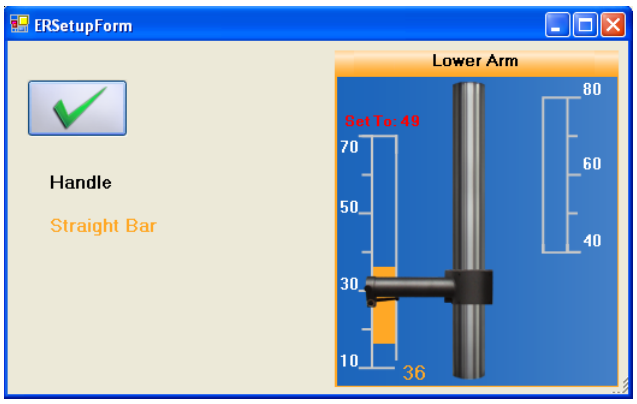


Figure 9-17. Column Load Cell Settings Screen

Step 4. Fasten the proper attachment to the CLC (Figure 9-18). Ensure all locking handles on the CLC and Column are properly tightened.

Figure 9-18. Attachment Secured to CLC

Step 5. Click on  in the Settings screen to proceed to the Test Administration screen.

Step 6. Click on  to start the test. A message will appear stating that the force meter needs to be zeroed and the client should not touch the force meter. Click **OK** for the computer to zero out the additional weight of the attachment.

Step 7. Once the attachment has been zeroed, instruct the client to push or pull the attachment (Figure 9-19).

Figure 9-19. Sample Column Load Cell Isometric Strength Tests

IV. PRE-DEFINED WORK SIMULATION TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

A. COMPONENTS USED FOR WORK SIMULATION TESTS

The Column Load Cell, Bottom Shelf, Lifting Crate, and Lifting Weights are always used with Dynamic Lift and Dynamic Carry Tests (Figure 9-20).

Figure 9-20. CLC, Bottom Shelf, Lifting Crate, and Lifting Weights

The lifting weights are only distinguished by color-coded labels so the client does not know how much weight is being added. The color coding is as follows: ***Yellow - 5 lbs, White - 10lbs, Red - 15lbs, and Green - 20lbs.*** In addition, ***the Lifting Crate weighs 10 lbs.***

Lastly, the Top Shelf may be used for certain Dynamic Lift Tests (Figure 9-21).

Figure 9-21.Top Shelf

B. DYNAMIC LIFT TESTS

Dynamic Lift tests call for the lifting crate to be moved in some sequence between the CLC and floor or between the CLC and Top Shelf.

C. DYNAMIC CARRY TESTS

Dynamic Carry tests call for the lifting crate to be carried from the CLC to a specified distance and back to the CLC.

D. ADMINISTERING WORK SIMULATION TESTS

Step 1. In the Test Initialization screen, click on  to access the Setup Instructions, which includes detailed information on setting up the column arms and CLC.

Step 2. Click on  to initialize the test.

Step 3. Refer to the Settings screen, which appears prior to the Test Administration screen, for additional test setup requirements (Figure 9-22).

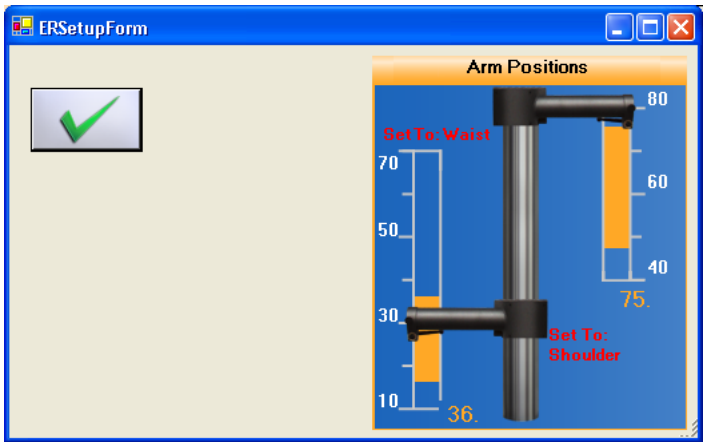


Figure 9-22. Column Load Cell Settings Screens

Step 4. If it isn't already, secure the Column Load Cell in the upright position to the appropriate column arm (Figure 9-23).

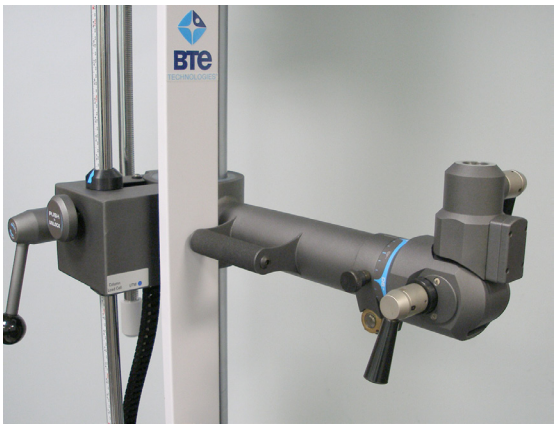


Figure 9-23. Secure the CLC to the Column Arm

Step 5. Secure the Bottom Shelf to the Column Load Cell (Figure 9-24). Ensure all locking handles on the CLC and Column are properly tightened.

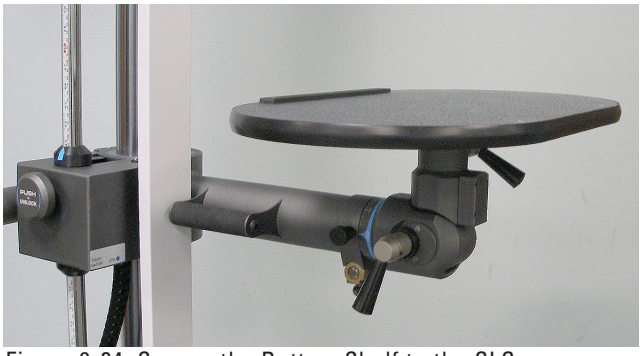


Figure 9-24. Secure the Bottom Shelf to the CLC

Step 6. If required, secure the Top Shelf to the other column arm (Figure 9-25).

Figure 9-25. Secure the Top Shelf to the Column Arm (If Necessary)

Note: The Top Shelf can be rotated $\pm$ 45° by lifting up on the wood portion of the shelf, rotating it to the left or right, and then releasing it.

Step 7. Click on  to start the test. A message will appear stating that the force meter needs to be zeroed and the client should not touch the force meter. Click **OK** for the computer to zero out the additional weight of the shelf.

Step 8. Once the shelf has been zeroed out, instruct the client to begin the test (Figure 9-26).

Figure 9-26. Sample Column Load Cell Dynamic Lift and Dynamic Carry Tests

V. CALIBRATION & VERIFICATION

It is recommended that calibration is performed on a weekly basis and verification is performed on a daily basis.

A. CALIBRATION EQUIPMENT (FIGURE 9-27)

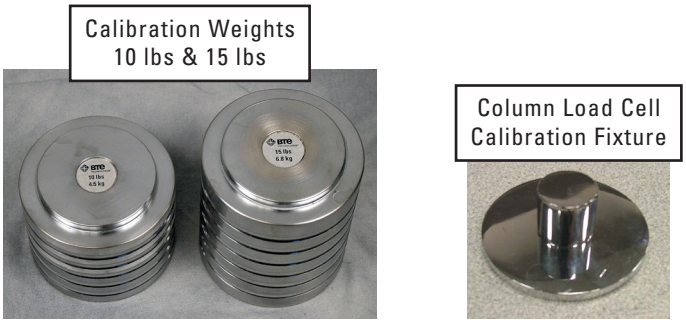


Figure 9-27. Column Load Cell Calibration Equipment

B. ACCESSING THE CALIBRATION & VERIFICATION SCREENS

Refer to Chapter 02c-V-C [Administration Menu - Manage Tools - Calibration] of the EvalTech Software Operator's Manual for additional information on the tool management and calibration screens.

The calibration screen may be accessed within the testing screen and within the Tool Management screen.

The verification screen may only be accessed within the Tool Management screen.

1. VIA THE TESTING SCREEN

Click on  , which is typically located at the bottom-center of the screen.

2. VIA THE TOOL MANAGEMENT SCREEN

Step 1. Access the Tool Management screen via one of the following two methods:

a) Within the Test Administration screen, click on  , which is located in the bottom-left corner of the screen.

b) Select the Administration Taskbar Menu and click on Manage Tools.

Step 2. On the left side of the screen, click on Column Load Cell. The right side of the screen will show the current input values for the tool.

Step 3a. Click on  in the bottom lower-center to access the calibration screen.

Step 3b. Click on  in the bottom lower-center to access the verification screen.

C. PERFORMING CALIBRATION

Prior to entering the calibration screen, verify the Column Load Cell is connected to the column.

The initial calibration screen should look as follows (Figure 9-28):

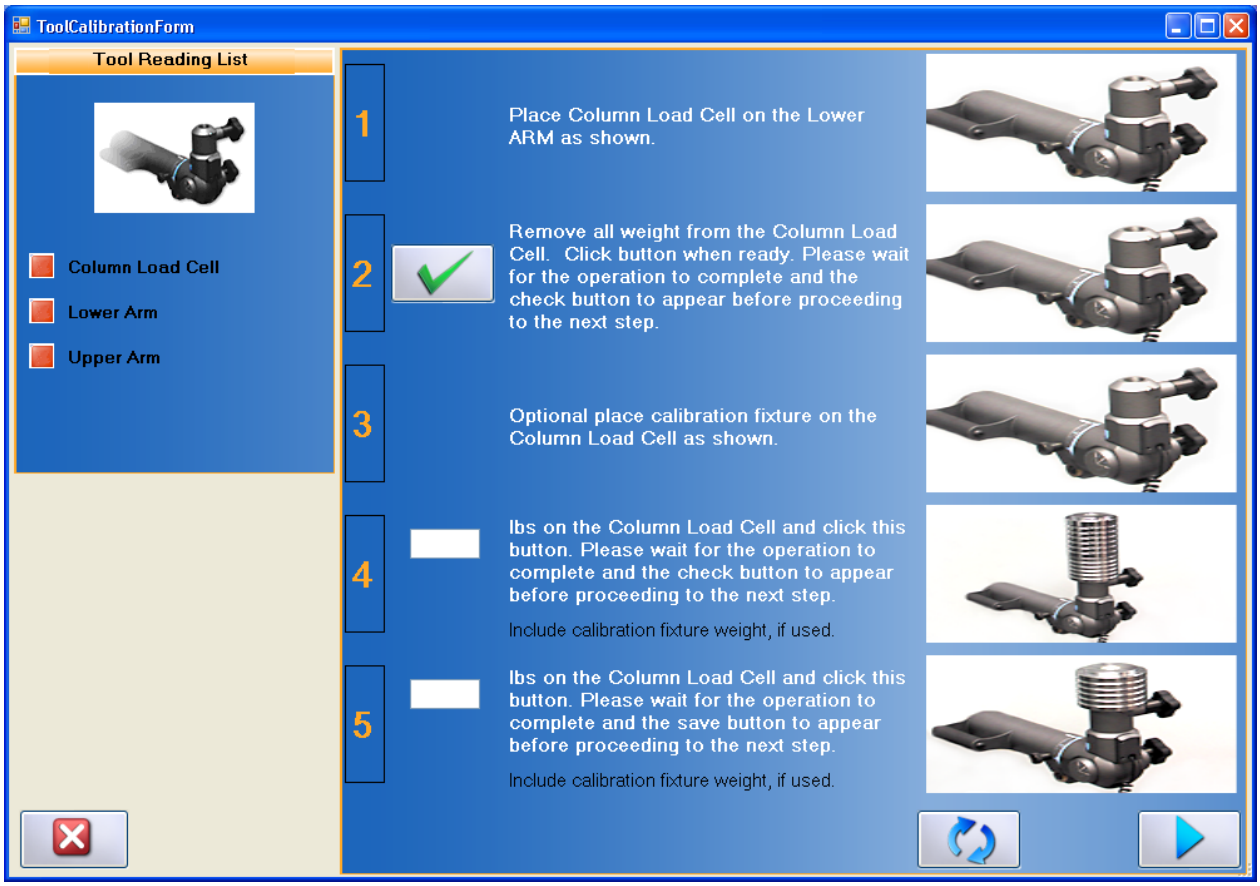


Figure 9-28. Column Load Cell & Column Arms Calibration Screen

Step 1. Secure the Column Load Cell to either column arm as shown in the calibration screen and attach an RJ45 cable to the CLC and mating column arm.

Step 2. Click on  to set the zero point (Figure 9-29).

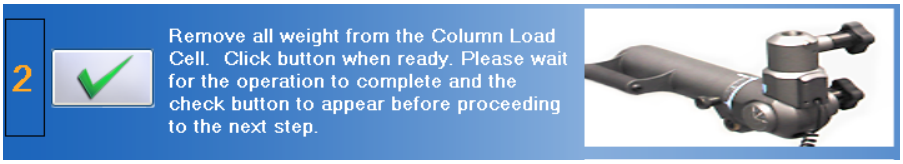


Figure 9-29. Column Load Cell - Set the Zero Point

Step 3. Insert the calibration fixture into the CLC.

Step 4. Place both calibration weights on the calibration fixture and type **25.7** (calibration fixture plus calibration weight) in the text field (Figure 9-30).

Step 5. Click on  to set the weight (Figure 9-30).

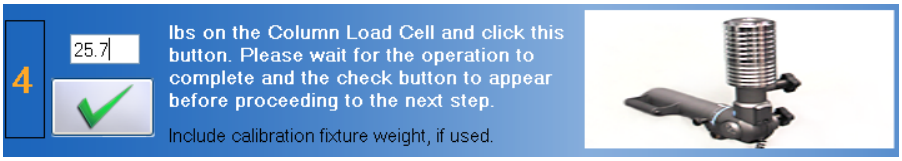


Figure 9-30. Column Load Cell - Set the Weight

Step 6. Remove both of the calibration weights and then place the 15 lb calibration weight back on the calibration disk. Type **15.7** in the text field (Figure 9-31).

Step 7. Click on  to verify the weight (Figure 9-31).

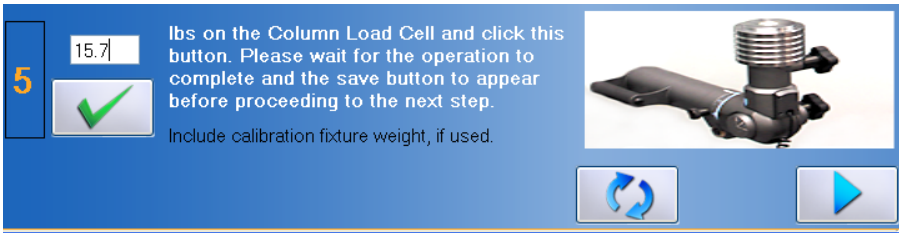


Figure 9-31. Column Load Cell - Verify the Weight

If the Column Load Cell was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 9-32).

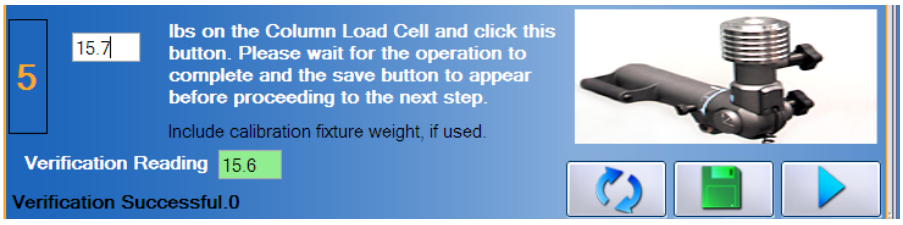


Figure 9-32. Column Load Cell - Verification Successful

If the Column Load Cell was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 9-33). You may try re-verifying the weight or re-calibrating the tool until the verification is successful.

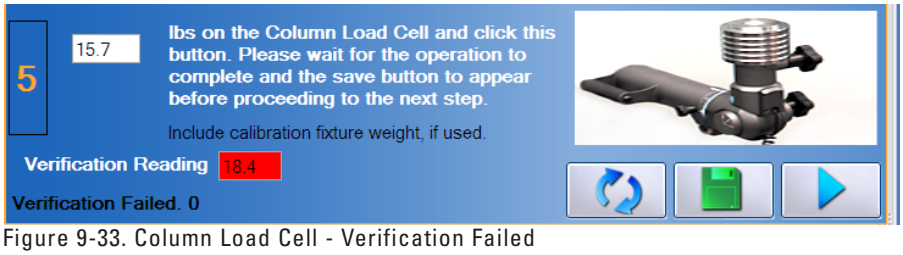


Figure 9-33. Column Load Cell - Verification Failed

Step 8. Once the tool has passed verification, click on  to save the data.

D. PERFORMING VERIFICATION

The verification screen allows you to quickly to verify the tool without having to go through the whole calibration. In addition, all verifications performed through the verification screen are included in the tool's calibration report.

Note: A tool may not be verified with the same weight that was used during calibration.

Step 1. If it's not already, insert the calibration fixture into the CLC.

Step 2. Place the 10 lb calibration weight on the calibration fixture and type **10.7** (calibration fixture plus calibration weight) in the text field (Figure 9-34).

Step 3. Click on  to verify the weight (Figure 9-34).

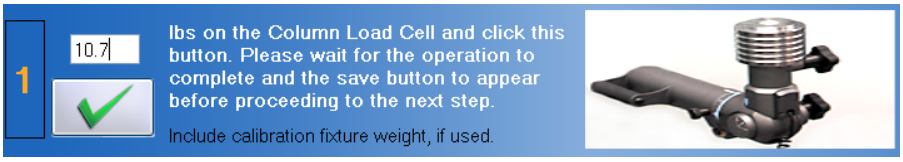


Figure 9-34. Column Load Cell - Verify the Weight

If the Column Load Cell was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 9-35).

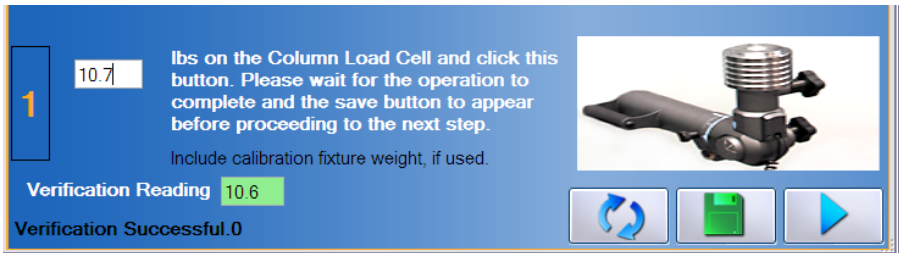


Figure 9-35. Column Load Cell - Verification Successful

If the Column Load Cell was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 9-36). You may try re-verifying the weight or re-calibrating the tool until the verification is successful.

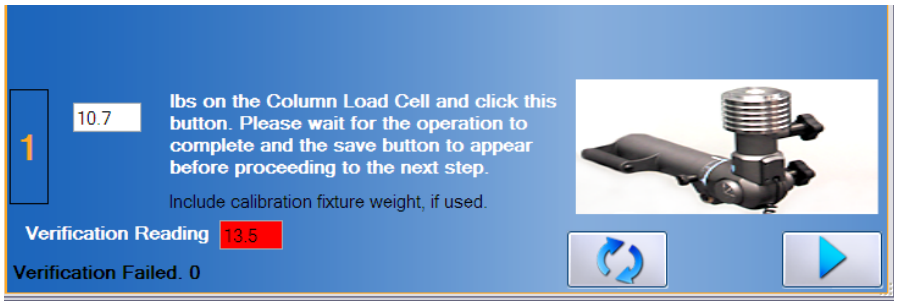


Figure 9-36. Column Load Cell - Verification Failed

Step 4. Once the tool has passed verification, click on  to save the data.

VI. TROUBLESHOOTING

A. TOOL NOT READING ANY VALUE OR NOT RECOGNIZED

1. VERIFY THE COLUMN IS RECEIVING POWER (REFER TO CHAPTER 01-I-A-2 FOR PICTURES)

- Unplug and replug the column power cable, which is behind the long white stabilizer bar, from the short converter cable
- Unplug and replug the short converter cable, which is behind the long white stabilizer bar, from the power adapter cable
- Unplug and replug the long power cable from the power adapter
- Unplug and replug the long power cable from the wall or power strip
- Verify the wall outlet or power strip is providing power
- The CLC, Column, and cable are not damaged, dirty at the connections, or have loose components

2. VERIFY THE COLUMN LOAD CELL IS PLUGGED IN AND COMMUNICATING PROPERLY

- Verify the cable is attached and pushed all the way into to the CLC and the RJ45 jack on the corresponding column arm
- Attach a new cable to the CLC and column arm
- Plug the cable into the other column arm

3. VERIFY THE COLUMN IS COMMUNICATING PROPERLY WITH THE HUB

Refer to Chapter 12 for information on preventing interference.

B. FORCE NOT RECORDING IN STRENGTH TEST

- Verify the actual test situation (i.e. how the client is performing the test) matches the expected test setup (i.e. what is specified under the EvalTech Test Setup).
- Verify all of the settings within the EvalTech Test Setup are correct (e.g. the test is set properly to push or pull).

C. CANNOT COMPLETE A LIFT OR CARRY TEST AS REQUIRED

- Verify that the testing situation matches the configuration outlined in the Test Setup screen (e.g. if the test should end when the client cannot lift anymore weight, then 'Test to Capacity' should be checked in the Test Setup).
- Verify the correct weight is being applied to the CLC:
  - Lifting Crate = 10 lbs
  - Yellow Weight = 5 lbs
  - White Weight = 10 lbs
  - Red Weight = 15 lbs
  - Green Weight = 20 lbs
- Make sure to secure the Bottom Shelf to the CLC prior to zeroing out the load cell at the beginning of the test.
- The client's heart rate may have met or exceeded the age-predicted maximum heart rate

(displayed as a red line on the HR graph). Pause, stop, and/or retest according to the applicable safety procedures.

D. UNABLE TO CALIBRATE OR VERIFY

If you are having trouble completing calibration or verification of the Column Load Cell, verify and attempt the following:

- Ensure that the CLC bottom handle is tightened such that the top of the CLC is not loose.
- Make sure the calibration fixture is not in the CLC for the first step of the calibration.
- Make sure to add the calibration fixture weight to the weight entered in the calibration screen (e.g. 25.7 or 15.7).
- Verify the calibration weight is entered correctly in the text fields.
- Remove the weights from the calibration fixture before placing the verification weight on the disk. This will allow the load cell to return to a zero weight.
- Click on  within the calibration screen and repeat the steps, but wait 3 seconds between applying the weight and clicking on the checkmark icon.

TABLE OF CONTENTS

UNIVERSAL TASK MASTER (UTM)

UNIVERSAL TASK MASTER (UTM)

I. INTRODUCTION

The Universal Task Master's primary use is to measure push and pull forces up to 500 lbs/227 kgs. However, through its innovative design, it is able to measure these forces in several work simulation exercises.

The four main features of the Universal Task Master, also known as the UTM, include the ability to receive several attachments (e.g. D handle, Palm Push, Box Grip, etc.), the ability to allow for supination/pronation positioning, its ability to accommodate independent hand spread, and the ability to rotate in the sagittal plane.

The main UTM components include the base and the two sides (Figure 10-1). The UTM base is the section that connects to the Column arm, and the sides are the components that can move along the UTM bar. Within the UTM base is a potentiometer, which measures the angle in the sagittal plane. Within the UTM sides are a load cell that measures forces, a potentiometer that measures the supination/pronation angle of the attachment, and a potentiometer that measures the position of the UTM side along the bar with respect to the center of the UTM.

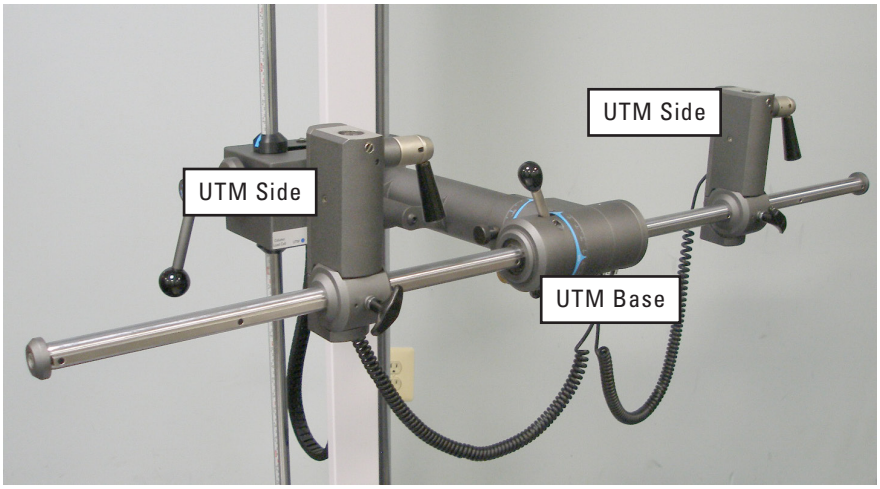


Figure 10-1. Universal Task Master

II. UTILIZING THE UNIVERSAL TASK MASTER

A. BASIC OPERATIONS OF THE UNIVERSAL TASK MASTER

1. SECURING THE UNIVERSAL TASK MASTER TO THE COLUMN

Refer to Chapter 08-II-C [EvalTech Column & Base - Inserting Attachment into the Arms] of this manual for information on securing the UTM to the column.

When attaching the UTM to the Column, ensure that all Column arm locking handles are properly tightened. If they are, then the UTM should not be able to move if weight is applied at either end of the bar.

2. SECURING ATTACHMENTS TO THE UTM SIDES

All of the EvalTech attachments may be used with the Universal Task Master. However, the following attachments are most commonly used with the UTM (Figure 10-2):

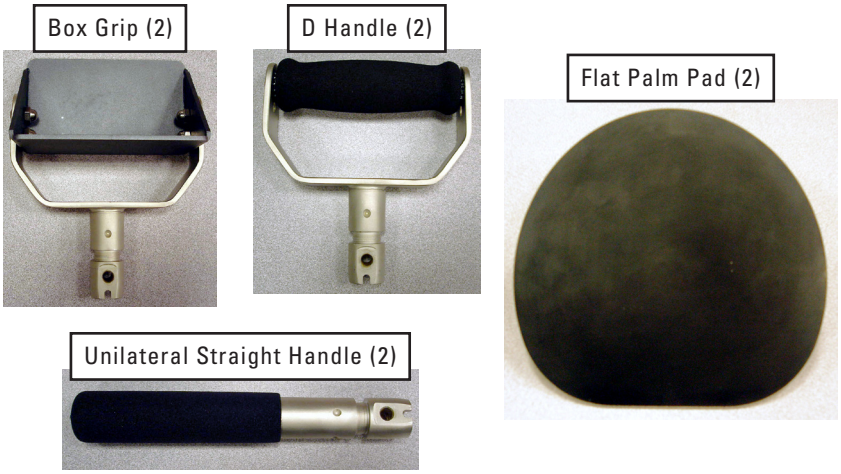


Figure 10-2. Commonly-Used UTM Attachments

All of the attachments are inserted in the same manner:

Step 1. Locate the top retractable handle, which is on the top right side of the UTM side (Figure 10-3).

Step 2. Rotate the top retractable handle 1 turn counter-clockwise (Figure 10-3).

Figure 10-3. Loosen Top Retractable Handle

Step 3. Pull the end of the handle and turn only the end portion a 1/2 turn in either direction; the pin should be resting against the surface of the collar (Figure 10-4).

Figure 10-4. Retractable Handle - Unlock Position

Step 4. Look down the top of the UTM side and verify the retractable handle pin is not visible. If the pin is visible, rotate the collar of the retractable handle counter-clockwise until the pin is not visible (Figure 10-5).

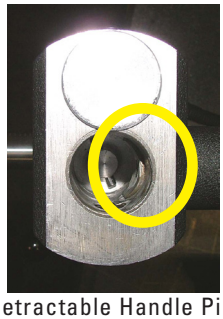


Figure 10-5. Retractable Handle Pin Not Visible

Step 5. Locate the groove on the shaft of the attachment you wish to insert; the retractable handle pin will line up with this groove. Insert the attachment and rotate it to the desired supination/pronation position (Figure 10-6).

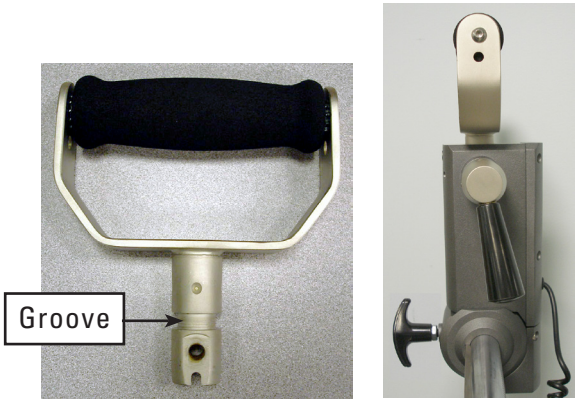


Figure 10-6. Insert the Attachment

Step 6. Pull the end of the retractable handle and turn only the end portion a 1/2 turn in either direction and let go when the pin is lined up with the groove on the retractable handle. The end portion should now be flush against the rest of the handle (Figure 10-7).

Figure 10-7. Retractable Handle - Lock Position

Step 7. Rotate the entire retractable handle clockwise until it is hand-tight.

Step 8. Pull on the attachment to verify it is secure in the UTM side and then proceed with testing.

3. ROTATING ATTACHMENTS TO THE DESIRED SUPINATION/PRONATION POSITION

Note that the UTM side is designed such that the attachment can only rotate 180°. Therefore, when you are rotating the attachment and it hits a stop, do not try to force it to keep rotating.

As mentioned earlier, the UTM sides allow for the inserted attachment to rotate into a supinated or pronated position (and any position in between).

Step 1. Locate the top retractable handle, which is on the top right side of the UTM side (Figure 10-8).

Step 2. Rotate the top retractable handle 1 turn counter-clockwise (Figure 10-8).

Step 3. Rotate the attachment to the desired position (Figure 10-8).

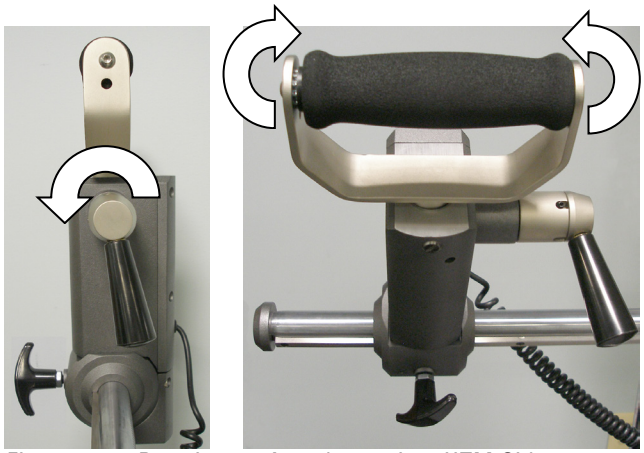


Figure 10-8. Rotating an Attachment in a UTM Side

To aid in positioning, the handle will snap into place at the neutral, pronation, and supination positions.

Step 4. Rotate the retractable handle clockwise until it is hand-tight.

The attachment is now secure in the UTM side and you can proceed with testing.

4. POSITIONING THE UTM SIDES ALONG THE BAR

In order to accommodate any desired amount of hand spread, the UTM sides have the ability to move along the bar. The hand spread range is 11in/28cm to 49in/124cm.

Step 1. Locate the locking handle, which is on the bottom front side of the UTM side (Figure 10-9).

Step 2. Rotate the locking handle 1 turn counter-clockwise (Figure 10-9).

Step 3. Move the UTM side to its desired location. Note that the UTM side moves best when it is grasped closer to the bottom section, which is near the locking handle (Figure 10-9).

Step 4. Rotate the locking handle clockwise until it is hand-tight.

The UTM side is now secure and you can proceed with testing.

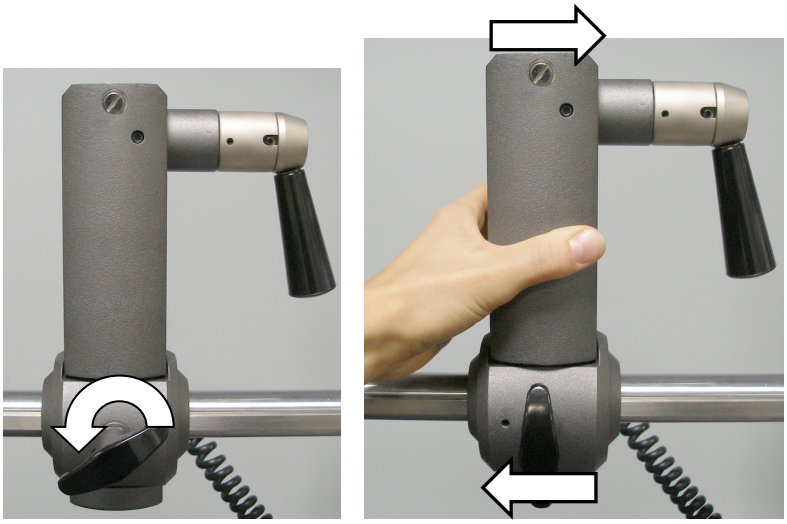


Figure 10-9. Locking Handle on a UTM Side & Moving the UTM Side along the Bar

5. ROTATING THE UTM IN THE SAGITTAL PLANE

The UTM has the ability to rotate in the sagittal plane, which allows you simulate tasks in a wide variety of positions (e.g. pushing down, pushing forward, pushing up, etc.). The UTM Sides can be positioned from 0° to 180° and every 5° in between.

Step 1. Locate the gear shift lever, which is located on the UTM base (Figure 10-10).

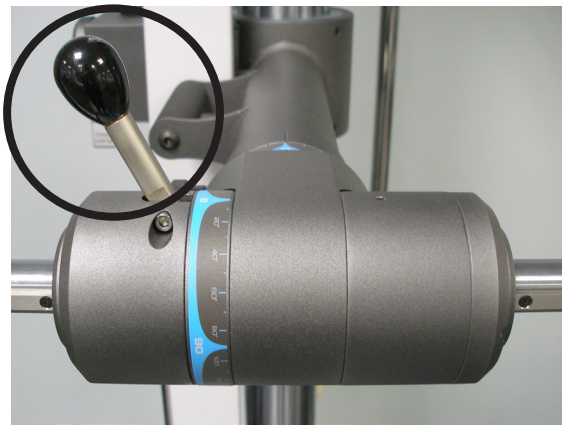


Figure 10-10. UTM Gear Shift Lever

Step 2. While holding onto the right UTM side with your right hand, use your left hand to move the lever from left to right (Figure 10-11).

Step 3. While holding onto the UTM side and pushing the lever to the right, rotate the entire bar to the desired position (Figure 10-11).

Figure 10-11. Rotating the UTM in the Sagittal Plane

Step 4. Once you have reached the desired position, move the gear shift lever from right to left. You should hear a snapping noise once the UTM has been locked into position (Figure 10-12).

The UTM is now secure and you can proceed with testing.

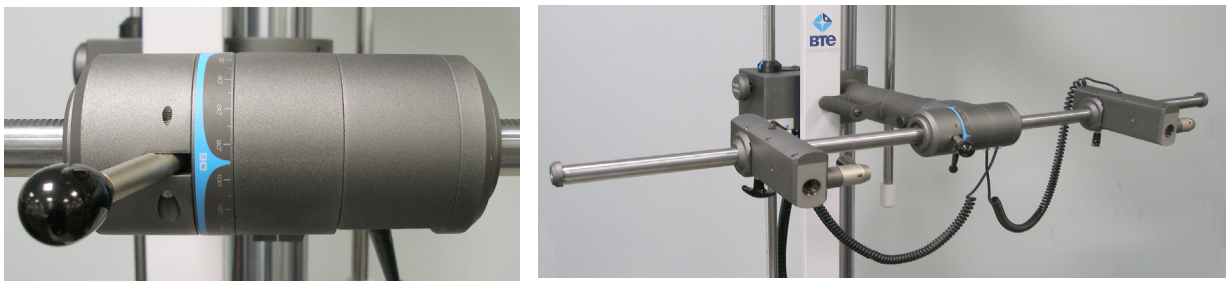


Figure 10-12. UTM Rotated 90° in the Sagittal Plane

B. CONNECTING TO THE SYSTEM

Prior to utilizing the UTM, you must connect the UTM sides to the UTM base and the base to the column.

1. CONNECTING THE UTM SIDES TO THE UTM BASE

Step 1. Locate the electronic connector board on the underside of the UTM base (there is one 15-pin serial socket and two RJ45 jacks) (Figure 10-13).

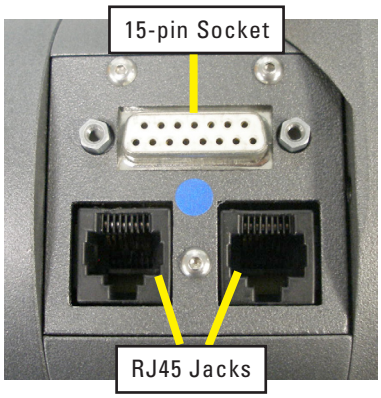


Figure 10-13. UTM Electronic Connector Board

Step 2. Locate the coiled cable on the left UTM side. Plug the cable connector into the closest RJ45 jack (Figure 10-14).

Step 3. Repeat Step 2 for the right UTM side.

Figure 10-14. Attach the UTM Side Cables

Do not attempt to connect the UTM Sides to the Portable Dock or the column - they will not work.

2. CONNECTING THE UTM TO THE COLUMN

Two serial cables (one 3 ft and one 13 ft) are provided with the system. Use whichever cable is ideal for the testing situation.

Always connect the serial cable from the UTM to the mating serial jack on the column arm (e.g. if the UTM is in the lower Column arm, then use the serial jack on the lower arm) (Figure 9-16).

Step 1. Locate the electronic connector board on the underside of the Column arm (there is one 15-pin serial socket and one RJ45 jack) (Figure 10-15).

Step 2. Locate the desired-length serial cable. Note the blue dots on each connector, above the serial sockets on the Column arms, and next to the serial socket on the UTM base.

Step 3. Lining up the blue dot on one connector with the blue dot above the serial socket on the Column arm, carefully insert the connector into the socket (Figure 10-15). In order to secure the connector to the column, turn the 2 screws, which are on each side of the connector, clockwise until they are tightened all the way down.

Step 4. Lining up the blue dot on the other connector with the blue dot next to the serial socket on the UTM base (Figure 10-15), carefully insert the connector into the socket. In order to secure the connector to the UTM base, turn the

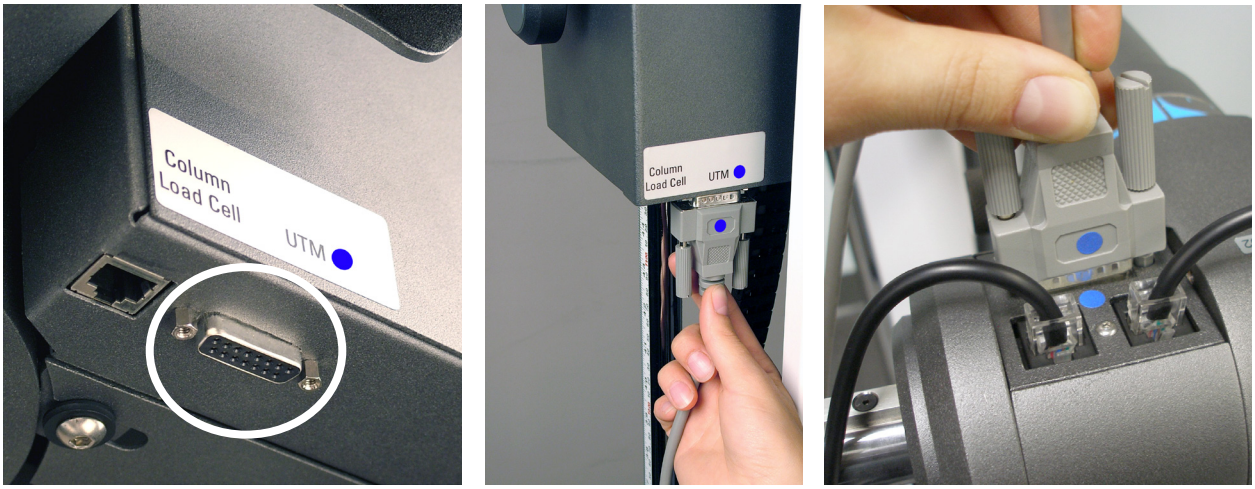


Figure 10-15. Connect the UTM to the Column

2 screws, which are on each side of the connector, clockwise until they are tightened all the way down.

The UTM is now fully connected and ready to be utilized.

IMPORTANT

Always unplug the serial cable from either end prior to removing the UTM from the Column arm. If the cable is not unplugged from one of the ends, stress will be placed on the UTM and column serial sockets, and this may damage the system.

III. PRE-DEFINED TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

A. PRE-DEFINED UTM ISOMETRIC STRENGTH TESTS

For generic UTM isometric strength testing, the following pre-defined tests are available:

- UTM - Standard Shoulder Height Pull Test
- UTM - Standard Shoulder Height Push Test
- UTM Cart Pull Test
- UTM Cart Push Test

B. ADMINISTERING AN ISOMETRIC STRENGTH TEST

Step 1. In the Test Initialization screen, click on  to access the Setup Instructions, which includes detailed information on setting up the Column arms and UTM.

Step 2. Click on  to initialize the test.

Step 3. Refer to the Settings screen, which appears prior to the Test Administration screen, for the test setup requirements (Figure 10-16).

Figure 10-16. UTM Settings Screen

Step 4. Secure the UTM to the appropriate Column arm in the specified orientation.

Step 4. Fasten the proper attachments to the UTM Sides (Figure 10-17).

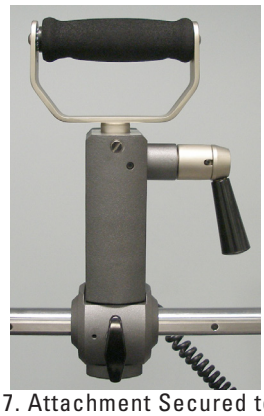


Figure 10-17. Attachment Secured to UTM Side

Step 5. Position the attachments, UTM Sides, and bar to the specified angles and locations.

Step 6. Move the Column arm to the specified height and angle, if necessary.

Step 7. Ensure all locking handles on the UTM and Column are properly tightened.

Step 8. Click on  in the Settings screen (Figure 10-16) to proceed to the Test Administration screen.

Step 9. Click on  to start the test. A message will appear stating that the force meter needs to be zeroed and the client should not touch the force meter. Click **OK** for the computer to zero out the additional weight of the attachments.

Step 10. Once the attachments have been zeroed, instruct the client to push or pull the attachments (Figure 10-18).

Make sure the client is pushing or pulling in the same axis as the tool handle. This ensures the force is accurately read.

Figure 10-18. Sample UTM Static Isometric Strength Tests

IV. CALIBRATION & VERIFICATION

It is recommended that calibration is performed on a weekly basis and verification is performed on a daily basis.

A. CALIBRATION EQUIPMENT (FIGURE 10-19)

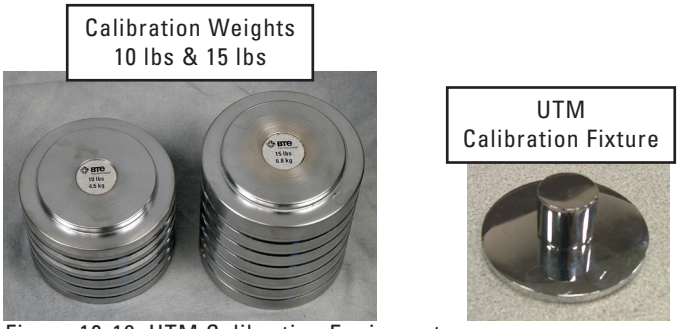


Figure 10-19. UTM Calibration Equipment

B. ACCESSING THE CALIBRATION & VERIFICATION SCREENS

Refer to Chapter 02c-V-C [Administration Menu - Manage Tools - Calibration] of the EvalTech Software Operator's Manual for additional information on the tool management and calibration screens.

The calibration screen may be accessed within the testing screen and within the Tool Management screen.

The verification screen may only be accessed within the Tool Management screen.

1. VIA THE TESTING SCREEN

Click on  , which is typically located at the bottom-center of the screen.

2. VIA THE TOOL MANAGEMENT SCREEN

Step 1. Access the Tool Management screen via one of the following two methods:

a) Within the Test Administration screen, click on  , which is located in the bottom-left corner of the screen.

b) Select the Administration Taskbar Menu and click on Manage Tools.

Step 2. On the left side of the screen, click on UTM. The right side of the screen will show the current input values for the tool.

Step 3a. Click on  in the bottom lower-center to access the calibration screen.

Step 3b. Click on  in the bottom lower-center to access the verification screen.

C. PERFORMING CALIBRATION

Prior to entering the calibration screen, verify the UTM is secured and connected to the column. Note that the data cables must be facing the floor during calibration (refer to Figure 10-1).

The initial calibration screen should look as follows (Figure 10-20):

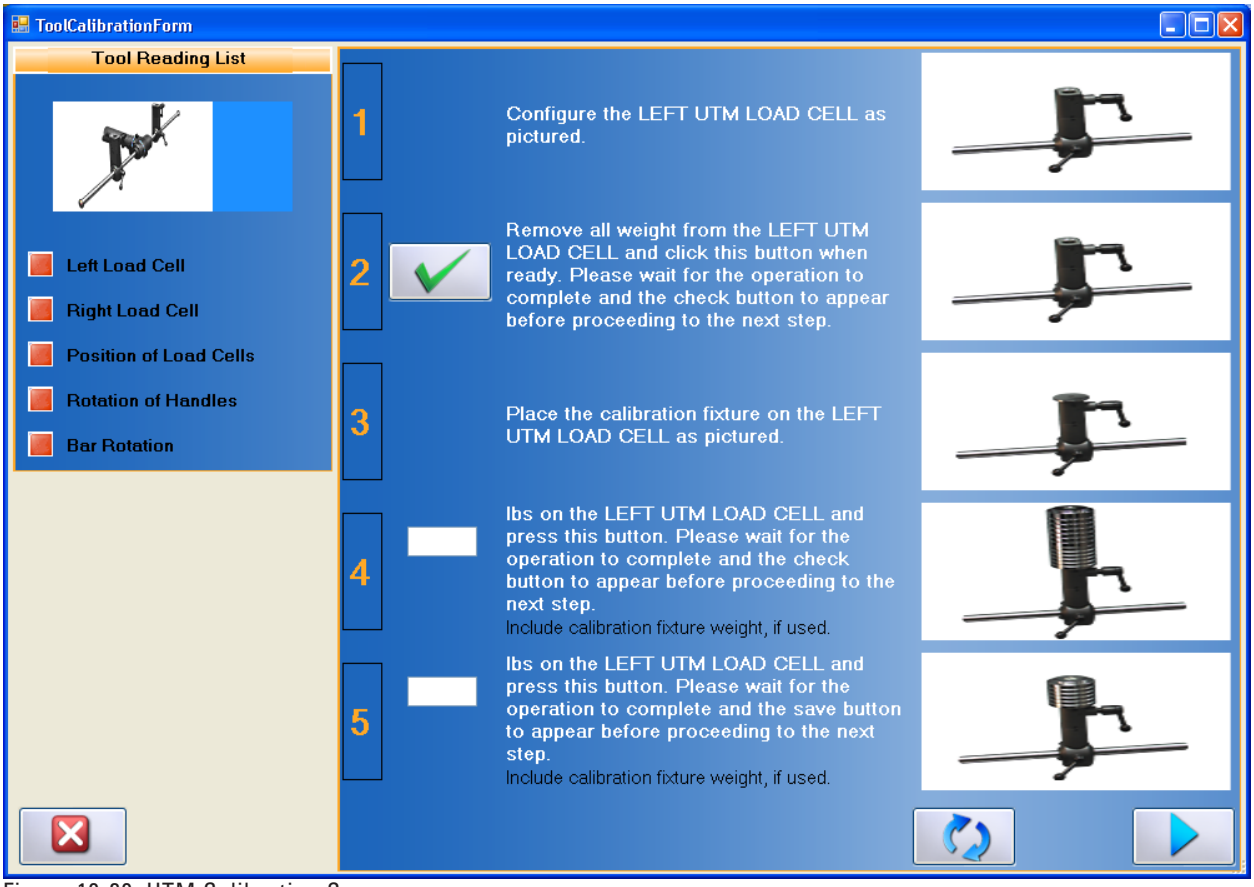


Figure 10-20. UTM Calibration Screen

If you wish to independently calibrate a specific attribute of the UTM, click on the desired attribute on the left side of the screen (Figure 10-21).

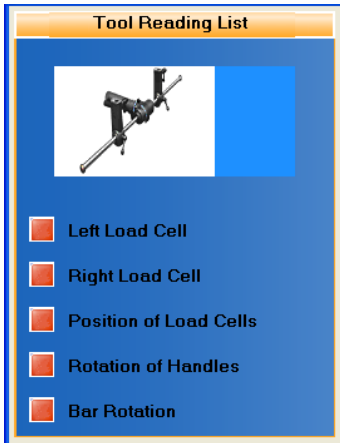


Figure 10-21. If Necessary, Select UTM Attribute to Calibrate

1. LOAD CELLS

Step 1. Position the UTM Side as shown in the calibration screen.

Step 2. Click on  to set the zero point (Figure 10-22).

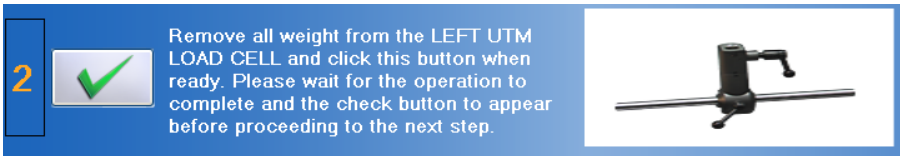


Figure 10-22. UTM - Set the Zero Point

Step 3. Insert the calibration fixture into the specified UTM side.

Step 4. Place both calibration weights on the calibration fixture and type **25.7** (calibration fixture plus calibration weight) in the text field (Figure 10-23).

Step 5. Click on  to set the weight (Figure 10-23).

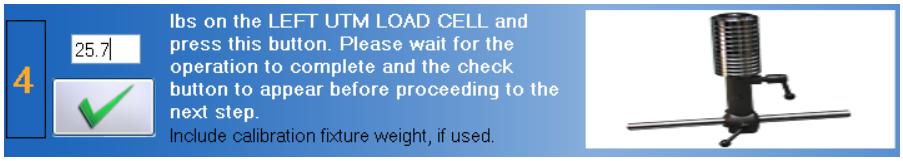


Figure 10-23. UTM - Set the Weight

Step 6. Remove both of the calibration weights and then place the 15 lb calibration weight back on the calibration disk. Type **15.7** in the text field (Figure 10-24).

Step 7. Click on  to verify the weight (Figure 10-24).

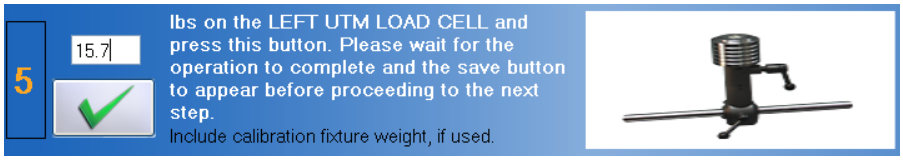


Figure 10-24. UTM - Verify the Weight

If the UTM was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 10-25).

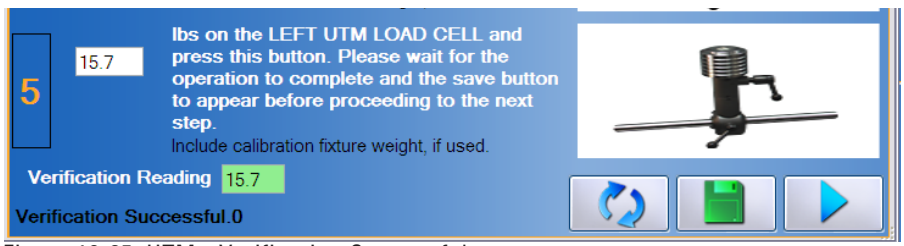


Figure 10-25. UTM - Verification Successful

If the UTM was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 10-26). You may try re-verifying the weight or re-calibrating the tool until the verification is successful.

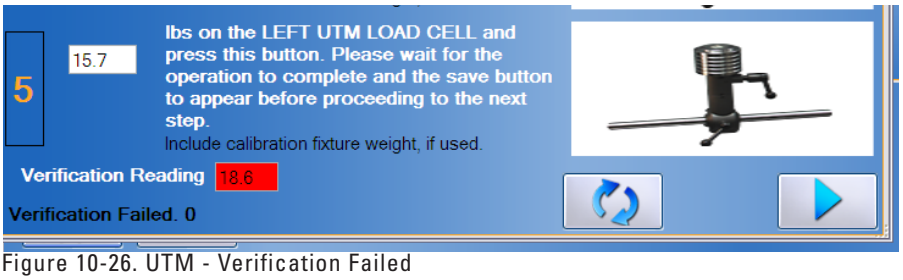


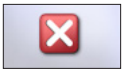
Figure 10-26. UTM - Verification Failed

Step 8. Once the tool has passed verification, click on  to save the data.

Step 9. Click on  to access the calibration screen for the right load cell.

Step 10. Repeat Steps 1-8 for the right side.

Step 11a. Click on  if you wish to proceed with the load cell positions calibration.

Step 11b. Click on  if you wish to exit the screen.

2. LOAD CELL POSITIONS

Step 1. Move the UTM sides to the initial locations shown in the calibration screen.

Step 2. Click on  to set the initial locations (Figure 10-27).

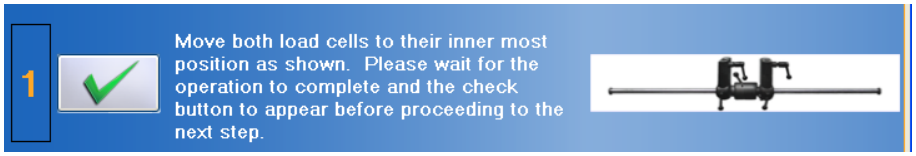


Figure 10-27. UTM - Set the Initial Locations

Step 3. Move the UTM sides to the final locations shown in the calibration screen.

Step 4. Click on  to set the final locations (Figure 10-28).

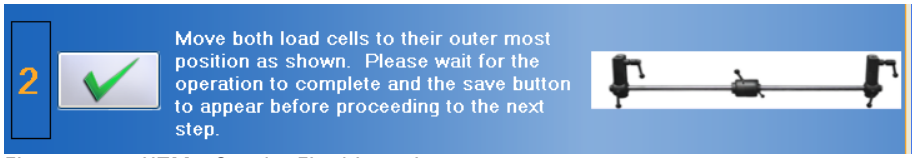
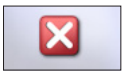


Figure 10-28 UTM - Set the Final Locations

Step 5. Click on  to save the data.

Step 6a. Click on  if you wish to proceed with the handle rotation calibration.

Step 6b. Click on  if you wish to exit the screen.

3. HANDLE ROTATION

Step 1. Insert an attachment into the specified UTM Side. Make sure the attachment is pushed all the way down and properly seated in the UTM Side.

Step 2. Rotate both of the attachments as specified in the calibration screen.

Step 3. Click on  to set the initial angle (Figure 10-29).

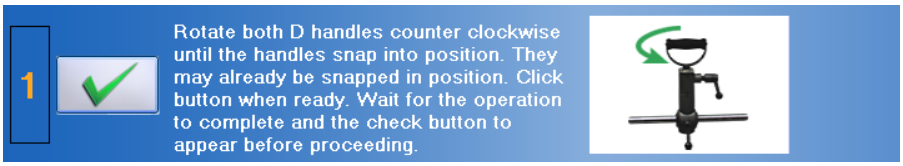


Figure 10-29. UTM - Set the Initial Handle Rotation

Step 4. Rotate both of the attachments as shown in the calibration screen.

Step 5. Click on  to set the final angle (Figure 10-30).

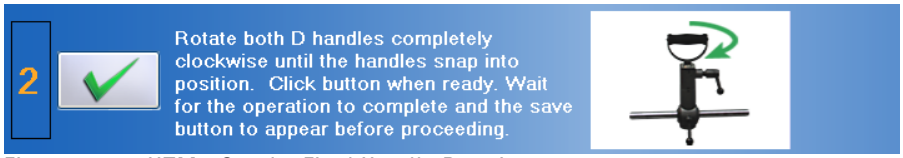
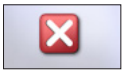


Figure 10-30. UTM - Set the Final Handle Rotation

Step 6. Click on  to save the data.

Step 7a. Click on  if you wish to proceed with the bar rotation calibration.

Step 7b. Click on  if you wish to exit the screen.

4. BAR ROTATION

Step 1. Position the UTM bar as specified in the calibration screen.

Step 2. Click on  to set the initial angle (Figure 10-31).

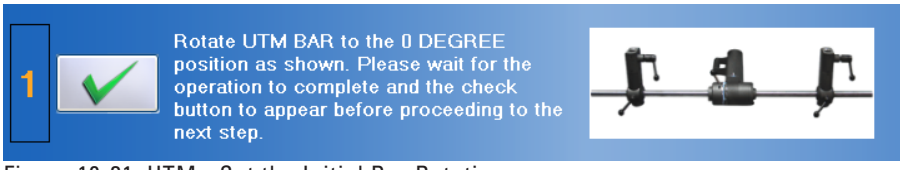


Figure 10-31. UTM - Set the Initial Bar Rotation

Step 3. Rotate the bar as specified in the calibration screen.

Step 4. Click on  to set the final angle (Figure 10-32).

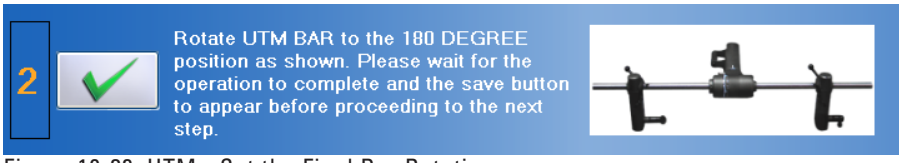


Figure 10-32. UTM - Set the Final Bar Rotation

Step 5. Click on  to save the data.

D. PERFORMING VERIFICATION

Verification may only be performed on the load cells.

The verification screen allows you to quickly to verify the tool without having to go through the whole calibration. In addition, all verifications performed through the verification screen are included in the tool's calibration report.

Note: A tool may not be verified with the same weight that was used during calibration.

Step 1. Insert the calibration fixture into the specified UTM side.

Step 2. Place the 10 lb calibration weight on the calibration fixture and type **10.7** (calibration fixture plus calibration weight) in the text field (Figure 10-33).

Step 3. Click on  to verify the weight (Figure 10-33).

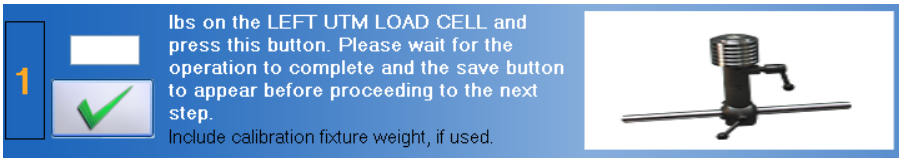


Figure 10-33. UTM - Verify the Weight

If the UTM was properly calibrated, then the screen will say the verification was successful and the measured weight will be in a green box (Figure 10-34).

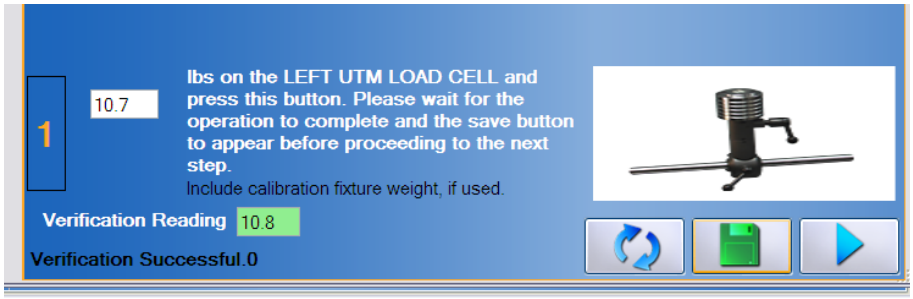


Figure 10-34. UTM - Verification Successful

If the UTM was not properly calibrated, then the screen will say the verification failed and the measured weight will be in a red box (Figure 10-35). You may try re-verifying the weight or re-calibrating the tool until the verification is successful.

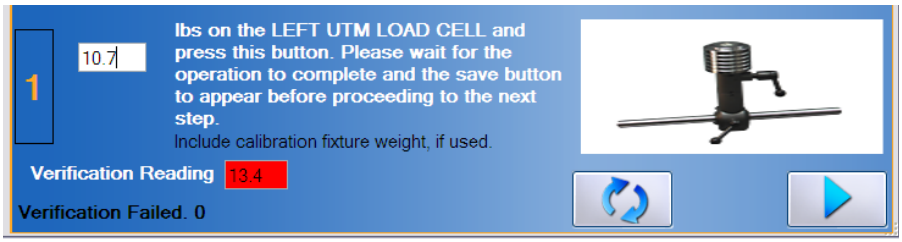


Figure 10-35. UTM - Verification Failed

Step 4. Once the tool has passed verification, click on  to save the data.

Step 5. Click on  to access the verification screen for the right load cell.

Step 6. Repeat Steps 1-4 for the right side.

V. TROUBLESHOOTING

A. TOOL NOT READING ANY VALUE OR NOT RECOGNIZED

1. VERIFY THE COLUMN IS RECEIVING POWER (REFER TO CHAPTER 01-I-A-2 FOR PICTURES)

- Unplug and replug the column power cable, which is behind the long white stabilizer bar, from the short converter cable
- Unplug and replug the short converter cable, which is behind the long white stabilizer bar, from the power adapter cable
- Unplug and replug the long power cable from the power adapter
- Unplug and replug the long power cable from the wall or power strip
- Verify the wall outlet or power strip is providing power

2. VERIFY THE UTM IS PLUGGED IN AND COMMUNICATING PROPERLY

- Verify the cable is attached and screwed in all the way into to the UTM and the serial jack on the corresponding Column arm
- Verify all of the cables on the UTM are facing toward the floor (refer to Figure 10-1)
- Attach a new cable to the UTM and Column arm
- Plug the cable into the other Column arm
- Ensure that the UTM, Column, and cable are not damaged, dirty at the connections, or have loose components.

3. VERIFY THE COLUMN IS COMMUNICATING PROPERLY WITH THE HUB

Refer to Chapter 12 for information on preventing interference.

B. FORCE NOT RECORDING IN STRENGTH TEST

- Verify the actual test situation (i.e. how the client is performing the test) matches the expected test setup (i.e. what is specified under the EvalTech Test Setup).
- Verify all of the settings within the EvalTech Test Setup are correct (e.g. the test is set properly to push or pull).

C. HANDLE ANGLE NOT CHANGING

- Verify the UTM cables are facing the floor and the UTM sides are plugged into their corresponding ports in the center of the UTM (Figure 10-1).
- Remove and insert the attachment from the UTM side. Make sure the retractable handle is engaging with the groove in the attachment and not the thru hole - the attachment should snap into place every 90 degrees.

D. HANDLE DISTANCE NOT CHANGING

- Verify the UTM cables are facing the floor and the UTM sides are plugged into their corresponding ports in the center of the UTM (Figure 10-1).

E. UNABLE TO CALIBRATE OR VERIFY THE LOAD CELLS

If you are having trouble completing calibration or verification of the UTM Load Cells, verify and attempt the following:

- Ensure that the UTM side bottom handles are tightened such that the sides are not loose.
- Ensure that the UTM bar rotation is 0°.
- Make sure the calibration fixture is not in the UTM Side for the first step of the calibration.
- Make sure to add the calibration fixture weight to the weight entered in the calibration screen (e.g. 25.7 or 15.7).
- Verify the calibration weight is entered correctly in the text fields.
- Remove the weights from the calibration fixture before placing the verification weight on the disk. This will allow the load cell to return to a zero weight.
- Click on  within the calibration screen and repeat the steps, but wait 3 seconds between applying the weight and clicking on the checkmark icon.

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FUNCTIONAL RANGE OF MOTION (FROM)

FUNCTIONAL RANGE OF MOTION (FROM)

I. INTRODUCTION

The Functional Range of Motion (FROM) pegboard (Figure 11-1) allows the evaluator to determine the positional tolerance of a client. The FROM system utilizes Methods Time Measurement (MTM), thus allowing the evaluator to extrapolate for occasional or frequent demands. Therefore, through the combined use of EvalTech software and the FROM pegboard, you will be able to accurately measure a client's capability in performing a task.

Figure 11-1. FROM Pegboard

II. METHODS TIME MEASUREMENT INFORMATION

Methods Time Measurement (MTM) is the industrial engineering based method for determining time-motion performance in conjunction with work-related activities. The MTM standard offers the means to determine an exact percentage score of performance against the most widely recognized criteria for the assessment of time-motion activities.

The assessment of time-motion is a vital concept to many manufacturing companies throughout the world. Without the means to assess time-motion on a standardized basis, it would be very difficult for assembly lines to run effectively. It would also likely raise the frequency of repetitive stress injuries; this would be due to the inability to determine whether or not a worker was being required to perform at a level exceeding their reasonable production. The MTM standard score allows an industrial engineer to effectively design production processes to most effectively complete job demands, while always taking into consideration the desire to minimize ergonomic risk factors.

MTM employs the usage of time-motion units to calculate the required performance of functional activities. The breakdown of MTM units is as follows:

1 hour = 100,000 TMUs (time-motion units)

1 minute = 1,677 TMUs

1 second = 27.8 TMUs

A. MTM USED FOR FUNCTIONAL TESTING AND EVALUATING INDIVIDUALS WITH DISABILITIES

The MTM standard score has been one of the most commonly used time-motion standards as it provides the most accurate and reliable means of evaluating performance. Other functional evaluation systems that have employed the MTM standard include WEST, VALPAR, ERGOS, and Lifestyle Enhancement Systems. In addition, several papers, which describe the use of the MTM standard for evaluations of individuals with disabilities, have been published throughout the world by international associations of industrial/time-motion engineers.

B. USING MTM FOR FUNCTIONAL TESTING

In functional capacity evaluations, the MTM standard score allows the evaluator to determine the extent of a test subject's capacity for positional tolerances as well as a specific productivity equivalency for the positional tolerance. Conventional positional tolerance protocols employed without a time-motion equivalency fail to take into consideration the fact that individuals must demonstrate functionality within the prescribed posture. For example, a test that asks the individual to reach overhead without the performance of a work-related activity will not be able to discern whether the individual is capable of performing gross manual or fine finger dexterity activities, which are elements crucial to overhead work. The objective is not to determine whether the individual can reach overhead, but rather if the individual is capable of performing functional activities in the overhead position.

In an effort to produce a standardized and reproducible method, MTM employs time-motion units; however, this requires the instructions and performance of the evaluated function to be accurate. Variations in the performance of the function can have an impact on the test subject's results. In tests employing the MTM standard score, a deviation in performance will usually lower the competitive level score of the test subject.

MTM is also very helpful with respect to functional testing by classifying levels of employability. The classifications and the associated ranges for the tests are as follows:

Exceeding Above Competitive	Above 140%
Above Competitive	101-140%
Competitive	80-100%
Entry Level	70-79%
Below Competitive	0-69%

C. MTM AND THE FUNCTIONAL CAPACITY EVALUATOR

The use of MTM standard scores is not intended to replace the functional capacity evaluator. It creates a standardized yet flexible basis for the administration of positional tolerance tests and for the performance of time-motion activities. In addition, MTM provides a scoring basis that is objective and ensures the reproducibility of the test results. Nevertheless, the observations of a skilled evaluator are still the most essential part of positional tolerance functional tests. In some situations, the individual may demonstrate the ability to assume and maintain a specific posture (e.g. kneeling, crouching, etc.), but the ability to perform at a pace commensurate with industry time-motion standards may be limited. In functional capacity evaluations, such limitations must be addressed to ensure the reliability and validity of the test process. Even if the test subject did not require a modification in the required posture, the skilled evaluator

would still note that while the position was assumed and maintained, the performance was limited by other physiological and/or psychological factors. Those performance limitations may include, but are not restricted to the following: pain resulting in decreased functionality; inability to perform at a satisfactory level within the full functional range of physical demand; limitations in other bodily functional areas (e.g. slowed performance in the kneeling posture due to physical limitations in handling/fingering); severely limited cognitive processing capabilities. The keen eye of the skilled evaluator is critical in recording observed deviations from the norm and providing an interpretation for variations in performance.

D. MTM'S APPLICATION TO THE BTE FUNCTIONAL RANGE OF MOTION SYSTEM

The Functional Range of Motion (FROM) System has twenty-two protocols for the evaluation of positional tolerances during the performance of functional activities. Eleven of the positional tolerance protocols are designed for measurements in the occasional work category, while the other eleven are designed from measurements in the frequent category.

The number of repetitions necessary to complete the occasional work demand protocols is set to most closely approximate a 5 minute timed tolerance test period. The number of repetitions necessary to complete the frequent work demand protocols is set to most closely approximate a 20 minute timed tolerance test period.

Separate protocols are employed in each positional tolerance for the occasional and frequent work demand categories; this is due to the common practice of extrapolating a limited time period performance to the frequent work demand capacity to be flawed. Tests that only require an individual to assume a position for a period not exceeding five minutes cannot accurately measure a worker's capacity for endurance.

An example of evaluating the results is if a test subject achieves a score in the competitive range (80-100) in the frequent demand protocol for a specific positional tolerance, then he or she has demonstrated the capacity for acceptable performance over the course of an eight hour day. It will also hold true that the test subject has successfully demonstrated the capacity for acceptable performance with regard to the occasional work demand. A test subject achieving a score above 100 has demonstrated the capacity for acceptable performance at or exceeding an eight hour day equivalency.

E. MTM TEST RESULTS APPLIED TO THE EVALUATION OF THE CLIENT/WORKER'S ABILITIES

Many large manufacturing companies employ industrial engineers who have derived time-motion standards for the employer's work site. For example, an engineer may have done an accurate analysis of a work situation and determined that the employee must perform kneeling activities on an occasional basis with a work flow rate equivalent to a 95 MTM standard. The evaluator now has the means to determine if the worker is capable of returning to the job and the specific demands of the workplace. Although 80 to 100 MTM is considered to be in the competitive range, an employer with a specific MTM standard will want the worker to be at or above that standard.

For employers not using time-motion standards, the ability to quantify a worker's capabilities within internationally recognized time-motion standards provides a firmer basis for assessing performance than a test where the subject is asked merely to assume a given position.

F. IMPORTANCE OF THE TESTING METHOD

The method by which the test subject performs a process is very important to the analysis of the demonstrated ability of that individual. Time-motion standards are set assuming the specific tasks and task elements will be performed in the most practical and efficient manner possible; therefore, the process must be performed in the same manner every time to ensure accuracy of the results.

For example, the upper level reach protocol of the FROM system requires the worker to remove a peg from the unit with one hand, transfer it to the opposite hand, and then place the peg into the corresponding hole in the next panel. The process calls out for the worker to initiate removal of the next peg while the prior one is still being placed in its proper location. However, if the test subject were to use only one hand to transfer the first peg from one panel to the other, the MTM score would reflect a significant negative influence. Specifically, the test subject would lose the advantage of having both hands work in concert. Conversely, if the test subject were to use both hands to pull two pegs out simultaneously and then move them into the appropriate holes on the corresponding panel, the test result would likely produce a higher MTM score.

G. MODIFYING THE TESTING PROCESS

Some individuals, due to impairment, may require modifications to the testing process. In such cases, use the comments section of the specific test to record any variance required to accommodate the worker's ability to perform the test. Any decrement from the norm in the test score should also be explained.

For example, an individual with residual effects from a closed head injury may have difficulties specifically related to one-sided weaknesses/deficits. Although the individual may be able to kneel without difficulty during the course of the test, the transfer of the peg from one hand to the other, as well as the placement of the peg into the hole using the impacted extremity, may be problematic. In a situation such as this one, it would be important to record the observation of the deficiency, but also to indicate the test subject demonstrated the ability to kneel without limitations to the lower extremities. The deficit should also be explained as being a possible performance limitation that could affect the ability to perform activities in the position if manual dexterity activities are required.

H. REPORTING AND OBSERVING ANYTHING OTHER THAN POSITIONAL TOLERANCES IN THE TIME-MOTION TEST PROCESS

Although the primary positional tolerance is the specific focus of a time-motion test using the FROM system, there are several secondary observations that can have significant bearing upon a functional capacity evaluation. For instance, observations related to the upper level reach activity include, but are not limited to the following: the ability to work with the cervical spine in extension; the ability to work with both upper extremities through a range (chest level to full extension reach) of motion; the ability to perform simple repetitive activities without unnecessary breaks; the ability to coordinate right and left side activities into one process; the possibility of tremor associated with overhead work affecting proprioception activities.

Some of the most unique observations will be in the area of work-conducive and non-conducive behaviors. Pain-related behaviors and the consistency of the report to the impairment are critical to an appropriate evaluation of the test subject.

In order to facilitate the client's performance of the activity without focusing on pain,

you may wish to establish goals for the protocol. When asked to perform a task, many individuals will focus on the completion of the that task. However, if an individual is not given a specific task to perform in the associated positional tolerance, they may focus on their physical state instead, and the subjective pain report may be exaggerated. This corresponds to the anecdotal reports of individuals who feel much better once they have returned to work after being in a self-limiting and restrictive environment. In addition, some individuals may be competitive, and once put to a task, which has a goal, will perform at a level that would exceed the evaluator's opinion of the functional capacity of the test subject in the absence of a time-motion/task test.

I. CONTRAINDICATIONS TO TESTING

The following are contraindications to this testing:

- If the subject's initial heart rate exceeds 70% of the age-predictive maximum heart rate (220 minus the test subject's age).
- If the test subject has a reported history of prior lower extremity or heart/cardiovascular problems, it may be necessary to obtain a release for this type of testing.

J. ENDING THE TEST

The test may be terminated manually or automatically as a result of any of the following:

- The test subject concludes the repetition and reports an inability to proceed due to discomfort that makes the continuation of the test impractical.
- The test subject's heart rate exceeds 85% of the age-predictive maximum heart rate.
- The evaluator concludes the test because the test subject appears unable to continue the test due to physical limitations.
- The test is successfully completed.

III. UTILIZING THE FROM PEGBOARDS

The FROM pegboard consists of 6 panels, which are placed in the following order from left to right: 6, 1, 2, 3, 4, and 5. Each of these panels contains 45 holes of 5 different colors and 3 zones: A, B, and C. In addition, your system is supplied with 30 pegs. The 3 zones are used to help identify the 3 main levels of activity: stooping and kneeling, standing, and reaching overhead. Lastly, the differently colored rows aid in finding the comparable row on another panel (Figure 11-2).

Figure 11-2. FROM Pegboard Attributes & Peg

IV. PRE-DEFINED TESTS & TESTING TEMPLATES

The EvalTech software includes several pre-defined tests and testing templates. For information on assigning and administering tests in the software, refer to Chapters 4 and 5 of the EvalTech Software Operator's Manual.

The EvalTech software contains the following positional tests to be used with the FROM pegboard:

- Axial Rotation
- Crouching
- Kneeling Reach
- Kneeling to Standing and Back
- Kneeling with Upper Level Reach
- Multi-Level Axial Rotation
- Standing Horizontal Reach
- Stooping Reach
- Stooping Reach with 36" Displacement
- Upper Level Reach

A. ADMINISTERING A FUNCTIONAL RANGE OF MOTION TEST

Step 1. The client should be instructed in the proper technique prior to starting the test. You may read the instructions aloud or click on the speak icon to have the instructions read aloud by the computer. Be sure to emphasize to the client that he or she is required to work as quickly as possible.

It is recommended that two rows of the test be completed prior to starting the actual test. This helps to ensure the instructions were understood.

Step 2. If the starting row is dependent on anthropometrics, then select the row color. Otherwise, skip to Step 3.

Step 3. Click on  to start the test.

Step 4. Click on the Rep Completed icon every time the client has finished the repetition.

The test will end once you indicate through the repetition counter that the final repetition is complete. You may also manually end the test by clicking End Test or Unable to Continue. Note that if the client is unable to continue, then the total time of the test will be displayed but no MTM rating will be shown since the task was not completed.

Once the test is successfully completed, a Rating icon will appear in the lower right corner. Click on the icon to view the MTM ratings scale, MTM score, and total time of the test (Figure 11-3).

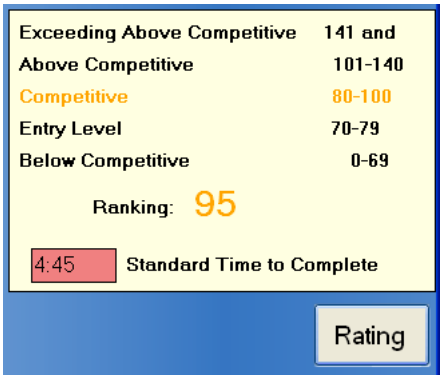

Figure 11-3. MTM Ranking & Time Completed

B. AXIAL ROTATION REACH (FIGURE 11-4)

Figure 11-4. FROM Axial Rotation Reach

1. PURPOSE

To determine a client's ability to axial rotation activities in a standing position and performing functional reaching on a frequent or occasional basis.

2. PROCESS

- The client is instructed to move five rows of pegs from Panel 6 - Zone B to Panel 4 - Zone B.
- The client should stand in the center of the board assembly, approximately 30 inches from the back panels while performing the test in order to achieve some back rotation.
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the highest level row and then proceeds in order to the lowest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order (i.e. far right bottom peg is moved first) until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

C. CROUCHING REACH (FIGURE 11-5)

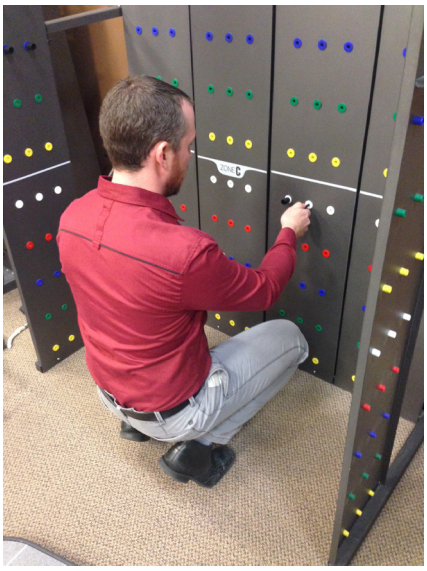

Figure11-5. FROM Crouching Reach

1. PURPOSE

To determine a client's ability to perform crouching/squatting activities with functional reaching on a frequent or occasional basis.

2. PREREQUISITES

The client must be advised that he/she must remain in the crouching/squatting position and may touch only one knee down to the ground after the completion of a repetition. The knee must return to the crouch/squat position prior to the transfer of any pegs for the next repetition.

3. PROCESS

- The client is instructed to move the five rows of pegs from Panel 2 - Zone C to the corresponding row of holes in Panel 3 - Zone C.
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the highest level row and then proceeds in order to the lowest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order (i.e. far right bottom peg is moved first) until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

D. KNEELING REACH (FIGURE 11-6)

Figure 11-6. FROM Kneeling Reach

1. PURPOSE

To determine a client's ability to perform kneeling activities with functional reaching on a frequent or occasional basis.

2. PREREQUISITES

The client is allowed the opportunity to wear knee pads if desired. The client must be advised that he/she must remain in the kneeling position during the repetition. The client is allowed out of the kneeling position during the rest period.

3. PROCESS

- The client is instructed to move the five rows of pegs from Panel 2 - Zone C to the corresponding row of holes in Panel 3 - Zone C.
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the highest level row and then proceeds in order to the lowest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order (i.e. far right bottom peg is moved first) until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

E. KNEELING TO STANDING AND BACK REACH (FIGURE 11-7)

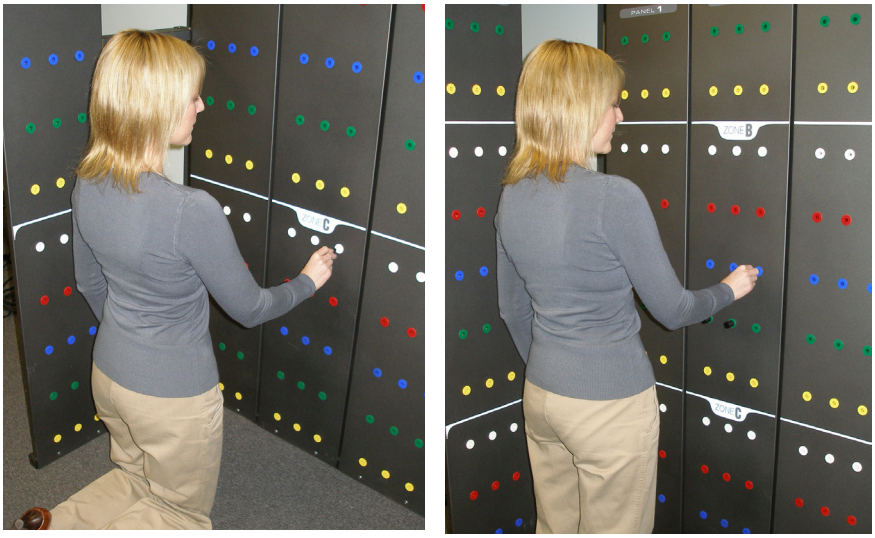

Figure 11-7. FROM Kneeling to Standing and Back Reach

1. PURPOSE

To determine a client's ability to perform activities requiring going into and out of the kneeling position and performing functional reaching on a frequent or occasional basis.

2. PREREQUISITES

The client is allowed the opportunity to wear knee pads if desired.

3. PROCESS

- The client is instructed to move a row of pegs from Panel 2 - Zone C at the lowest row to the next highest row directly above the row from which the activity started.
- Only 3 pegs are used in this test. The pegs will be moved to the corresponding hole directly above.
- Two of the pegs must be moved with dominant hand and the third peg must be moved with the non-dominant hand.
- The client must be in the standing position before he/she commences placement of the pegs into the lowest row of Zone B.
- Once the pegs have reached the top row in Zone B, a test repetition has been completed.
- The client then proceeds to move the pegs downward, one row at a time employing the same process.
- The client must return to the kneeling position before he/she commences placement of the pegs into the highest row of Zone C. Upon reaching the lowest row of holes in Zone C, another repetition has been completed.

F. KNEELING WITH UPPER LEVEL REACH (FIGURE 11-8)

Figure 11-8. FROM Kneeling w/Upper Level Reach

1. PURPOSE

To determine a client's ability to perform kneeling activities with functional reaching on a frequent or occasional basis.

2. PREREQUISITES

The client is allowed the opportunity to wear knee pads if desired. The client must be advised that he/she must remain in the kneeling position during the repetitions. The client is allowed out of the kneeling position during the rest period.

The setting of the five rows of pegs is determined by locating the lowest row of holes equivalent to the chest height of the client while in the kneeling position. The prerequisite kneeling position must be one in which the client is in an erect position from the knees upward.

3. PROCESS

- The client is instructed to move the five rows of pegs from Panel 2 - Zone B (height adjusted) to the corresponding row of holes in Panel 3 - Zone B (height adjusted).
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the lowest row and then proceeds in order to the highest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order (i.e. the far right top peg is moved first) until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

G. MULTI-LEVEL AXIAL ROTATION REACH (FIGURE 11-9)

Figure 11-9. FROM Multi-Level Axial Rotation Reach

1. PURPOSE

To determine a client's ability to perform multi-level reaching activities on a frequent or occasional basis.

2. PREREQUISITES

The client is asked to stand next to one of the side panels of the FROM pegboard and raise his/her right arm with fingers extended to the highest level while remaining with both feet flat on the floor. The highest row reached with the distal tip of the middle finger exceeding the top of the peg hole will be the highest row used during the evaluation. If the fingertip does not exceed the top of the peg hole, the next highest row is used.

3. PROCESS

- To complete one repetition, the client is instructed to move five rows of pegs in the following order:
  Panel 6 - Zone A (height adjusted) → Panel 5 - Zone B
  Panel 5 - Zone B → Panel 6 - Zone B
  Panel 6 - Zone B → Panel 5 - Zone A (height adjusted)
  Panel 5 - Zone A → Panel 6 - Zone A
- The transfer process requires the client, when going from left to right, to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand. When going from Panel 5 to Panel 6, the transfer process is reversed.
- The client commences with the lowest level row and then proceeds in order to the highest-level row.

H. STANDING HORIZONTAL REACH (FIGURE 11-10)

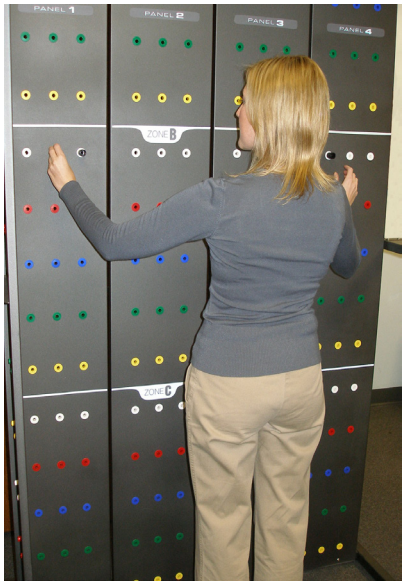

Figure 11-10. FROM Standing Horizontal Reach

1. PURPOSE

To determine a client's ability to perform activities requiring horizontal reaching in a standing position on a frequent or occasional basis.

2. PROCESS

- The client is instructed to move five rows of pegs from Panel 1 - Zone B to Panel 4 Zone B.
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the highest level row and then proceeds in order to the lowest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order (i.e. the far right bottom peg is moved first) until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

I. STOOPING REACH (FIGURE 11-11)

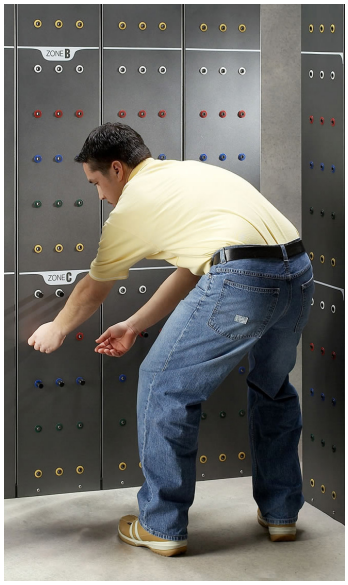

Figure 11-11. FROM Stooping Reach

1. PURPOSE

To determine a client's ability to perform stooping activities with functional reaching on a frequent or occasional basis.

2. PREREQUISITES

The starting height for this protocol is determined by having the client stand next to Panel 6 with both arms resting at the side. The row that is covered by the fingertips of the client's right hand will be the top starting row for the activity.

The client must be advised that he/she may only return to an erect posture during the rest period. It should also be anticipated that the client will flex the knees for the movement of the bottom one or two rows.

3. PROCESS

- The client is instructed to move the five rows of pegs from Panel 2 (height adjusted) to the corresponding row of holes in Panel 3 (height adjusted).
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the highest level row and then proceeds in order to the lowest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order (i.e. the far right bottom peg is moved first) until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

J. STOOPING WITH 36" DISPLACEMENT REACH (FIGURE 11-12)

Figure 11-12. FROM Stopping w/36" Displacment Reach

1. PURPOSE

To determine a client's ability to perform stooping activities with horizontal displacement functional reaching on a frequent or occasional basis.

2. PREREQUISITES

The test requires the placement of a 28" high work surface table in front of the FROM pegboard.

The client is allowed to lean against the table while placing the pins in the proper holes. The client must be advised that he/she may only return to an erect posture during the rest period.

3. PROCESS

- The client is instructed to move the five rows of pegs from Panel 2 - Zone B to the corresponding row of holes in Panel 3 - Zone B.
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the highest level row and then proceeds in order to the lowest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

K. UPPER LEVEL REACH (FIGURE 11-13)

Figure 11-13. FROM Upper Level Reach

1. PURPOSE

To determine a client's ability to perform shoulder level and above reaching activities on a frequent or occasional basis.

2. PREREQUISITES

The client is asked to stand next to one of the side panels of the FROM pegboard and raise his/her right arm with fingers extended to the highest level while remaining with both feet flat on the floor. The highest row reached with the distal tip of the middle finger exceeding the top of the peg hole will be the highest row used during the evaluation. If the fingertip does not exceed the top of the peg hole, the next highest row is used.

3. PROCESS

- The client is instructed to move five rows of pegs from Panel 2 - Zone A (height adjusted) to the corresponding row of holes in Panel 3 - Zone A (height adjusted).
- The transfer process requires the client to take the peg out of the hole with the left hand, transfer it to the right hand while the peg is out of the hole, and then place the peg into the corresponding hole with the right hand.
- The client commences with the lowest level row and then proceeds in order to the highest level row.
- Once the fifteen pegs have been moved, the process is completed in reverse order until all fifteen pegs are restored to their original position. This constitutes the completion of one repetition.

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TROUBLESHOOTING GUIDE

I. GENERAL PREVENTION OF INTERFERENCE BETWEEN WIRELESS COMPONENTS

Interference, which can result in an inability to acquire accurate data, may occur in the following scenarios:

- The antennas of any wireless components are within 3 feet of each other (e.g. the antenna on the Hub is within 3 feet of the antenna on the Portable Dock & Transmitter).
- There is not a direct line of sight between the antennas of the wireless components. In addition, any large piece of metal that is between the antennas will cause interference.

You may prevent interference by maintaining your system in the following manner:

- Do not allow the Portable Dock & Transmitter to fall on the floor.
- Regularly check the USB cable that is attached to the Hub.
- Verify the antennas are in good working order and properly secured.

You may also prevent interference by using the following guidelines:

- Place the Hub in a location that ensures the antenna of the Hub will always be at least 3 feet from the antenna on the Portable Dock & Transmitter and Column.
- Verify there is a direct line of sight between the Hub antenna and the Portable Dock & Transmitter antenna.
- Verify there is a direct line of sight between the Hub antenna and the Column antenna.

II. COMMON PROBLEMS AND SOLUTIONS

A. UNABLE TO CAPTURE HEART RATE

Refer to Chapter 02 (Heart Rate System) for extensive troubleshooting information

B. UNABLE TO OBTAIN READINGS FROM A TOOL CONNECTED TO THE PORTABLE DOCK

1. VERIFY THE FOLLOWING

- The batteries in the Portable Dock & Transmitter are charged and less than a year old.
- The antennas are properly secured to the Portable Dock & Transmitter and Hub.
- The Hub is plugged in to the computer and the Dock is powered On.
- There is no interference between the Hub and Dock (see previous section).
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable.
- The Dock has not been dropped or hit hard - if so, then turn the power off for ~5 seconds and then back on.

2. ATTEMPT THE FOLLOWING

- While the tool is plugged into the Portable Dock, turn the Portable Dock off and then back on.
- Turn off the Portable Dock, attach a new cable to the tool and Portable Dock, and then turn the Dock back on.
- Turn off the Portable Dock, plug the cable into another port on the Dock, and then turn it back on.
- Turn off the Portable Dock, insert freshly charged batteries, and then turn it back on.
- Try a different combination of batteries - if one of the batteries has gone bad, then the Portable Dock will not work properly.
- Exit the software, unplug and replug the Hub USB cable, and then restart the software.
- Shut down the software and computer using proper Windows shut-down procedures, unplug the Hub USB cable, plug the cable into another available USB port (the ports on the front may be used), turn on the computer, and restart the software.

C. UNABLE TO OBTAIN READINGS FROM A TOOL CONNECTED TO THE COLUMN

1. VERIFY THE FOLLOWING

- The antennas are properly secured to the Column and Hub
- The Hub is plugged in to the computer and the Column is powered
- There is no interference between the Hub and Column (see previous section)
- The Hub has not been dropped or hit hard - if so, then unplug and replug the USB cable
- The Column is receiving power (refer to Chapter 01-I-A-2 for pictures)
  - Unplug and replug the column power cable, which is behind the long white stabilizer bar, from the short converter cable
  - Unplug and replug the short converter cable, which is behind the long white stabilizer bar, from the power adapter cable
  - Unplug and replug the long power cable from the power adapter
  - Unplug and replug the long power cable from the wall or power strip
  - Verify the wall outlet or power strip is providing power

2. ATTEMPT THE FOLLOWING

- Detach and attach both ends of the cable at the tool and the column arm; make sure the cable is properly secured after reattaching.
- Attach a new cable to the tool and column arm.
- Plug the cable into the other column arm.
- Exit the software, unplug and replug the Hub USB cable, and then restart the software.

- Shut down the software and computer using proper Windows shut-down procedures, unplug the Hub USB cable, plug the cable into another available USB port (the ports on the front may be used), turn on the computer, and restart the software.

III. TECHNICAL SUPPORT

If you are able to verify all of the possible solutions related to the scenario, but the problem still exists, then please use the following avenues for further assistance:

- 800.331.8845 (U.S. & Canada)
- 410.850.0333 (Domestic & International)
- service@btetech.com
- Support Section of www.btetech.com

Appendix A

EMC Guide

Safety with Regard to Electromagnetic Disturbances

- Electromagnetic environment of intended use: Professional healthcare facility environment
- WARNING: Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.
- WARNING: Use of accessories, transducers and cables other than those specified or provided by BTE could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.
- WARNING: Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the EvalTech/Evaluator, including cables specified by BTE. Otherwise, degradation of the performance of this equipment could result.
- NOTE: The emissions characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If used in a residential environment (for which CISPR 11 class B is normally required), this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.

- Emissions and immunity tests compliance information:
    - Emissions class: Class A
    - The equipment is compliant with the following standards:
        - **IEC 60601-1-2:2014**, Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic disturbances - Requirements and tests
        - **CISPR 11:2010,** Limits and methods of measurement of radio disturbance; Characteristics of industrial, scientific and medical radio frequency equipment
        - **IEC 61000-4-2:2008**, Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test
        - **IEC 61000-4-3:2010**, Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test

- **IEC 61000-4-4:2012**, Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test
- **IEC 61000-4-5:2005**, Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test
- **IEC 61000-4-6:2013**, Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Conducted immunity test
- **IEC 61000-4-8:2009**, Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 8: Power frequency magnetic field immunity test
- **IEC 61000-4-11:2004**, Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips and interruptions immunity test
- **IEC 61000-3-2:2014**, Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16A per phase)
- **IEC 61000-3-3:2013**, Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16A per phase and not subject to conditional connection

- There are no deviations from the listed collateral standards.
- No precautions are needed for the expected service life to maintain the device basic safety with regard to electromagnetic disturbances.
- RF transmitters and receivers incorporated in the device operate in the following frequencies:
    - Portable Dock and column URFIO 900 MHZ or 868 MHz; The configuration as setup at BTE and cannot be changed by the user. The Effective Radiated Power (ERP) is equal to 12.6mW.
    - Bluetooth Hip Unit (BHU): 2.4 GHz (BHU can be incorporated in the system instead of the Portable Dock.) The Effective Radiated Power (ERP) is equal to 2mW.
    - Polar heart rate monitor; The Effective Radiated Power (ERP) is equal to 2.8mW
    - Bluetooth heart rate monitor: 2.4 GHz; The Effective Radiated Power (ERP) is equal to 1mW