

# **TRIAX 2010 SURFACE IMPACT TESTER**

## **USER'S MANUAL**

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## **1.0 INTRODUCTION**

The Triax2010 Tripod system is primarily intended to be used to provide data to measure the impact attenuation of surfaces under and around playground equipment, while the Triax2010 “A” missile is intended to test sports fields. When properly configured and used by a properly trained operator, the Triax2010 can be used to perform surface impact attenuation tests in accordance with applicable US and International standards, such as ASTM Standard Specification Designation F1292-09 Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment & ASTM F1936 10, Standard Specification for Impact Attenuation of Turf Systems as Measured in the Field.

\*Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA, 19428-2959, United States 610.832.9585

## **2.0 SYSTEM COMPONENTS FOR TRIPOD SYSTEM**

The Triax2010 system consists of the Triax2010 hand held controller, a hemispherical head form and a support tripod. Also included with the Triax 2010 system are cables to connect the controller, head form and tripod, an 8” x 8” rubber reference mat and fitted carrying cases.

The hand held controller is battery powered, and records the results of drop tests. The LCD display will show the Peak G, HIC, angle of impact and time and date, while the impact velocity and HIC Interval (Delta T) are shown optionally. The controller connects to the tripod with a 16 foot long, highly flexible cable with locking connectors. A second 16 foot highly flexible cable connects the tripod to the head form. An SD Memory Card is used to store the results of up to 1000 drop tests, and allows the user to copy the drop test results to the included PC application program for report generation and archival purposes.

Internal to the head form is a tri-axial sensor (accelerometer) which produces electrical signals proportional to the G value of the head form’s impact with the surface being tested. The hand held controller measures these voltages to calculate and display the Peak G and HIC results of drop tests. Affixed to the head form is a normally on electromagnet. This magnet allows the head form to be suspended from the lifting cable of the tripod, allowing the user to set exact drop heights above the surface to be tested. The normally on nature of the electromagnet requires no battery power to be used while the user prepares for the test, preventing the head form from falling unexpectedly should the batteries grow weak.

The Tripod is used to support the head form and provide a repeatable drop height and drop location. A steel cable is used to support a steel block to which the head form’s electromagnet is attached. The height of the head form above the surface can be adjusted

by lowering or raising the steel block by adjusting the position of the steel lifting cable. The Tripod also provides a convenient way to support the cables from the hand held controller to the head form, preventing the trajectory of the head form from being unduly influenced.

### **3.0 HAND HELD UNIT**

The hand held unit is shown in PHOTO 1. The main parts of the hand held are the eight key membrane keypad, the liquid crystal display (LCD), the battery cover and the cable connector.



**Photo 1 - Triax2010 Hand Held**

#### **3.1 Key Switch Functions**

1. ON - Used to turn unit on. Press and hold this key until the display becomes readable.
2. OFF - Press momentarily to turn unit off. The Triax2010 will automatically turn off after three minutes if no keys are pressed.
3. ENTER - Press this key to view the G versus time graph of the currently selected drop.

4. START - Press this key to start a drop test.
5. YES - This key has a different function depending on the current menu display of the Triax2010. From the drop test data display, pressing and holding this key will show the LCD contrast display menu. Other available functions will be noted in text messages at the bottom of the display when in the respective menus are displayed.
6. NO - Functions similar to YES key, except gives alternate choice to an operational question. Pressing and holding this key for approximately three seconds allows the user to enter the clock, folder and configuration menus.
7. LAST – Allows the user to step through the drop test results, in descending order. Using the SD Memory Card the Triax can record up to 100 drop test in each of 10 folders for a total of 1000 drop tests. Drops are labeled 1 through 100 and only the drop tests stored in the currently selected folder are available for display (see Appendix C for information on changing folders). Each time the drop number is changed any test data available for the drop will be displayed. If no test data is available (no drop has been recorded at the respective drop number) the PEAK, HIC and ANGLE data will be shown as dashes.

Holding the LAST key will cause the Triax2010 to step through the drop test results at a rate of about 1 drop per second. If while the LAST key is held the ENTER key is pressed the drop number will change by ten. This allows the user to quickly scan through the available 100 drops.

8. NEXT - Similar to the LAST key, except that the drop tests will be stepped through in ascending order.

### **3.2 Cable Connector**

The Triax2010 connects to the tripod by a 16 foot long highly flexible cable. The cable material and connectors are of a specific nature and should only be replaced by original types available from the manufacturer. Both ends of the cable are identical, and either end can be plugged into the hand held unit or the Tripod. Note that the Tripod has two identical cable receptacles and the cable from the hand held controller may be inserted into either receptacle. A second, identical cable is supplied with the Triax 2010 system and is used to connect the other Tripod cable receptacle to the receptacle on the head form.

To ensure proper operation, the plug will only mate the receptacle when it is properly oriented. To achieve proper orientation, rotate the plug as it is gently pressed up to the receptacle. When the correct orientation is achieved the plug will snap into the receptacle with a minimum of force. Proper orientation can also be determined by aligning the red dot on the plug with the slot on the inside of the receptacle before pressing the two

together. To disconnect the cable, pull on the knurled section of the plug. Do not try to rotate the plug (as to tighten or loosen) once it is snapped into the receptacle.

### 3.3 Battery Cover

The Triax2010 makes use of five (5) disposable AA batteries. To change the batteries grasp the battery cover at the serrated area, squeeze slightly and pull off. The gray battery holder tab will now be visible. Push down on this tab slightly and pull the battery holder out of the Triax2010. Remove the single screw with a #1 Phillips screwdriver and separate the top and bottom sections of the battery holder. Replace with FIVE FRESH AA batteries, being certain to observe polarity as marked by “+” signs molded into the battery holder base.

Slide the battery holder back into the Triax2010 and press firmly with both thumbs until an audible click is heard as the tab snaps into the body of the hand held unit. Replace the battery cover before use.

Also located under the battery cover is the SD Memory Card used for storing drop test results. To remove the memory card press gently inward until a click is heard and then release. The memory card will spring outward and can then be removed.



**Photo 2 – Battery Cover removed showing battery box and SD Memory Card**

#### **4.0 HEAD FORM**

Photo 3 shows the head form. The head form is machined of solid aluminum and designed and tested to be in conformance with applicable standards. The normally on electromagnet is mounted to the top of the head form connects to the steel lifting block of the tripod. The face of the magnet which contacts the steel lifting block should be kept free of rust, nicks and scratches. Also be sure to remove any debris which might become stuck to the electromagnet during storage or use. For the magnet to have full holding force and not inappropriately release (allowing the head form to fall) the face of the magnet and the steel block must form a perfect connection with no gaps. If the face of the magnet should become rusted use only Scotch-bright type scouring pads to clean. Using sand paper or other course materials may cause deep scratches which will affect the holding power of the magnet. The head form is connected to the either receptacle of the Tripod unit by one of the 16 foot long flexible cables.

**Photo 3 – Head Form**



## 5.0 TRIPOD

The Triax2010 Tripod is shown in Photo 4. Nine sections of legs are provided with the Tripod to allow a maximum drop height of up to approximately 12 feet (drop height is measured from the bottom of the head form to the top of the surface to be tested.)



**Photo 4 - Tripod with Head Form and Reference Pad**

**CAUTION! Erecting the tripod can be a hazard due to tipping.**

To erect the tripod, two persons are recommended. Use of proper head protection is also suggested, as the operating height of the tripod will, in most cases, be above the head of the operators exposing them to the hazard of being struck by either the head form or the tripod.

Under the head of the tripod are two cable receptacles. The function of these receptacles are identical, and either one can be connected to the head form or the hand held controller.

## 5.1 Tripod Legs

The leg sections are connected by interlocking connectors as shown in photo 5. Before connecting the tripod leg sections ensure that the mating surfaces are free from sand or other debris. The connectors are precision fitted and any foreign object on the connectors could prevent them from properly connecting. To start the coupling, align a female and male leg end piece. Press the spring loaded metal pin down to allow the pin to slide into the slot. Once the pin is fully in the slot rotate one of the leg sections fully until the spring loaded metal pin pops up, locking the legs together.



Photo 5 – Tripod Leg Connector

**WARNING:** Make sure that the locking pin fully extends after the leg sections are coupled as shown in photo 6A. Failure to do so could allow the leg section to unexpectedly disengage, causing the tripod to fall and possible strike and injure anyone nearby.



Photo 6A – Properly connected leg section with pin fully extended



Photo 6B – INCORRECT connection – pin not fully extended

Three of the nine leg sections feature a rounded end. These must always be installed as the lowest leg sections when the Tripod is erected.

Whenever connecting leg sections the Tripod must first be laid on a horizontal surface. After the desired number of leg sections is connected carefully stand the Tripod up while simultaneously spreading the legs out for stability.

**WARNING: Always use the same number of legs sections on each of the three legs.**

## 5.2 Lifting Cable and Locking Device

For fine adjustment of drop height, a flexible steel cable is used to raise and lower the steel lifting block. To prevent the cable position from changing one of the screw-in leg

sections is fitted with a locking device. This locking device should be installed on the leg which is nearest where the steel cable comes out of the top of the Tripod.

The steel cable is fed from the head of the tripod, along one of the legs and into a hole in the top of the locking device. The cable then passes through the locking device and out the bottom. To adjust the height of the head form, pull down on the part of the steel cable below the locking device. Next, slowly lift the red handle on the locking device to free the cable. When at the proper height, press down firmly on the red handle to lock the cable.

For additional drop height control, the position of the locking device on the leg section can be adjusted by loosening the wing head screw on the back of the assembly and sliding the assembly as required. Tighten the screw when complete.

**WARNING: When the red locking handle is raised or the screws holding the locking device are loosened the weight of the steel lifting block will cause the lifting cable to slide through the locking devices, or the locking device to slide upward on the leg. The user must firmly hold onto the cable, preferably with a gloved hand, before lifting the red handle or loosening the locking device screws. If the steel lifting block is allowed to fall uncontrolled the sliding of the steel cable through the user's unprotected hands could cause serious injury to the user.**

**When adjusting cable position the head form should be removed from the magnet to prevent accidental release.**

**Never allow anyone to stand under the tripod as the falling of the steel lifting block or the head form could cause serious personal injury.**

**THE HEAD FORM CAN ALSO BE RELEASED FROM THE MAGNET DUE TO SHARP JOLTS DURING ADJUSTMENT.**

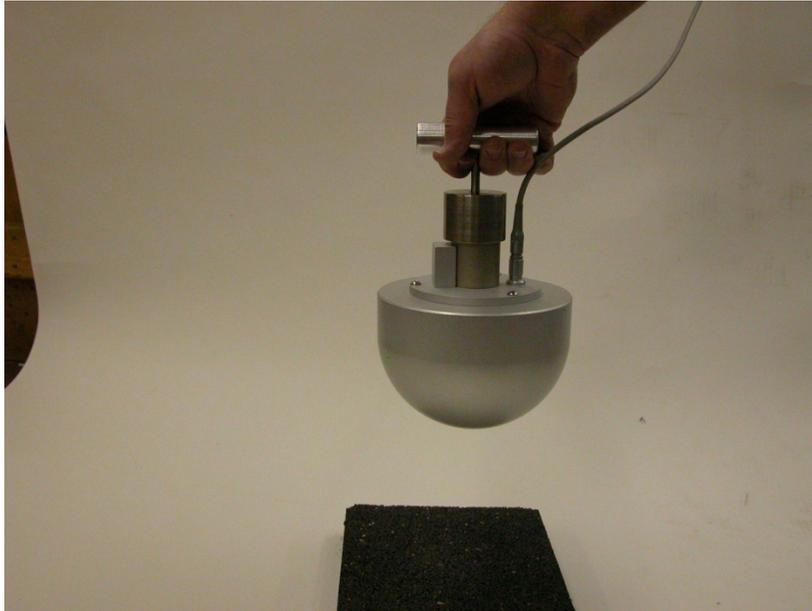
### **5.3 Steel Lifting Block and Leg Clamp**

At the end of the steel cable is the steel lifting block. This block gives the head form electromagnet a surface to grip to before being released. As with the electromagnet the mating surface of the lifting block must be kept free of rust and scratches.

The steel lifting block is attached to the star shaped leg clamp. This clamp allows the Tripod legs to be retained during shipment and storage.

### **5.4 Hand Held Drop Handle**

Preliminary testing without setup of the tripod can be conducted using the optional hand held drop handle. The use of the drop handle is shown in photo 7. When using the handle leave the release mechanism set to magnet (see Appendix B.3)



**Photo 7 – Hand Held Drop Handle**

## **6.0 TRIAX2010 TRIPOD SYSTEM USE**

### **6.1 Performing Drop Tests**

Refer to applicable standards to determine which locations and from which heights a drop test is to be performed. Following the information in section 3.2, connect the cables and erect the tripod so that the head form will be suspended above the desired test location.

To perform a drop test:

6.1.1. Turn the hand held unit on by pressing and holding the ON key until the display comes on.

6.1. 2. Select or confirm in which folder and drop number the drop test results will be recorded.

6.1.3 Mate the electromagnet of the head form to the steel lifting block.

6.1.4 Confirm the height of the bottom of the head form from the surface using the fixed measuring device.

6.1.5 Press the START key. A message will appear on the display indicating that the Triax 2010 is being prepared for the drop test. The first time the Triax 2010 is turned on after being turned off (or automatically turning itself off) approximately 12 seconds will be required for the Triax 2010 to become ready and display “READY FOR TEST”. Approximately 5 seconds will be required to reach the ready condition on subsequent test.

To release the head form, press the YES key. After a short delay of about 2 seconds the head form will be released from the holder and fall to the surface. After the impact the message “PLEASE WAIT CALCULATING” will appear on the display for up to approximately 5 seconds as the Triax2010 computes the Peak G and HIC for the impact. When the calculations are complete, the display will show the new Peak G and HIC values. Additionally, the display will show the calculated height from which the head form was released from the tripod and the angle of impact. An angle of zero (0) would indicate that the head form impact was perpendicular to the surface being tested.

The user may optionally configure the Triax 2010 to display the HIC interval which the Triax 2010 display calls “Delta” Delta refers to the difference in time (or delta) between the t1 and t2 integration limits of the HIC interval.

Note: At any time while the Triax2010 is preparing for a drop test, the test can be canceled by pressing the NO key. The test will be canceled without changing any test results previously saved in the Triax2010 memory.

**WARNING: Depending on the surface being tested the headform may rebound significantly and strike either an adjacent structure or the user. Care must be taken by the user to ensure that they are not in the rebound zone or serious injury may occur.**

***CAUTION: CARE MUST BE TAKEN TO ENSURE THAT THE CABLE BETWEEN THE HEADFORM AND THE TRIPOD TOP IS NOT CRUSHED BETWEEN THE HEADFORM AND ANY ADJACENT STRUCTURES.***

Before the Triax 2010 indicates it is ready to perform a drop test the internal circuitry will perform a test of the connecting cables to ensure they are properly connected and free from breaks. If any problems with the cables are detected the display message will show “UNABLE TO MAKE DROP TEST THE HEAD FORM CABLE IS UNPLUGGED OR DAMAGED” If this occurs verify that the cables are firmly connected. Also, carefully inspect the entire length of both cables to determine if any damage has occurred. Cables can be damaged if they are pinched between a rebounding head form and a hard surface. Replacement cables are available from the technical support center. Do not discard damaged cables as they can be repaired at a substantial savings over the cost of new cables.

In the case where one of the connecting cables is damaged a temporary connection can be made directly from the hand held unit to the head form. In this mode it is highly likely that the cable will be pulled causing a change in the fall trajectory of the head form. This test mode is not recommended for normal operation.

## **6.2 Daily System Verification**

Before performing drop tests on the subject surface, the Triax2010 should be tested to ensure that the system is functioning properly. This test is performed by dropping the head form on a reference pad, which was supplied with the system. Appendix A details the procedure for this test. The test should be performed on a daily basis before starting surface tests. Not performing the prior to use test could render field data invalid if the subsequent verification test shows a non-compliance issue.

## **6.3 Analysis of test result**

Before continuing with the next drop test, the operator should briefly review the current test to detect any obvious problems with the data.

## **6.4 Verify impact velocity**

Compare the impact velocity as calculated to the theoretical velocity for the respective drop height. (See F1292-04, section 9.1.2.) If impact velocity is not within limits, repeat the drop test.

## **7.0 REPORT GENERATION**

The Triax2010 system is supplied Windows XP/WIN7 compatible application. This application can be used to upload drop test results and impact wave forms to a personal computer. The application allows the operator to generate reports of the drop test in both table and graph formats, and to enter comments describing the drop tests. The drop tests can also be saved to the computer's file system, allowing archival storage of test results.

### **7.1 Installation**

The application is provided in the USERDOCS folder located on the SD Memory Card supplied with the Triax 2010. It is suggested that this folder be copied to the user's PC, and an archival copy also be created. The USERDOCS folder should then be deleted from the SD Memory Card freeing folders for use by the Triax 2010.

Install the Triax2010 host application on a PC compatible by running the SETUP.EXE program supplied in the \USERDOCS\HOST folder. The setup program will ask questions to properly install the software. If the setup program indicates that a file on the PC is newer than a file about to be installed by setup, click the setup option to keep the existing file on the PC.

The application program is provided as part of the Triax 2010 system and may be installed on as many computers as the operator desires.

Note: When installing the software on some computer several warning and error messages may appear. The first error message will warn the user that a file about to be copied is older than the file existing on the PC. Select the option to keep the existing file. Next, an error message may appear indicating an error has occurred and will prompt for Cancel, Retry or Ignore. Select the Ignore option and when prompted if you are sure you want to ignore this error select YES. For each of the next errors select the Ignore option. Despite these error messages the software will install correctly.

### **7.2 Uploading Test Results**

All drop test results are stored on the Triax 2010 SD Memory card, in one of ten available folders. To start remove the SC Memory Card from the Triax 2010 and insert it into an SD Memory Card reader connected to the PC. Note that as some PC's feature internal card readers one is not included with the Triax 2010 system. To use a PC not equipped with a card reader many low cost (less than US\$20) models are available from local computer stores.

Start the Triax2010 application and select the Memory Card menu option, and then click Select Drops for Upload. A box will appear allowing the selection of which drops to upload. If it is unknown which drop numbers have been data select all 100 drops. The

application will attempt to load all 100 drops but will ignore drops for which there is no data.

Note: Select all drops by clicking the box next to the “1”, and then holding down the shift key while clicking the box next to the “100”.

Before clicking Upload, ensure that the location of the memory card and folder shown in the Memory Card Path box is correct. If not correct, click the Browse button and select the correct folder.

Each drop test is stored on the memory card in a proprietary file format. The file name for a drop test is DRPxxx.DRP where xxx will be replaced with the number of the drop (001 to 100.) After drop tests have been uploaded and saved on the PC, Windows Explorer may be used to delete the .DRP file so as to prevent confusion for the user during subsequent testing. The .DRP files do not need to be erased as the Triax 2010 hand held controller will overwrite old drop test files with new drop test files.

### **7.3 Adding individual comments to each drop**

The host application allows comments to be added for each drop. Typical uses for comments would be to indicate the location on the surface the drop test was made or any observation particular to the specific drop. To add or edit a comment, click once on the desired drop and then hit the ENTER key. A text box will appear allowing the adding of a new comment or editing of an existing comment for the selected drop. Press ENTER when complete.

### **7.4 Adding a batch comment**

To add or edit a single comment to summarize all the drops within a batch, double click on the text box immediately below the menu bar. A text box will appear allowing the adding of a new batch comment or editing of an existing batch comment. Press ENTER when complete.

### **7.5 Viewing Impact Waveforms (Graphs)**

To view the impact waveform, double click on the desired drop test.

### **7.6 Archiving Data**

To archive test data, select Save to Data File under the File menu option. A text box will appear prompting for a file name to which all drop tests currently displayed will be saved as a single file. The files are saved in a proprietary format, with a file extension of .TRW

### **7.7 Retrieving Archived Data**

To retrieve test data, select Load Data File under the File menu option. A text box will appear prompting for a file name from which all drop tests will be retrieved.

## 7.8 Options Menu

Several options are available under the Option menu item. This menu item is used to select which Windows system printer is used to print reports, the units of drop height or impact velocity to display, and whether the HIC Interval will be displayed on reports.

NOTE: The HIC Interval is an obscure technical detail regarding how the HIC was calculated for a given drop. Some new standards are using the HIC Interval as an added pass / fail criteria but it has not yet found wide use. Most users will want to leave the HIC Interval setting left to HIDE to prevent confusion.

## APPENDIX A

### TRIAx 2010 VERIFICATION PROCEDURE AND CALIBRATION

#### Why use a reference pad?

The measurements made by the Triax2010 are not easy to duplicate using other test equipment. As such there must be a means for a user to ensure that the instrument is working properly between factory calibrations. When a Triax 2010 is manufactured and tested at the factory and is in a known good condition, a series of drop tests are performed on a sample rubber mat. The mat is then supplied with the respective Triax 2010 system and whenever it is retested by the user the results should be in line with those originally obtained at the factory.

#### Establishing Reference Pad Values

Subsurface conditions (i.e. the hardness and thickness of concrete) will affect the reference pad values and yield different values than the factory values. To fully utilize the reference pad, reference pad values for a particular subsurface must be obtained.

To do this, select a location with a concrete surface that can be used to perform the reference drop (i.e. work shop floor, side walk, etc.) Place the reference mat on this surface and perform a drop test, using the average of 2 of 3 drops as outlined elsewhere in this document. This value will be the reference value for all future reference drops, and should be entered in the Calibration Data Record on the line labeled "Initial User Reference Mat Average." This value should agree within the Initial Factory Calibration Average within +/- 15% on Gmax. For all future reference drops, use the same location where the reference drop was performed, and compare the new results to the Initial User Reference Mat Average.

Note: The Initial Factory Reference Average is the average of drops 8 and 9 on the Calibration Certificate supplied with the Triax 2010 system.

An 8" (203sq mm) square rubber reference mat has been supplied with this unit to be used for field reference verification purposes. The procedure below serves only as a verification of the factory function of the device.

There are no user accessible means of performing calibration adjustments.

NOTE: The field reference mat must be stored at normal room temperature and humidity conditions in order to provide reliable results.

The field verification procedure is as follows:

Place the reference mat on a level, clean and smooth concrete surface.

Using a tape measure, measure 36" (915mm) from the top of the mat to the bottom most point of the head form.

When the head form is steadily suspended at 36" (915mm) directly over the center of the mat, the drop test may now be performed. Any variations or errors in this procedure will result in invalid results.

Note: When using the "A" missile system the drop height is 24", and is measured from the surface to the center of the release knob.

The results of the field verification procedure should agree with the following initial factory calibration data. If the field results do not agree within  $\pm 15\%$  on Gmax, or the TRIAX2010 hand-held unit was not calibrated within two years of purchase or factory re-calibration, your unit may require re-calibration. For factory re-calibration, please contact

Technical support at the address and phone number listed on the cover page of this manual.

**ADVISORY: The TRIAX2010 hand-held unit must be re-calibrated at the FACTORY every two years.**

The following page can be printed and used for recording reference pad results.



## APPENDIX B

### TRIAX2010 SETTINGS

#### B.1 TIME AND DATE

To access the time and date menu, turn the Triax 2010 on and hold the NO key for several seconds until the SET DATE AND TIME menu appears. Follow the instructions on the menu to set the current date and time. Note that for 24 hour time format use the ML (military time) setting instead of AM or PM. The date is in the format of MM-DD-YY.

#### B.2 DISPLAY CONTRAST

The contrast of the display can be adjusted to suit ambient lighting conditions. To enter contrast adjust mode, turn Triax2010 hand held unit ON. Press and hold either the YES for three seconds until the DISPLAY CONTRAST menu appears. Follow the instructions on the menu to adjust the display contrast.

Note: The display technology in the Triax 2010 is improved and display contrast will not be affected by temperature variations.

#### B.3 CONFIGURATION

To change the height or velocity units, release mechanism, HIC interval display or back light operation the configuration menu is used. To access the configuration menu turn the Triax 2010 on and hold the NO key until the SET DATE AND TIME menu appears. Release the NO key and press the YES key to access the CONFIGURATION menu.

Use the ENTER key to step between menu items, and the LAST and NEXT key to select between possible choices. The RELEASE setting should be left as MAGNET when using the Tripod. If set to MANUALHEMI the head form can be lifted manually by the operator and dropped to make preliminary drop tests. The other available choices (AUTO, TUBE, MANUAL A) should not be used.

The operation of the display back light may be set to OFF, ON or TIMED. In OFF the display back light will not be used. Battery life will be increased but display readability will be severely diminished. If set to ON, the back light will be on whenever the Triax 2010 is on. If set to TIMED the back light will remain on for 30 seconds after any key is pressed. The TIMED selection is the default setting and provides a good compromise between battery life and display readability.

## APPENDIX C

### SD MEMORY CARD

The Triax 2010 stores drop test results on standard SD Memory Cards, one of which is included with each new Triax 2010 hand held controller. Several manufacturers offer SD Memory Cards and the Triax 2010 has been tested with 2GB cards manufactured by SanDisk and Transcend. Other manufacturer's cards may be used but have not been verified for proper operation.

The Triax 2010 operation of the SD Memory Card is identical to the operation of the PC file system. Files and folders can be copied, deleted and created using standard PC applications such as Windows Explorer.

The Triax 2010 allows the user to store drop results in one of ten folders on an SD card. When a new SD card without any folders is installed in the Triax 2010 drop test results will be stored in the ROOT folder (the folder is not actually called ROOT. If the SD card were installed in a PC and was called drive E: the ROOT folder would be "E:\")

Using Windows Explorer the user can create up to nine more folders on the SD card for storing drop test results. Folder names must be from 1 to 8 characters long and contain only alpha (A – Z) and numeric (0 – 9) characters and should hve no spaces (ie. Folder1). Sub folders are not supported by the Triax 2010 file system.

To select a folder into which to store drop test results, turn on the Triax 2010 and press and hold the NO key until the SET DATE AND TIME menu appears. Continue to hold the NO key for an additional two seconds until the CURRENT DATA FOLDER menu appears. The currently selected folder will be displayed, and the user can use the NEXT and LAST keys to step through the available folders. When the desired folder is selected press the ENTER key.

If the current folder is deleted (using a PC) upon turning the Triax 2010 on the user will be prompted to select a new folder. If a new folder is not selected the default ROOT folder will be used for drop test data.

If the SD Memory Card is not inserted into the Triax 2010, or the card is write locked, the user will be warned that no drop test data will be saved. Drop tests can still be performed and the results manually recorded by the user. In addition the Triax 2010 will not allow the user to access any drop other than drop 1.

With 100 drops in each of ten folders and SD Memory Card will hold a total of 1000 drops, requiring approximately 2.5 megabytes of storage. Although not recommended, the remainder of the SD Memory Card can be used for storing other user data without hindering operation of the Triax 2010.

## DROP TEST VECTOR (XYZ) COMPONENTS

The Triax 2010 can be set to record the X, Y and Z component of each drop test to separate files on the SD card. To enable this feature first access the SD card folder menu as explained above. When the folder menu is visible press and hold the YES key for several seconds until the SAVE XYZ VECTOR COMPONENT DATA menu appears. Use the up and down arrows to set this feature on or off as desired, and then press ENTER to return to the drop data menu.

The default for this feature is off so that component data files are not created. When on, the vector components data will be saved on the SD card using the names DRPxx.DRZ, DRPxx.DRY and DRPxx.DRX where xx is the respective drop number. Using the Triax 2010 host program the individual component files can be loaded and saved to a .csv file for further analysis.

## APPENDIX D

### Triax 2010 “A” MISSILE SYSTEM

#### D.1 GENERAL

The Playground Clearing House USA, Inc. Triax2010 can be purchased configured for testing of playing field surfaces to ASTM specification F1936 using the “A” missile system.

#### D.2 GUIDE TUBE

The guide tube has three legs for support. Swing the guide legs out from the tube and lock the support arms in place with the supplied pins. Position the guide tube above the test location. The legs can be extended so that the tube is perpendicular to the test surface. The center of the release knob should be 24” above the surface to be tested. For surface systems with low stability; such as infill systems, supporting plates may have to be placed under the legs to maintain the tube in a level position.



Photo D.1 – Legs Extended



Photo D.2 – Close Up of Leg Strut

### D.3 CABLES

Two gray cables are provided to connect the “A” missile to the Triax 2010 hand held unit. Note that the cables are not identical. Looking in the connectors at end of the cables will show that one has 4 pins and the last has 7 pins. The 7 pin cable is used to connect the Triax 2010 hand held to the release knob mechanism on the side of the guide tube. The 4 pin cable is used to connect the release knob mechanism to the “A” missile. All cables must be connected for proper operation.

### D.4 HAND HELD SETUP

Referring to section B.3 CONFIGURATION of the Triax 2010 user manual, set the RELEASE to TUBE.

### D.5 PERFORMING A TEST

1. Using the handle, place the head form in the top of the tube. It will be prevented from falling by a metal pin protruding into the tube about 4" down from the top.
2. Coil the missile cable on top of the missile in the tube. It is important that the cable have slack so it does not get pulled as the missile falls.
3. Press the Triax 2010 ON key.
4. Select the desired drop number and press the START key.
5. When the display shows "PULL RELEASE KNOB" quickly pull the block knob fully back to release the head form.
6. The display will show "PLEASE WAIT CALCULATING" for approximately 2 – 3 seconds and then the drop test results will be displayed.

***CAUTION – BEFORE PULLING THE RELEASE KNOB LOOK TO ENSURE THAT FEET ARE NOT BELOW THE OPENING OF THE TUBE. THE WEIGHT OF THE FALLING MISSILE WILL CAUSE SEVERE INJURY!***

7. Reach into the tube and grab the missile handle. Return the missile to the start position by pulling out the black knob and lifting the missile out of the tube.

***WARNING – NEVER LIFT THE MISSILE BY PULLING ON THE GRAY CABLE. THE CABLE IS NOT STRONG ENOUGH FOR THIS USE AND WILL BE DAMAGED.***

8. Refer to the appropriate testing specification to determine the procedure for accumulating test data and averaging test results.

## APPENDIX E

### TROUBLESHOOTING

#### E.1 BATTERIES

The Triax 2010 is powered by (5) standard AA batteries located in a plastic pack which snaps into the hand held. Battery life is determined by the amount of use of the instrument but typically will be several months. The Triax 2010 will alert the user when the batteries are low and need to be replaced. However, if questionable operation should occur the first step is to replace the batteries with a known good set of FRESH batteries. Many times users will replace the batteries with batteries which have been found in the carrying case, not realizing these are old batteries which should have been discarded.

#### E.2 CABLES and CONNECTORS

In most cases, the Triax 2010 will alert the operator that a cable is broken and the testing cannot continue until the cable is replaced. But in some cases the cable might look fine when in fact there is an intermittent break in the cable which cannot be detected by the Triax 2010. As a test is made and the cable flexes the connection of the cable is lost and incorrect drop results are obtained. These drop results will show abnormally high peak G and HIC values (an HIC value of 9999 is a typical result.)

Carefully inspect the cables to see if any signs of damage are visible. Often a crushed section may be found which can be the result of the head form striking the cable.

The plugs and receptacles used in the Triax 2010 system are a high precision type that resists disconnection during the impact of the head form and surface. Debris, particularly particles of sand, can enter the receptacle and prevent the plug from fully engaging. This can result in symptoms similar to a bad cable. Debris lodged in a receptacle or plug can typically be removed by a blast of air from either a work shop air hose or a spray can type duster.

In a situation where a cable is determined to be damaged a single cable can be used to connect the hand held directly to the head form, bypassing the connection via the tripod. In addition if an examination of the cables does not show any obvious damage, use a single cable to make the hand held to head form connection. Alternate between the cables until the problem can be traced to operation with a specific cable. The test results will not be affected by this type of connection, but extra care needs to be taken to ensure that the cable does not affect the trajectory of the head form during the fall.

New cables are available from the factory, and damaged cables can often be repaired at a cost savings.

#### E.3 SENSOR ERROR

The sensor (accelerometer) in the head form is sensitive to moisture, such as might be experienced from condensation on the head form. Care should be taken to prevent condensation from forming on the head form, such as not storing the system in an unheated space or in the cargo area of a car or truck.

A sensor which has been affected by moisture will cause the SENSOR ERROR message to be displayed. In this case the head form should be removed to a warm area and allowed to dry for 3 to 4 days. Consult the factory for techniques to speed this process.

#### E.4 MEMORY CARD ERROR – UNABLE TO SAVE DROP

The Triax 2010 internal clock which is used to time stamp the drop data files on the SD card has an incorrect setting. To clear this problem follow the instructions in section B.1 to reset the clock.

#### E.5 SD CARD FOLDER NAMES

When viewing the SD card files the names of the folders might appear incorrect, typically containing a percent sign (%) when not expected. The SD card folder names are limited and may only be eight characters long and contain only letters (A – Z) and numbers (0 – 9) Spaces, punctuation, underscores and other special characters are not allowed.

## APPENDIX F

### WARRANTIES AND REPRESENTATIONS

Warranty: The Traix2010, excluding connecting cables, is warranted for material and workmanship for a period of one (1) year from the date of shipping to the first purchaser of record.

Representations: No representations are made other than those stated. This instrument is for data acquisition and it is the sole responsibility of the purchaser and user to determine its application in any particular circumstance. The purchaser and user of the Surface Impact Tester is directed to section 21 - Precision and Bias - of the ASTM F1292-09 and F355-10 standards to clearly understand the variations, repeatability and reproducibility of the results.

The use of this instrument is invalid and not covered by any warranty or any representation should any of the conditions of compliance with ASTM F1292-09 and / or ASTM F355-10, including, but not limited to periodic calibration, not be performed.



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## Certificate of Compliance

### TRIAX 2010

*The Triax 2010 system for surface resiliency testing meets the equipment specifications as stated in*

**ASTM F1292-09**

*Paul Bamburak*

08/20/2010

Paul Bamburak, P.E.

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# Certificate of Compliance

## TRIAX 2010

*The Triax 2010 system for surface resiliency testing meets the equipment specifications as stated in*

EUROPEAN STANDARD EN-1177

*Paul Bamburak*

08/20/2010

Paul Bamburak, P.E.

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## Certificate of Compliance

### TRIAX 2010 "A" MISSILE

*The Triax 2010 system for sports surface testing  
testing meets the equipment specifications as  
stated in*

**ASTM F355-10a**

*Paul Bamburak*

10/01/2012

Paul Bamburak, P.E.

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