

Boston Digital™ Arm System

User's Manual



This manual provides guidance for the user of the LTI Boston Digital™ Arm System. The system should be set up and adjusted by a qualified prosthetist. The following instructions are a guide to help you maintain this system and achieve maximum functionality and reliability.

=
=

Liberating Technologies, Inc.

325 Hopping Brook Road, suite A
508-893-6363

Holliston, MA 01746-1456
Fax 508-893-9966

www.liberatingtech.com

CONTENTS

1. Fitting
2. Operation
 - 2.1 Strength
 - 2.2 On-off switch
 - 2.3 Free-swing feature
3. Battery & Battery Charging
 - 3.1 Battery
 - 3.2 Battery installation & removal
 - 3.3 Battery charging
4. Maintenance
 - 4.1 Maintenance
 - 4.2 Cleaning
 - 4.3 Lubricants
 - 4.4 Disassembly
 - 4.5 Falls
 - 4.6 Sweat
5. Troubleshooting the system
 - 5.1 Entire system does not operate
 - 5.2 Difficult to control
 - 5.3 Component does not operate

1. Fitting

1.1 Socket and harness fit are two of the most important factors in achieving a successful fit. Powered prostheses depend on input devices such as myoelectrodes, Touch Pads, servo-transducers or switches and the operation of the system will deteriorate if the socket or harness does not fit well. If either of these change significantly causing a poor fit, schedule a visit with your prosthetist to have them checked and if necessary re-adjusted. Weight loss or gain, muscle development or atrophy and even postural changes can affect the fit and therefore the operation of your prosthesis.

2. Operation

Each Boston Digital Arm System is configured differently but there are several common features that can be discussed here;

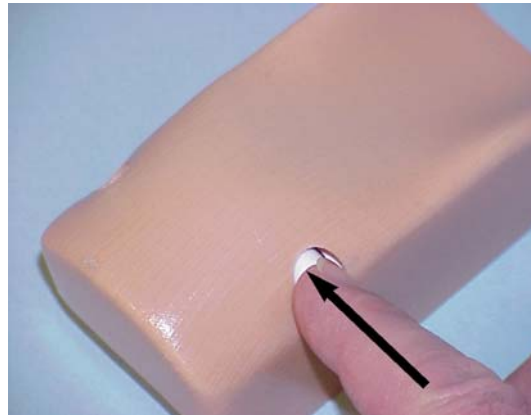
2.1 Strength - how much can it lift?

The Boston Digital Arm drive is designed to actively lift up to 10 pounds (maximum) at a distance of one foot (or 8 kilos at 30 cm) – length of a typical forearm. This load does not include the weight of the hand gripper, wrist disconnect, wrist rotator or other devices at the end of the forearm. These components often weight 1-1½ pounds (500-750g) and with a long forearm their weight may be centered at more than a foot from the elbow joint, thus reducing the lifting ability of the arm. As a result, the arm may only be able to lift an object weighing 7-9 pounds. Light-weight components are available and if lift or prosthesis weight becomes a problem, you should discuss these options with your prosthetist.

More important than the active lift is the passive lift. Wherever the elbow is positioned it automatically locks. Activating the motor disengages this lock. The locked elbow is designed to support 50 pounds at one foot (23 kilos at 30 cm). This is often a greater load than most people find to be comfortable when applied to the socket and harness.

2.1 On-Off Switch

The system on-off switch is located on the left side of the removable battery. To turn the system on, depress the switch – it should stay depressed. To turn the system off, depress the switch further – it will then extend to the original position, flush with the battery cover. Turn the system off whenever you remove the prosthesis.



2.2 Free Swing Feature

The mechanical free swing latching lever is located on the right side of the prosthetic elbow. To release the elbow joint and allow it to “free swing” the lever must be slid away from the elbow joint. This position is best for walking and for other activities where the elbow is not in use, such as entering or exiting a vehicle. The elbow will swing freely between the two limit stops when the pin is disengaged. The range of motion is approximately 44 degrees and the lower limit is positioned by moving the elbow.



For walking, fully extend the elbow and disengage the pin. For driving a car or performing other tasks like mowing the lawn, the lower stop should be raised somewhat so that the upper limit is higher. By experimenting you will find out what works best for you. For normal prosthetic elbow joint motion reengage the elbow free swing lock lever. This allows the elbow to be driven through its full range of motion.

3. Battery & Battery Charging

3.1 Battery

The Boston Digital Arm System is supplied with two custom removable batteries. These are Ni-Cd batteries supplying 1100 mAHr at 12 volts. For most users, one battery is adequate to last an entire day depending on the prosthetic components, condition of the battery and the frequency of use.

3.2 Battery Installation & Removal

Batteries can be removed for replacement as necessary, however we recommend recharging the battery in the prosthesis (see section 4.3). To remove a battery simply insert the recharge connector. This depresses a latch mechanism freeing the battery for removal. Using the recharge plug as a handle, lift the front edge of the battery. The battery will pivot on two hinge pins at the rear of the battery. Grasping the front of the battery continue to lift until the battery clears the hinge pins.



Installing a battery is the reverse process. Place the rear of the battery into the elbow forearm first, positioning it so that the two slots on the battery align with the pins on the inside of the forearm frame. Once in position on these hinge pins, lower the forward edge of the battery until it engages the locking pin and latches in place.

3.3 Battery Charging

Boston Digital™ Arm Systems are supplied with two chargers; a Fast Charger (BE255) and a Slow Charger (BE256). The Fast Charger is recommended for daily use. This charger is more efficient and assures that the battery is fully charged. The Slow Charger is intended as a back-up to the Fast Charger. Users often prefer the Slow Charger when travelling because it is smaller and lighter than the Fast Charger.



Fast Charger (BE255)

An optional Charger-Evaluator (BC21) is also available for users who want to track their battery condition/capacity.

The battery should be recharged in the prosthesis, although it can also be recharged once removed. To recharge the battery in the prosthesis, turn the prosthesis off and remove it. Then insert the recharge plug into the receptacle located on the forward right side of the battery case. Plug the charger into the wall outlet and if using the Fast Charger, observe the lights on the charger. The green light should illuminate. The green light will remain on until the battery is fully charged and then will flash indicating that the charge cycle is complete. This process will take up to 75 minutes depending on the battery's state of charge. If the green light on the charger goes out after several minutes, this indicates that there is a problem with the battery and the spare battery should be installed. The faulty battery should be returned to your prosthetist for evaluation.

The Fast Charger starts off with a slow charge and it will not start the fast charge cycle until the battery voltage reaches 10V. If the charger does not detect 10V in 20 minutes, the green light will go out indicating a bad battery. Either a cell has been reversed and in this case the battery should be returned to your prosthetist or the battery has been sitting idle for a number of weeks and has self-discharged. In the latter case, it may be possible to salvage the battery. Try to charge the battery several more times before returning it to your prosthetist.

Periodically (twice a month), it is recommended that the battery be *discharged* to purge any battery "memory" that has occurred from previous use. The Fast Charger is designed to control the discharge cycle. The Charger will bring each cell down to 1 volt (or 10 volts for the entire battery) and then automatically recharge it. To initiate this *discharge*, follow the same procedure as for charging the battery. As soon as the green light illuminates, press the *Discharge* button on the front of the charger. The yellow light will illuminate indicating that the battery is discharging. Once the discharge is complete the charger will automatically switch back to the charge mode – the yellow light will flash and the green light will illuminate. When the charge cycle is completed, the green light will also flash indicating that the battery can be removed from the charger. This entire process may take several hours depending on the initial state of charge of the battery.

Batteries must not be over-discharged as can occur when leaving the battery *on* when the prosthesis is not in use. This can cause permanent damage to the battery. Make sure that the on-off switch is in the *off* position when you remove the prosthesis!

Ni-Cd batteries also "self-discharge" over time, they lose charge while sitting idle. Although this self-discharge process is slow, a charged battery left unattended for weeks is likely to be discharged when needed. Therefore we recommend either swapping batteries periodically (i.e. weekly) or recharging the spare battery outside the prosthesis occasionally to keep it fresh.

The battery can be "topped off" with the Fast Charger to obtain a partial charge if there is not adequate time for a full charge. Follow the same procedure as recommended for a full charge and when it is time to stop the charge, simply remove the recharge plug from the battery.

Fast Chargers have a 115/220V switch which allows them to be used in foreign countries where 220 volt, 50 Hz mains power is provided. Slide the switch to the appropriate setting for the U.S (115V) or for a foreign country (220V). The Charger uses a standard "computer" power cord so when arriving in a foreign country simply purchase a suitable power cord at any business supply store.

The Slow Charger (BE256) is designed to charge the battery overnight. Just turn the prosthesis off and plug the charger into the recharge receptacle. Leave this charger plugged in for 8-10 hours and remove the plug. The battery should be fully charged. The Slow Charger is not intended as a long-term trickle charger and batteries should not be left connected to this charger for more than about 10-15 hours. Slow Chargers are available for use in Europe and the UK – contact your prosthetist if you plan to travel abroad.



Slow Charger (BE256)

4. Maintenance

4.1 The Boston Digital™ Arm System requires little maintenance. Generally, once successfully fitted, there is no need to make adjustments to the System unless the socket fit changes (i.e. the user gains or loses weight), increases/decreases muscle strength or requires different components or different control set-up. If you are operating the elbow or any other component using myoelectric control and this is your first prosthesis, you will probably find that adjustments are needed as your muscles strengthen and coordination improves. Typically you will need to have the system "tuned-up" after about a week and then again about a month later. Expect to visit your prosthetist about every six months thereafter so that the system can be checked out and all straps and other components can be kept in good repair.

4.2 The exterior of the prosthetic system can be cleaned with a damp cloth if necessary. Water and other cleaning fluids should not be used because they may cause damage to the electrical components. The prosthetic system should never be immersed in water and if this should occur by accident, it should be returned to the prosthetic shop as soon as possible.

4.3 Lubricants should not be applied to the prosthetic system. All parts that require lubrication have permanent lubricants applied at the time of assembly.

4.4 Do not attempt to disassemble the prosthetic system (other than removing the battery for replacement). The system is fabricated and sealed to prevent dirt from entering critical areas. Any attempts to disassemble the prosthetic system will **void the warranty**.

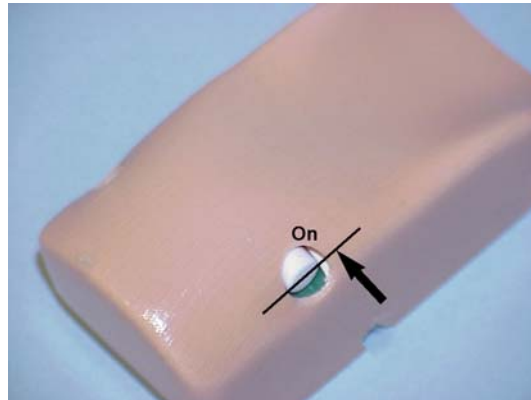
4.5 What happens if I fall? There are times when you want a product to fail. If you fall on your prosthesis or a heavy object falls on it, you want it to fail in a safe way. The free-swing lock pin and the limit stop pins are designed to fail when subjected to a severe overload. If this should occur, consult your prosthetist. It may be necessary to send your prosthesis back to the manufacturer for evaluation and repair.

4.6 Sweat contains salt and is very corrosive. It will damage circuits and even mechanisms made of stainless steel and those protected with special coatings. If anything is permitting sweat to enter the prosthetic system, it should be prevented. If sweat runs down the inside or outside of the socket, you should apply an absorptive cloth band immediately and then consult your prosthetist to determine how this can be prevented before it damages the mechanisms or circuits.

5. Troubleshooting the Boston Digital™ Arm System

5.1 The System does not operate:

- a) Check the on-off switch and make sure the switch is in the *on* position (depressed, see figure at right),
- b) Check the battery to make sure that it is installed correctly,
- c) Check to see that the battery is charged, recharge if necessary (observe the charger lights). Make sure that the Fast Charger switch is on the appropriate setting (115V-US or 220V-foreign),
- d) If the battery is suspected as the problem, install the spare battery,
- e) If the Fast Charger is suspected as the problem, try the Slow Charger



5.2 The System operates but is difficult to control;

- a) Make sure that the socket is properly aligned and the harness positioned properly,
- b) Check all cables and connectors,
- c) Check to see that the free swing lever is engaged (locked),
- d) See whether the socket is loose. If you have lost weight, the electrodes may not be making adequate contact with the skin surface. These electrodes should leave a slight imprint in the skin.

5.3 One component in the system does not operate (i.e. hand or elbow)

- a) Check the wrist disconnect for the hand or gripper
- b) If you use a switch as part of the control system, check to see that the wires are not damaged.

Liberating Technologies, Inc.

325 Hopping Brook Road, suite A
508-893-6363

Holliston, MA 01746-1456
Fax 508-893-9966

www.liberatingtech.com