

Triax 2000

PORTABLE SURFACE IMPACT TESTER

USER'S MANUAL

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1.0 INTRODUCTION

The Triax2000 system is intended to be used to provide data to measure the impact attenuation of surfaces under and around playground equipment. When properly configured and used by a properly trained operator, the Triax2000 can be used to perform surface impact attenuation tests in accordance with ASTM Standard Specification Designation F1292-04 Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment.

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

2.0 SYSTEM COMPONENTS

The Triax2000 system consists of the Triax2000 hand held data acquisition unit, a hemispherical head form and a flexible cable to connect the hand held unit and the head form. An available option is an electromagnetic holding device mounted to an adjustable height tripod. This tripod allows the head form to be suspended an accurate distance above the test surface and then precisely released so as to assure an impact perpendicular to the test surface. An additional feature of the tripod and hand held combination is the ability to measure the time of the drop from release to initial impact so as to allow the hand held unit to calculate and display the actual drop height or impact velocity. This allows the operator to be certain that the cabling did not slow the head form's fall, and is required for ASTM F1292-04 test procedure compliance.

Included as standard with the Triax2000 system is a desktop base stand, RS232 cable and Windows 95/98/XT compatible report generation program. This program allows the user of the Triax2000 to extract test information from the hand held unit and create printed reports, complete with graphs showing G versus time, for archive and audit purposes.

3.0 HAND HELD UNIT

The hand held unit is shown in FIGURE 1. The main parts of the hand held are the eight key membrane keypad, the liquid crystal display

(LCD), the battery cover and the head form and tripod cable jacks. The six gold plated strips on the rear of the hand held unit are used to make electrical contact for RS232 communications when the hand held is placed in the desk stand.

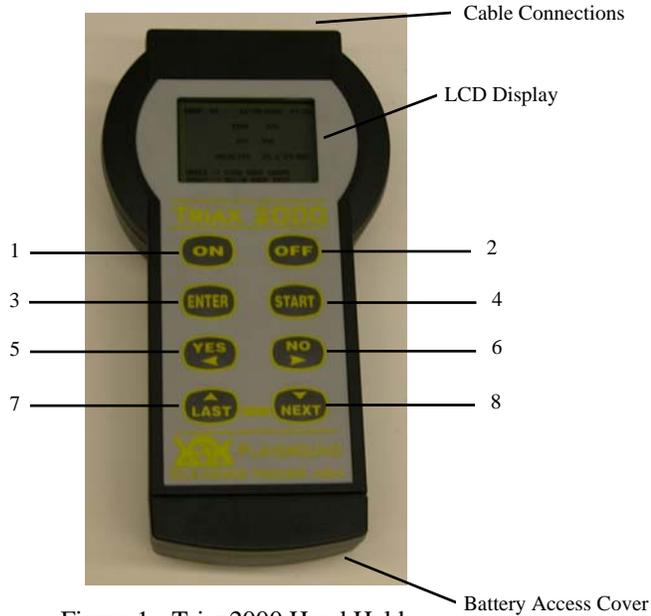


Figure 1 - Triax2000 Hand Held

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 Triax2000 will automatically turn off after 5 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 mode of the Triax2000. The current function, if any, will be displayed in a text message at the bottom of the display.

6. NO - Functions similar to YES key, except gives alternate choice to an operational question. Pressing and holding this key for approximately 3 seconds will present the clock set menu.

7. LAST - Causes the last drop test results to be displayed. The Triax can record up to 48 drops in internal memory. These drops are labeled 1 through 48. Pressing the LAST key decrements the drop number by 1. If on drop 1, drop 48 will be displayed the next time the LAST key is pressed. Pressing and holding this key for 3 seconds will display the contrast adjust menu.

8. NEXT - Similar to the LAST key, except that the drop number is incremented by 1 every time NEXT is pressed. At drop 48, the next press will show drop 1. Pressing and holding this key for 3 seconds will display the contrast adjust menu.

3.2 Cable Jacks

The Triax2000 connects to the head form by a 20 foot flexible cable, which is supplied as standard. Both ends of the cable are identical, and either end can be plugged into the hand held unit. To insure proper operation, the plug will only mate the jack when it is properly oriented. To do this rotate the plug as it is pressed up to the jack. When the right orientation is achieved the plug will snap into the jack with a minimum of force. Proper orientation can also be determined by aligning the red dot on the plug with the red dot on the jack before pressing the two together. To disconnect the cable, pull on the knurled section of the plug.

Note that the cable for the head form is a four pin type, which can be checked by examining the plug at the end of the cable. When equipped with the optional tripod a three pin cable is also supplied. Improper cable connections are prevented as the three pin and four pin cables are not interchangeable.

3.3 Battery Cover

The Triax2000 makes use of 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 Triax2000. 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. Duracell type MN1500 LR6 batteries are recommended as they are readily available and are physically constructed so as to fit properly in the battery holder. Some brands of batteries have been noted to be wrapped in thicker plastic materials which prevents proper contact between the ends of the battery and the contacts inside the Triax2000.

Slide the battery holder back into the Triax2000 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.

Assuming daily use, a fresh set of batteries will last an estimated 4 to 6 months. For best results, replace the batteries with a fresh set at an interval of no more than 6 months.

4.0 HEAD FORM

FIGURE 2 shows the head form. The head form is machined of solid aluminum and designed and tested to be in conformance with ASTM F1292-04. The round steel block mounted to the top of the head form is designed to be used with the electromagnet holder, which is part of the tripod. The head form is connected to the hand held unit by the 20 foot cable (See section 3.2)



FIGURE 2 - head form

5.0 TRIPOD

The Triax2000 Tripod is shown in Figure 3. The legs of the tripod are adjustable to provide a maximum drop height of up to approximately 12 feet. NOTE: Drop height is defined as the distance from the bottom of the head form to the top of the surface to be tested.



Figure 3 - Tripod with Head form hanging & 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 three cable jacks. The three pin jack connects the tripod to the three pin jack on the hand held unit. The first four pin jack, which is adjacent to the three pin jack, is connected to the 4 pin jack on the hand held unit. The other four pin jack is used to connect the tripod to the head form (a second 20 foot cable is provided with the tripod to make this connection.) Thus, when using the tripod the head form is not connected directly to the hand held unit but rather to the tripod. This new configuration helps to prevent the cables from interfering with the trajectory of the head form during free fall.

The Tripod does not have an on-off switch. When the three prong cable is connected at both the Tripod and hand held ends the Tripod will automatically turn on. When the Tripod is not going to be used for extended periods of time disconnect either end of the three prong cable to turn off the Tripod and conserve battery life.

5.1 Tripod Batteries

The tripod is powered by three (3) disposable “C” size batteries. To replace the batteries remove the lid of the tripod head by removing the two Phillips type screws. The lid will simply lift off. The batteries will then be visible, held in place by an aluminum “U” bracket. Remove the “U” bracket by removing the two Phillips type screws holding it in place. Life expectancy of the tripod batteries is 4 to 6 months depending on use. The batteries should be replaced at a maximum interval of six months.

5.2 Tripod Legs

Each leg of the Tripod consists of up to four sections. The first section connects directly to the top of the Tripod by quick release pins. The bottom section of the first leg is threaded to accept up to three extension legs for a maximum height of fourteen feet. For safest use screw the desired sections together with the tripod laying on a flat surface. Then carefully stand the Tripod up while simultaneously spreading the legs out for stability.

CAUTION: Always use the same number of leg sections on each of the three legs.

5.3 Holder Cable and Locking Device

For fine adjustment of drop height, a flexible steel cable is used to raise and lower the electromagnetic holder. This cable has an adjustment range of approximately 7 feet. 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. Note that when adjusting cable position the head form should be removed from the magnet to prevent accidental release.

WARNING: A METAL CABLE STOP IS ATTACHED TO THE STEEL CABLE TO PREVENT THE COILED CABLE OF THE ELECTROMAGNETIC HOLDER FROM BEING OVEREXTENDED. IF THE HEADFORM MUST BE LOWERED MORE THAN 7 FEET, SHORTEN THE LENGTH OF THE TRIPOD LEGS.

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 wing head screw when complete.

CAUTION: When making adjustments to the steel cable or the locking device assembly it is recommended that the head form be removed from the electromagnetic holder. The weight of the head form will cause the cable and / or locking device to quickly move if not held tightly by the operator. This could result in serious injury from being cut by the steel cable or being struck by the falling head form. THE HEAD FORM CAN ALSO BE RELEASED FROM THE MAGNET DUE TO SHARP JOLTS DURING ADJUSTMENT.

CAUTION: Never operate the release lever without having firm hold of the steel cable. The weight of the head form will cause the cable and head form to quickly move if not held tightly by the operator. This could result in serious injury from being cut by the steel cable or being struck by the falling head form.

5.4 Electromagnetic Holder

At the end of the steel cable is an electromagnetic holder. This device is a normally on magnet that mates with the steel block on the top of the head form and allows the head form to be suspended from the drop cable. When the head form is to be released the circuitry in the tripod supplies a short pulse of electrical power to the holder which will momentarily turn off the magnet, allowing the head form to fall.

For proper operation, both the face of the electromagnetic holder and the mating surface on the head form steel post must be free of dirt and dents.

Before attempting to connect the head form and holder, use a soft towel or rag to clean any residue such as sand, mud, etc. from both mating faces. Even a single grain of sand would result in a loss of magnetic holding power, leading to an unexpected release of the head form and endangering the safety of the operator.

6.0 TRIAX2000 SYSTEM USE

6.1 Making a drop test with the Tripod

Refer to ASTM F1292-04 to determine which locations and from which heights a drop test is to be performed. Following the information in section 5, 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 which location in the hand held memory will be used to record the current drop. Forty-eight memory locations are available. Select one by using the LAST and NEXT keys.

6.1.3 Mate the head form to the electromagnetic holder.

6.1.4 Confirm the height of the bottom of the head form from the surface using a surveyor's measuring rod.

6.1.5 Press the START key. A message will appear on the display "RELEASE MECHANISM NOT READY CHARGING.. xx%" This indicates that the tripod circuitry is charging its internal components in preparation to pulse the electromagnetic holder. After approximately 30 seconds, the display message will change to "DROP MECHANISM READY PREPARING TRIAX2000 FOR TEST" (Note: If the tripod was already on for a few minutes, the display might immediately show the ready message) Depending on the age of the tripod batteries, the tripod might require up to 1 minute to change to the ready state. If after 1 minute the ready message has not yet appeared, check for the following: 1.) three pin cable connected between tripod and hand held unit; and 2.) verify tripod batteries are good.

After several seconds the display message “TRIAx2000 READY FOR TEST” will appear. To release the head form, press the YES key. After a short delay of about ½ second, the head form will be released from the holder and fall to the surface. If all cables were connected properly, the display message will show “PLEASE WAIT CALCULATING” This message will remain for up to 20 seconds as the Triax2000 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.

Note: At any time while the Triax2000 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 Triax2000 memory.

Caution: Depending on the surface being tested the head form may rebound significantly and strike either an adjacent structure of the operator. Care must be taken by the operator to ensure that they are not in the rebound zone or serious injury may occur.

WARNING: CARE MUST BE TAKEN TO ENSURE THAT THE CABLE BETWEEN THE HEAD FORM AND THE TRIPOD TOP IS NOT CRUSHED BETWEEN THE HEAD FORM AND ANY ADJACENT STRUCTURES. IF ANY SUCH COLLISIONS OCCUR THE CABLE MUST BE VISUALLY INSPECTED TO VERIFY IT HAS NOT BEEN DAMAGED.

Before the Triax 2000 indicates it is ready to perform a drop test the internal circuitry will perform a test of the four prong 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 four prong 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 Alpha Automation, Inc. 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 four conductor 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 Triax2000 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.

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.

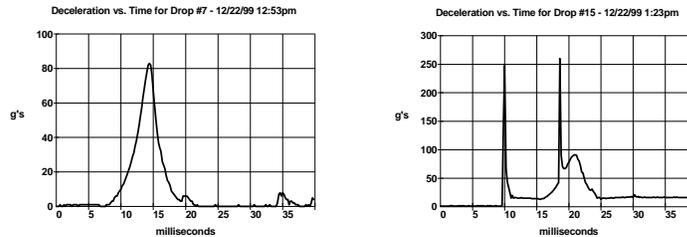
6.4 Verify impact velocity

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 drop test.

6.5 Impact wave form shape

Press the ENTER key to view a G versus time graph of the impact wave form. While it is impossible to predict a “perfect” shape of this wave form, the shape should generally be a smooth bell shaped curve rising from 0 G, up to the peak G value, and falling smoothly back down to 0 G. Figure 4 is an example of an acceptable wave form obtained by a drop onto a urethane tile sample. Figure 5 is an example of a wave form with sharp peaks, or “spikes”. These spikes are not part of the actual impact but caused by poor cable connections or broken wires within the cables. In this case, the cables and connections should be carefully inspected and the drop test repeated.

Figure 4 - Acceptable impact wave Figure 5 - Impact wave form showing unacceptable spikes



ing unacceptable spikes

7.0 REPORT GENERATION

The Triax2000 system is supplied with a desk stand, RS232 cable and Windows 95/98/XT compatible software program. This software can be used to upload drop test results and impact wave forms to a personal computer. The program 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 Software installation

The operator should install the Triax2000 host application on their PC by running the SETUP.EXE program supplied on the disk. The setup program will ask questions to properly install the software.

7.2 Uploading test results

Connect the RS232 cable between the desk stand and an unused COM port on the PC. Note which COM port gets used.

Place the hand held unit into the desk stand. The six gold stripes on the back of the hand held make contact with the six gold springs in the center of the desk stand. For a good connection to be made, both the desk stand and the Triax2000 must be sitting on the same flat surface, such as a Formica table top.

Start the Triax2000 host program on the PC. The first time the program is used COM port and printer selections must be entered under the Options pull down menu.

Before attempting to retrieve test data from the hand held unit, make sure the hand held unit is turned on by pressing the ON key.

APPENDIX A

TRIAx 2000 REFERENCE PAD DATA SHEET AND VERIFICATION PROCEDURE:

Subsurface conditions (i.e. the hardness and thickness of concrete) will effect 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 in front of your office, 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 Reference Data Record on the line labeled "Initial User Reference Mat Average." This value should agree within the Initial Factory Reference Average within +/- 15%. 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.

An 8" (203 mm) square rubber reference mat has been supplied with the Triax2000 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 calibration verification procedure is as follows:

Place the reference mat on a level, bare 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



WARN-

ING: A FACTORY CALIBRATION CERTIFICATE HAS BEEN INCLUDED FOR THE ACCELEROMETER INSIDE THE HEAD FORM IN THIS KIT. SENSITIVITY LEVELS FOR THIS SPECIFIC ACCELEROMETER HAVE BEEN PROGRAMMED INTO THE TRIAX 2000 HAND HELD. IT IS CRUCIAL THAT THE HEAD FORM AND TRIAX2000 HAND HELD ARE KEPT TOGETHER AS A PAIR TO ENSURE ACCURATE RESULTS.

CAUTION! Measurements made with head forms and hand held units that have not been calibrated as a set will yield inaccurate results!

APPENDIX B

TRIAX2000 SETTINGS

B.1 DISPLAY CONTRAST

The contrast of the display can be adjusted to suit ambient lighting conditions. Ambient temperature also affects contrast. To enter contrast adjust mode, turn Triax2000 hand held unit ON. Press and hold either the NEXT or LAST key for 3 seconds. The display message "DISPLAY CONTRAST ADJUST" will appear. Use the LAST and NEXT keys to change display contrast as desired. Press the ENTER key to save contrast setting for future use. Note that when moving from an office setting to significantly hotter or colder outdoor conditions and the Triax 2000 is turned on, the display might either become completely black or remain faded out. In either case the display will be unreadable. When this occurs press the and hold the NEXT or LAST keys to put the Triax 2000 in contrast adjust mode. The NEXT key will darken the display and the LAST key will lighten the display. Continue to hold the NEXT or LAST key until the desired contrast is achieved.

B.2 DATE AND TIME SETTING

All drop tests are date and time stamped for reference purposes. To set the date and time turn the Triax2000 on. Press and hold the NO key for 3 seconds until the display message "DATE AND TIME SET" appears. Follow the display messages to set the date and time to the proper settings.

B.3 UNITS AND RELEASE MECHANISM

Once you have completed setting the time and date (see B.2), press the "YES" key to access the next screen which allows you to choose drop height or velocity units. While the cursor is on the UNITS line use the NEXT or LAST key to step through the available choices of FEET, FEET / SEC., CM, or CM / SEC. Press the enter key to accept the setting and move to the next setting. While in this screen the type of release mechanism can be selected. Use the NEXT or LAST key to step through the choices of MANUAL, TRIPOD or TUBE. The TUBE setting is for the F355 "A" Missile system which is available separately from Alpha Automation, Inc. Press ENTER to accept the setting and

START to return to the main screen.

APPENDIX C

WARRANTIES AND REPRESENTATIONS

Warranty: The Triax2000, excluding connecting cables, is warranted for material and workmanship for a period of 1 year from the date of shipping to the first purchaser of record.

It is the responsibility of the operator to familiarize themselves with the ASTM F1292-04 standard and its application. There are no representations made as to the ASTM F1292-04 Standard in any manner and all questions and concerns must be directed to appropriate ASTM committee. Training is available from Canadian Playground Advisory (contact technical support department.)

Certificate of Compliance: Each complete unit (Triax2000, tripod and surveyor's rod) will be delivered with a certificate that the unit conforms to the requirements for instrumentation for the ASTM F1292-04 free fall method. A certificate of calibration of the accelerometer will accompany the unit at the time of sale and each time the annual calibration is completed.

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 F1292-04 standard 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 F1292-04, including, but not limited to annual calibration, not be performed.



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CERTIFICATE OF COMPLIANCE

TRIAx 2000

*The Triax 2000 system for surface
resiliency testing meets the equip-
ment specifications as stated in*

EUROPEAN STANDARD
EN-1177

Paul Bamburak, P.E.

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