Clegg Instructions
0-150g unit
Clegg Software

1. Do not attach USB cord!!! FIRST RUN SOFTWARE
2. Insert CD
3. Open CD Folder
4. Double Click "Clegg Setup" Icon
5. Follow Instructions on Screen
6. Allow time for drivers to install (1-2 Minutes)
7. Plug Clegg into USB on computer
8. Allow time for drivers to install again if necessary (1-2 Minutes)
9. Computer will say "Your device is ready to use - Device Driver installed successfully"
10. Once drivers are installed you can open program and download data
11. Be sure control module is in "download" mode before attempting to download data.
DESCRIPTION:
This manual is for all models of the Clegg Impact Soil Tester, distributed by Turf-Tec International.

Dr. Baden Clegg developed the Clegg Impact Soil Tester (CIST) while working for the Department of Civil Engineering at the University of Western Australia in the 1970s. The Clegg Hammer is a simple to use device consisting of two basic components: a flat-ended cylindrical mass (the hammer) and a guide tube. When the hammer strikes the soil surface, a precision accelerometer mounted on the hammer feeds its output to a Control Unit, which provides a digital readout. A sequence of drops of the hammer constitutes one test called a Clegg Impact Test (CIT).

The Clegg offers a rapid, simple, and relatively inexpensive assessment of strength/stiffness properties of a variety of soils, aggregates, and synthetic materials. The Clegg Impact Test result provides information on the strength/stiffness properties of the material under test. The impact test result reflects and responds to characteristics that influence strength. Such influences include material type, grading, layer thickness, density, moisture condition, and possibly the condition of the underlying layer. With all things being equal regarding material type and layer thickness and the nature of the support base, the primary influences on strength/stiffness are the density and / or moisture condition of the material. CIT may be used to observe changes in strength/stiffness for a material with the changes in compaction, density, and moisture content.

Parts, Accessories, and Batteries:
- Hammer
- Guide tube
- Control Unit (with boot & strap)
- BNC coaxial cable
- Square 12 x 12 inch pad for 0-150 g models
- Locking pin to attach hammer to guide tube (2.25 kg model)
- Charger
- USB Cable
- User’s manual
- Storage bag
- Software
Batteries:
There are three batteries in the Control Unit. Two are rechargeable AAs. When these batteries need recharging, the LED on the keypad will illuminate. Charge only with the charger provided with unit. Charger plugs into the bottom of control unit. The other is a coin cell battery. This battery has a life of several years. When the internal date and time no longer are held in memory, this coin cell will need to be replaced.

Note: Do not replace the batteries. A mismatch in battery type can cause incorrect results or damage to the electronics and charger. Unauthorized disassembly will void any warranty.

Care:
The Clegg Impact Soil Tester has been designed to be simple to use and to provide years of service. Though primarily used outdoors in many types of situations, it is a scientific instrument incorporating specialized electronic components meaning that due care is necessary to ensure trouble free performance and to avoid costly repairs. Following are some precautions to observe.

AVOID PROLONGED EXPOSURE TO EXTREME HEAT AND COLD. Do not leave the instrument in full sun or in freezing temperatures when not in use. In conditions of extreme cold the display may not activate. If this is suspected, warm the control unit before using.

EXTERNAL SIGNAL CABLE: This component is prone to being damaged through being pinched, pulled, worn or cut. Ensure that the connectors are not strained, bent out of round or broken and that the plugs and sockets are kept clean.

LOCKING THE HAMMER IN THE GUIDE TUBE: (2.25 Model) Always pin the hammer in the guide tube with the locking pin provided when not using the instrument or when transporting.

KEEP CLEAN AND DRY: Keep all components clean and dry, not only for correct test operation but also for the sake of protecting the instrument. When testing, do not allow material build-up inside the guide tube or on the hammer that would prevent a free-fall of the hammer. Ensure that the hammer strike face is clear of any material build-up before starting each test. When leaving or storing the instrument, wipe down the
hammer and guide tube, etc, so that all is dry and relatively clean. Never apply water under pressure when cleaning.

**HAMMER AND CONTROL UNIT ARE NOT WATERPROOF:** Do not expose the hammer or control unit to rain. If moisture enters either the hammer or control unit damage may result. If moisture does enter the control unit, remove the AA batteries immediately and allow the circuitry to dry.

**DO NOT EXCEED 150 G UNITS:** Permanent damage to the accelerometer may result if it is overloaded. To best protect the Clegg, do not operate in such a manner that values regularly exceed 15 CIT units or 150 gravities. There are 10 Gs “gravities” per 1 CIT unit. Please note, the 0-150 G unit will not read any number over 150g.

If uncertain as to the hardness of the material to be tested, start with drops from a very low height, progressively getting higher until it is determined that it is safe to drop from the standard drop height. If it is determined that the standard drop height is too high, make note of what is considered to be a safe-drop height for the particular situation and develop criteria for such materials based on this lower drop height. Be aware that the output is not directly proportional with the output obtained from using the standard drop-height so any correlation with other outputs or test properties will need to be re-determined or recalculated.

Be aware that the accelerometer generates a signal regardless of any other electronics or power supply - it is always "on" to vibrations. Protect the hammer from extreme shock even if the Control Unit is not switched on or connected. Do not drop the hammer directly on concrete.

**EACH HAMMER AND CONTROL ARE CALIBRATED AS A SET:** Do not swap out either the hammer or the control unit. Mismatching of these will give inaccurate results.

**NEVER PLACE HANDS OR FEET IN OR UNDER THE GUIDE TUBE:** Beware that the hammer is made to move freely inside the guide tube and injury is possible if the hands or feet are placed in the path of the hammer. Use special attention if lifting the Clegg as the hammer can slide.

**WARNING:** Authorized personnel should only perform disassembly and calibration. Unauthorized disassembly or calibration will void any warranty.
Operational Check:

A 12 x 12 inch black foam pad is supplied with the 0-150 g units for the user to verify that the instrument is working properly. The operational check is carried out in a similar fashion as the standard test but always with the foam pad in place on a smooth concrete surface. The foam pad is not used for normal testing but only when making an operational check.

**Note:** The phrase “Foam Pad and Check Ring” applies whether or not the shape is round and square, unless otherwise indicated.

**It is suggested to make an operational check:**
- Upon receipt of the instrument before any testing
- When results are not in accordance with expected results
- If the instrument has experienced some trauma

**Caution:** Do not operate hammer on concrete without the foam pad in place as damage to the instrument may result.

Operational Check Procedure:

To determine the foam pad value for the first time, carry out a modified Clegg Impact Test procedure to obtain six readings on a suitable surface, preferably one that is at a "home" location and on bare concrete. This same "home" location should be used for future operational checks as differences in surfaces will change reading results.

For a "home" site, select a firm solid base such as a bare concrete slab floor. Be sure that the surface is smooth, dry and clean and that the surfaces of the foam pad and hammer strike face are dry and free of any foreign material. Place the foam pad such
that the hammer is centered on the pad and that the base of the guide tube is resting entirely on the floor—not the foam pad. **The foam pad must be between the hammer and floor. The hammer must strike the foam pad and not the floor.**

Take the average of the six drops on different areas of the pad near the center to obtain the pad value. Note this average on the pad with an indelible marker on the foam test pad or note in a logbook along with the tolerance of plus or minus 2 G’s.

During future operational checks, make note of the value and tolerance on the foam pad (written on the foam pad or log book) and compare with measurements. The average reading should agree with the value and tolerance marked on the pad. If a 2-3 % difference is noted, you should contact Turf-Tec International for an RMA number and have the Clegg factory recalibrated.

### To attach level on Clegg:

1. Simply remove double side tape cover, do not touch exposed adhesive

2. Attach level on opposite side of Clegg from control unit screws. *(Be careful not to cover hole for securing center shaft with pin).*

3. Press firmly in place.

4. Note once attached, tape will not allow you to re-position level.
Control Unit Setup and Operation:

The handheld Control Unit is a microprocessor driven device which offers several data viewing and manipulation options. The handheld control unit has a USB port that allows information to be shared between a computer and the handheld unit. This is accomplished through the Transmit and Retrieve Utilities contained in the Clegg software CD.

Selecting Test Options in Setup Mode

The SETUP option allows the user to set how the data is managed based to meet the test protocol.

PEAK: The display indicates the Peak impact value of a series of drops. (Max 9 drops) This setting should not be used in testing artificial or natural grass fields as one drop is recommended so PEAK should show "OFF".

AVERAGE: The display indicates the Average impact value of a series of drops. (Max 9 Drops)
CIV / G: Your Clegg Impact tester will read two different settings, CIT units and Gravities. There are 10 Gs “gravities” per 1 CIT unit, therefore the Gravities setting is more sensitive than the CIT setting and should be used when testing athletic fields and playgrounds. The G setting is used almost exclusively on testing sports turf areas.

SITE SETUP: The user can manually set the site number.

Performing a Clegg Impact Test

1. Ensure that the BNC coaxial cable is properly connected between the control unit and hammer. To connect a BNC plug to socket, line up the slots of the plug with the pins on the socket. Press the plug on and turn the plug clockwise through 90° until it locks. (To remove, reverse steps.)

2. Ensure that the striking face of the hammer is free of foreign material and the inside of the guide tube is reasonably clean so that the hammer is able to fall freely.

3. Select a test site and clear any loose surface material or foreign objects from the test spot that could produce a result not indicative of the material being tested.

4. Press ON Button

5. Use Up and Down arrows to move cursor to TEST.

6. Press SELECT button

7. Place tester vertically in position and hold down guide tube with a foot on the base flange. Brace with leg and/or knee if necessary to hold tube steady and as near to vertical as possible, with bubble in center of level.

8. Verify Control Unit display is in correct window.

9. Raise the hammer until the white line, on hammer, is even with the top of the guide tube. Drops should be made with the line within + 1.25 cm (1/2 inch) from the top of the guide tube.

10. Drop hammer and read test results from screen.
11. Use **Up** and **Down** arrows to move cursor to "Save" or "Delete" depending on whether you want to save the reading or delete it. Press "Select".

12. A new screen appears:

- **View** - Will view data
- **New Site** - Will create a new test site in data logger (use when switching from one field to another
- **New Drop** - Continue testing
- **Menu** - Goes back to main menu

(Use **Up** and **Down** arrows to move cursor to move between these settings)

13. Move to next test location

**Testing Artificial Turf Areas**

When Testing Artificial Turf Areas there are several things to keep in mind. Depth of infill material is critical to having consistent readings on the field. There are several devices that are available to test infill depth and these should be used prior to testing Gmax in order to ensure consistency from area to area.

If high readings over 100 Gravities are recorded, the area can be groomed and then re-tested until desirable readings are achieved. This may or may not include the addition of more infill material. Follow manufacturer recommendations for types, particle size, proper application techniques, grooming and depth of infill.

The main thing to remember is consistency of the surface. The outcome you are looking for is that the entire field should be close to the same Gmax reading from end zone to end zone and side to side. This will ensure safety for athletes as the entire field will be consistent.

**Testing Natural Turf Area**

When Testing Natural Turf Areas there are several things to keep in mind. Soil moisture plays a huge role in the Gmax reading on natural grass. It is important that testing be done when the soil is the same moisture range each time you test.
Moisture readings can be done with several types of moisture sensors that are available on the market and these readings should be recorded along with the Gmax readings. If moisture readings are higher or lower between tests, the results will not be comparable.

Also, testing should be done about the same time of day the approximate same hours after the last irrigation event to insure similar soil moisture conditions. In addition testing should not be done if rainfall has occurred within a 48 hour period.

If high readings over 100 Gravities are recorded, the area can be Aerified and then re-tested until desirable readings are achieved. This may or may not include solid tines, hollow tines, slicing, spiking or water injection. Water should not be used as a tool to gain lower readings as the lower Gmax readings might be desirable for preventing the likelihood of head injury, however the added moisture might interfere with proper footing.

The main this to remember is consistency of the surface. The outcome you are looking for is that the entire field should be close to the same Gmax reading from end zone to end zone and side to side. This will ensure safety for athletes as the entire field will be consistent.

**Transferring Data from the Control Unit**

Minimum System Requirements
Windows operating system (Windows XP or higher)
Microsoft .NET Framework 4.0
One USB Port
CD Drive

Loading Software
Place software disc into computer CD drive and click on Run, in Start menu.

Starting Out (Diagram A)
• Plug the Clegg handheld device into the computer via a USB cable.
• After a few moments windows should indicate everything is ok, or ask to select a driver.
• The driver setup is optionally executed as part of the main setup.
• The driver setup is placed at \{program files\}\Lafayette Instrument\CleggTurf\.
• Launching the application will bring you to the following screen.
Diagram A

Handheld Communication / Data Download (Diagram B, Diagram C)
• Set the Clegg handheld to the “Download” setting
• Select the hammer weight in the bottom left and press the “Download” button
• If the dialog in Diagram B appears, please select the best matching COM port
• After the download finishes you are presented with the dialog shown in Diagram C
• Selecting “Yes” will delete the values from the Clegg handheld

NOTE: Once deleted, the data cannot be retrieved.
View Results (Diagram D)
- The data view should now appear; optionally you can get back to this screen from the main interface by pressing the “View data” button in the bottom right.
- The data is automatically saved from the download; you can press “Load” to recall any previous data.
- You can Save/Export the data to other file formats.
- You can also highlight the grid and perform a Ctrl-C to copy the data.

Diagram C
WARRANTY
We guarantee the instrumentation against all defects in materials and workmanship to the ORIGINAL PURCHASER for a period of one (1) year from the date of shipment, unless otherwise stated. During this period, Lafayette Instrument will repair or replace, at its option, any instrumentation found to be defective in materials or workmanship. If a problem arises, please contact our office for prior authorization before returning the item. This warranty does not extend to damaged instrumentation resulting from alteration, misuse, negligence or abuse, normal wear or accident. In no event shall Lafayette Instrument be liable for incidental or consequential damages. There are no implied warranties or merchantability of fitness for a particular use, or of any other nature.

RETURNS
*Equipment may not be returned without first receiving a Return Goods Authorization Number (RGA).*
Suggested Clegg Drop Points for Gmax readings on Football Fields

- The Clegg 2.25 kg reading should be the first drop of the hammer
- Total of 10 test areas.
- Drop points 1 through 8 are required areas.
- Drop points 9 and 10 are areas of your choosing in areas where you suspect high Gmax levels might be expected (areas where equipment enter the field or bench areas for example.

Penn State’s Center for Sports Surface Research
Formula converting Gmax from Clegg to F355 units

***Note*** The reading should be the *first drop* of the hammer, not the highest reading after 4 drops as described in the ASTM F355 instructions.

Clegg Impact Soil Tester using the regression equation

\[(F355 \times 0.81) - 27.1 = \text{Clegg Impact Soil Tester Value}\]

"The regression coefficient for this equation was 0.95 and indicates that the Clegg Impact Soil Tester would be a suitable device to measure the surface hardness of artificial and natural grass playing fields."

The inverse equation is as follows:

\[
\frac{(\text{Clegg Impact Soil Tester Value} + 27.1)}{0.81} = F355
\]

*Required reading:*
"Surface Hardness (Gmax)"
By: Andrew S. McNitt, Thomas Serensits and Dianne M. Petrukak
The Pennsylvania State University
http://cropsoil.psu.edu/ssrc/research/infill/surface-hardness-gmax
Also:
http://cropsoil.psu.edu/ssrc/sportsturf-scoop/gmax
Video Showing uses of Clegg:
http://www.youtube.com/watch?v=4Cq1O8TNmI