



 **CLEGG HAMMER**

2022 Manual

**CLEGG HAMMER
MANUAL 4.5kg**

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System Description

Dr. Baden Clegg developed the Clegg Impact Soil Tester while working for the Department of Civil Engineering at the University of Western Australia in the 1970's. The Clegg Hammer is an easy-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 sends a digital readout to a handheld tablet. A drop or sequence of drops of the hammer constitutes one test called a Clegg Impact Value (CIV).

The Clegg offers a rapid, simple, and relatively inexpensive assessment of the strength and stiffness properties of a variety of soils, aggregates, and synthetic materials. 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 are the density and/or moisture condition of the material. The CIV may be used to observe changes in strength/stiffness for a material with the changes in compactive effort, density, and moisture content.



Hardware

Device Parts

Hammer • Guide Tube • Control Unit • Internal BNC coaxial cable • 12x12 inch foam Calibration Pad • Charger • Storage Case • Tablet with Clegg Control App (available in the Google Play store and Apple App store) • Silicone Testing Ring • International set of plugins for global outlets • GPS enabled Android tablet • Protective tablet case with lanyard

ACCESSORIES • Cart (10 kg model) • Android Tablet • Carrying Case • Global set of electrical plugin adapters

Specifications

Model - Maximum Gravities (g) - Maximum CIV's

96051 4.5 kg - 1200g - 120civ

- Battery Life: 12 Hours
- 3.7V/1.75Ah Lithium Ion Battery
- Complete Charge in 3 hours
- Results displayed/stored on tablet-based app

Precautions

The Clegg Impact Soil Tester has been designed to be easy-to-use and 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 avoid costly repairs. To prolong the use of the device, observe the following precautions.

AVOID PROLONGED EXPOSURE TO EXTREME HEAT AND COLD Do not leave the instrument in full sun or freezing temperatures when not in use.

In conditions of extreme temperature, the control unit may not activate. If this is suspected, allow the control unit to cool (or warm) before use.

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. Any build-up could prevent an accurate free fall of the hammer. Ensure that the hammer strike face is clear of any material build-up before starting each test. When transporting 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.



Clegg Impact Soil Tester with Clegg Control App

DO NOT EXCEED MAXIMUM LIMITS Overloading may cause permanent damage to the accelerometer. To best protect the Clegg, do not operate in such a manner that values regularly exceed the device's stated maximum limits. Maximum limits can be found in the Specifications table on page 7 of this manual.

If the hardness of the material to be tested is uncertain, 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 this 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.

The accelerometer generates a signal regardless of any other electronics or power supply; it is always “on” detecting vibrations. Protect the hammer from extreme shock even when 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 control unit. Mismatching of these parts will give inaccurate results.

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

WARNING: Only authorized personnel should perform disassembly and calibration.

Unauthorized disassembly or calibration will void any warranty.

Control: Power

To power on control unit, toggle the power switch to the ON position where illuminated side of switch is depressed against the panel.

When control unit is powered on, the Power LED will flash to show the device is in an unconnected state. At this time, the unit is able to be paired/connected to the tablet. The control unit is paired via the Clegg Control app (available Google Play or Apple app store). When the device is in a connected state, the Power LED will stay lit continuously.

If the device is left in an unconnected state for a period of 10 minutes, it will automatically shut down. In order to power on the device on after an automatic shutdown, do either of the following: • Plug the device in to charge • Toggle the power switch OFF, then back ON

BATTERY The Control Unit contains a rechargeable battery. Recharge the battery using the included charging cable. Do not replace the battery. A mismatch in battery type can cause incorrect results or damage to the electronics and charger.

Unauthorized disassembly will void any warranty. Return the unit to Clegg Global for battery replacement.

Control unit can be charged by either a computer's USB port or with the supplied wall adapter. Charging via the supplied wall adapter results in a faster charge rate. While unit is charging, the charge LED will be illuminated red. Once charging has completed, the LED will shut off.

Control: Hammer Connection

The cable is now internal and connects the hammer to the control unit.



Clegg Impact Soil Tester with Clegg Control App

Control: Operational Check

A 2inch check cylinder is provided 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 check cylinder in place on a smooth concrete surface. The cylinder is not used for normal testing but only when making an operational check.

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

Operational Check Procedure

To determine the calibration 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 an easily accessible “home” location. This same location should be used for all future operational checks.

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 calibration cylinder and hammer strike face are dry and free of any foreign material. Place the cylinder under the guide tube such that the hammer is centered on the pad. The cylinder must be between the hammer and floor. The hammer must fully strike the calibration cylinder and not the floor.

Each drop should be 32-38 CIV +/- 2 CIV Note this average in a logbook along with the tolerance of +/- 2 CIV units or 20 G's. NOTE: There are 10 G's “gravities” per 1 CIV unit.

During future operational checks, make note of the value and tolerance on the calibration pad and compare with measurements. The average reading should agree with the logged value. Also mark or paint a line on the area of the concrete slab to show the area where the calibration check will be performed. This way, the same area is used to ensure consistency.



Check Cylinder

Hammer Drop Procedure

The 4.5 kg model hammers may be dropped in the freehand method.

FREEHAND For standard drop height, raise the hammer until the hammer hits the stopper at the top, then drop. This stopper ensures the proper drop height is achieved each time.

CAUTION: Do not operate hammer on concrete without the calibration cylinder in place as damage to the instrument may result.

Performing a Clegg Impact Test

Outlined below are typical test protocols for Compaction Control and Impact Control.

The Compaction Control protocol is employed to measure highly compacted materials potentially used in a construction site. The Impact Control protocol is used to measure materials where high compaction is undesirable such as athletic fields. Testing protocols may vary depending on the material and parameters being evaluated.

Compaction Control

The suggested standard protocol for performing a Clegg Impact Value (CIV) for surfaces where Compaction Control is the goal is the original four-drop peak protocol developed by Dr. Clegg. Compaction Control is used for surfaces that are being prepared for roads, bridges, foundations, or trench reinstatement.

Typically, the 4.5 kg or 10 kg hammer models are used for Compaction Control.

Set up appropriate Compaction Control test parameters in Clegg Control app. *See the Test Setup section on page 24 for more detailed app setup instructions.*

Impact Control

The suggested protocol for performing a Clegg Impact Value (CIV) for surfaces where Impact Control is the goal is a one-drop protocol. Impact Control is used in situations where soft surfaces and hard surfaces could result in the decline of performance and the increase in injuries (athletic fields, racetracks, tennis courts, golf courses, etc.).

These surfaces are exposed to routine maintenance such as tilling, grating, aeration, and leveling steps with the intent of producing a finished product which falls within a specific range or window of impact values (not too soft and not too hard).

Typically the 0.5 kg and 2.25 kg hammer models are used for Impact Control.

Additionally, impact values noted in literature for natural and synthetic turf are often displayed in gravities (G's). NOTE: There are 10 G's "gravities" per 1 CIV unit.

Set up appropriate Impact Control test parameters in Clegg Control app. See the Drop Modes section on page 20 for more detailed app setup instructions. 10

Custom Protocols

Based on an examination of literature, different protocols have been used to target different surface and subsurface characteristics. These custom protocols (different number of drops, variations in drop height, peak impact value, or average impact value) can be effective when consistently used across an area.

In the case of Impact Control, there are no hard and fast rules because the results are dependent on soil type, organic matter, moisture content, and the influence of the turf grass and its root zone. It is recommended to run a few experiments to determine the protocol that works best for your application or use your experience which may well be the best predictor of what range of impact values provide the desired results.

To determine a custom protocol, the initial step would be to collect or use historical data (Clegg impact values) on surfaces you want to monitor. Take experimental data when the surface is in a desired condition and an unacceptable condition.

With this data you can:

- Select an acceptable range of impact values for the surface
- Track the change in impact values as maintenance or modifications are made to the surface

NOTE: Field test data has shown strong correlations between Clegg Impact Values or gravities (G's) to a number of other units of measure for Impact and Compaction. The F355 formula is with a 2.25 kg and the MPa and CBR formulas are taken with a 4.5 kg.

- $F355 = (\text{Clegg g's} + 27.1) / .81$
- $\text{MPa} = 0.088 (\text{CIV})^2$
- $\text{CBR} = .1691 (\text{CIV})^{1.695}$



Clegg Impact Soil Tester with Clegg Control App

Testing Procedure

Once the desired protocol has been chosen and set up in the Clegg Control app, follow this procedure to complete the testing process.

1. For standard Compaction and Impact Control tests, be sure that Display: PEAK is selected in the Clegg Control app settings.
2. Enter or select the appropriate drop site in the Clegg Control app. For more information about setting a drop site, read the Drop site on page 27.
3. Ensure that the app is open and a new location is set ready to receive a value. For more information, read Control: Hammer Connection on page 10.
4. 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.
5. Locate then select the appropriate drop location in the Clegg Control app 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. Scuffing with a foot is generally adequate.
6. Place device vertically in position and hold down guide tube with a foot on the base flange. Brace guide tube with leg and/or knee (if necessary) to hold tube steady and as close to vertical as possible.
7. For Compaction Control Raise the hammer to white line and drop. Without moving the guide tube, repeat this step three more times for a total of four drops and save the readings into memory. This set of four drops represents the standard compaction test protocol.
8. Move to next drop location and repeat steps 3 through 7.

Depending on the surfaces/materials being tested, a custom protocol may be used. For Impact Control Raise the hammer to the stopper at the top and drop. This single drop represents the standard impact test protocol.

Standard Drop Height

Raise the hammer until the hammer hits the stopper at the top of the guide and release.

Plunger* to release the hammer to drop. 96055 10 kg

ASTM and Australian Standards

ASTM D5874 Standard test method for determination of the impact value (IV) of a soil.

AS 1289.6.9.1 Soil strength and consolidation test – Determination of stiffness of soil – Clegg impact value (CIV).

Hardware Warranty

Clegg Global guarantees its 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, Clegg Global will repair or replace, at its option, any instrumentation found to be defective in materials or workmanship. If a problem arises, 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 Clegg Global 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. Warranty period for repairs or used instrumentation purchased from Clegg Global is 90 days.

Clegg Global offers the information in this manual in good faith as a guide to suggested operation and procedure. Actual operation of the instrument or reporting and interpretation of the test results are the sole responsibility of the user. Liability is not accepted for any inaccuracies this manual may contain or for any defects in the Clegg Soil Impact Tester. Furthermore, it is the responsibility of the user to establish appropriate safety and health practices.

Clegg Control App



What is New?

What is New? The Clegg Control app replaces the previously available Clegg Control hardware with an app and a tablet. The app is more user-friendly and contains many more advanced features. The app further improves the Clegg test process by allowing users to preset specific testing locations and save scores based on previously tested locations.

Connect a Device

In order to connect the Clegg Control app to a Clegg device, be sure that the tablet with the Clegg Control app has Bluetooth enabled; the Clegg Control unit uses Bluetooth to communicate with the tablet. If a situation arises where the app is started without Bluetooth enabled, the app will display a warning allowing the user to enable Bluetooth.

1. Enable Bluetooth via tablet settings.
2. Tap the menu (hamburger-style) button (3 vertical dots) on the upper right of the screen.
3. Tap SELECT DEVICE from the new window.
4. For a new app installation Tap the SCAN button under the Scan for Available Devices area.

For an existing app installation, a list of previously connected devices is available. The devices are listed by serial number. The device serial number is available via the silver tag on the Control unit.

Tap the SELECT button for the device to which you wish to connect.

Once the device is connected, the battery level of the Control Unit is denoted by an icon in the top right of the screen.

App Settings

The App settings screen is used to personalize the application to the specific needs of each testing body. The App settings screen is available by tapping the menu button (3 vertical dots) on the upper right of the screen and selecting APP SETTINGS.

What are the available settings?

- Drop unit: CIV, g, F355, MPa, CBR*
- Display statistic: Peak, Average
- Export Preference: All Drops, Only Peak
- GPS Location Acquisition: Enabled, Disabled
- New Location Threshold: 5 meters, 10 meters, 20 meters, 50 meters, Disabled
- Latitude direction: North, South
- Longitude direction: East, West

* Note: The additional units of Megapascal (MPa - defines Resilient Modulus) and California-Bearing Ratio (CBR) are available when using a 4.5 kg Clegg device.

- $MPa = 0.088 (CIV)^2$
- $CBR = .1691 (CIV)^{1.695}$

Contact Support

Should you have any issues with the Clegg Control app, a contact support form is available by selecting CONTACT SUPPORT.

Drop Modes

The Clegg Control app has 2 drop modes: Advanced and Quick testing. Each time the application starts, the startup screen will have the user pick between Quick and Advanced testing. From the Home page for each type of test, the user will be able to switch to the other test type using the menu button and selecting either QUICK TESTING or ADVANCED TESTING.

Quick Testing Mode

Quick Testing Mode Allows a user to quickly make and store the scores for a series of drops from multiple locations. No settings are pre-loaded when performing a Quick Test. It is possible to add drops from multiple locations by tapping the NEW LOCATION button or configuring the app to automatically detect movement of the tablet. See the Using New Application Threshold section on page 26 for more information about available settings.

Setting Up a Quick Test

Click the Begin Test Button. Title your project and begin dropping. With GPS enabled, you can move to the next location and drop the hammer one time. A popup will ask you if this is a new location. You click the yes and continue with the remaining drops. Repeat.

If the popup message appears between drops and you have not moved, reply no. This will allow the drops to be added to the current location.

Create a Session

A Quick test can be started by tapping NEW TEST from the Manage Quick test screen.

Before beginning a test session be sure to have the necessary app settings selected via the App settings screen. Specific settings are detailed in the App settings area of this manual; the specific settings for standard procedures are available in the Testing procedure section.

1. Tap the NEW button on the Manage Quick test screen to display Run session screen.
2. Verify the on-screen details.
 - Serial number and status of Clegg device connection (at left)
 - Use the ADD LOCATION button as testing moves to different locations
 - Enter Test Description and Test Conditions in labeled locations
3. If necessary, connect Clegg device by tapping CONNECT button.
 - A connected device will become disconnected after 30 minutes of downtime.
 - A disconnected device will power off after 10 minutes. For more information about how to power up the device, see the Control: Power section on page 10.

Performing a Drop

When performing a drop, it is important to follow appropriate testing procedures.

Standard testing procedures are available in the Performing a Clegg Impact Test section on page 15. Each drop score is listed in order and can have comments added by tapping the drop value.

Adding a Drop Location

There are multiple ways to add new Drop locations for Quick tests. Comments can be entered for each location in the box labeled Location Comments. Tap on an existing location to go to that location.

- New Application Threshold can automatically prompt to add a new location when the GPS coordinates suggest the user has moved to a new location. Required distance can be set up via the App settings.
- Tap ADD LOCATION to create a new location

Using New Application Threshold: During a Quick Test, the app compares the current drop location with the previous drop location and prompts the user about creating a new location if the distance between drops exceeds this threshold. The selection should be based on the GPS accuracy and the typical distance between drop locations for the user. If Disabled is selected, the App will not perform the comparison.

Advanced Testing Mode

Advanced Testing Mode Allows users to create specific locations to define and store testing scores. For more information about creating an Advanced Drop test, read the Setting up an Advanced test section on page 27. The Clegg Control app uses the terms DROP SITE and DROP LOCATION to describe differing levels of location organization and cannot be used interchangeably.

What is a Drop Site?

WHAT IS A DROP SITE? A Drop site often describes the place where the testing is located (e.g. a specific road or sporting complex). A Drop site must be entered in order to continue the Advanced testing process. Drop sites are defined using a name and optionally an address.

How do I add a Drop site?

- A Drop site is added by tapping the NEW SITE button on the Manage sites screen
- Drop locations can also be added in advance by tapping the ADD button in the Drop locations area of the Drop site screen.

How do I edit a Drop site?

- Select a Drop site by tapping the EDIT button on the Manage sites screen.
- Site name and address as well as any available drop locations can be added or edited from the Edit site screen.

What is a Drop Location?

A Drop location describes the precise location of each testing drop. Drop locations can be defined using a name and optionally a description or GPS location. Stored locations can be optionally carried over into subsequent tests in order to make testing even simpler and more consistent.

How do I add a Drop location?

- Locations can be set up in advance using the Add or Edit Drop site screens.
- Add a new Drop site or select a Drop site by tapping the EDIT button on the Manage sites screen.
- Add a Drop location by tapping ADD button in the Drop locations section.
- On-the-fly by tapping the “+” icon in the Drop locations area of the Run session screen.

How do I edit a Drop location?

- Select a Drop site by tapping the EDIT button on the Manage sites screen.
- Select a Drop location by tapping the EDIT button corresponding to the drop location.
- Descriptions, GPS location and future usage can be edited.

Setting up an Advanced Test

Setting up an Advanced Test In order to run a Clegg Impact Test, be sure to first define a Drop site. Drop locations can be added in advance or on-the-fly via the Run test area. A short Help wizard is available by tapping the menu button (3 vertical dots) on the upper right of the screen and selecting HELP WIZARD.

Create a Session

CREATE A SESSION Before beginning a test session be sure to have the necessary app settings selected via the App settings screen. Specific settings are detailed in the App settings area of this manual; the specific settings for standard procedures are available in the Testing procedure section.

1. Tap the NEW button under a Drop site to bring up the Run session screen.
2. Verify the on-screen details.
 - Drop site location (at left)
 - Serial number and status of Clegg device connection (at left)
 - Drop locations, add additional locations by tapping “+” icon (at left)
 - Enter desired Site conditions in available text area (at left)
 - Drop Type: AVERAGE or PEAK (at right); controlled via App settings
3. Connect Clegg device by tapping CONNECT button, if necessary
 - A connected device will become disconnected after 30 minutes of downtime.
 - A disconnected device will power off after 10 minutes. For more information about how to power up the device, see the Control: Power section on page 10.
4. Follow the appropriate Testing procedures. Standard testing procedures are available in the Performing a Clegg Impact Test section on page 15.

Selecting a Drop Location

The listing of Drop locations can be traversed in multiple ways. In order to go down the list in sequential order tap the NEXT LOCATION button above the Drop location list. If you desire to move through the list in any order, tap a location name from the list. The currently selected Drop location is highlighted in green.

Performing a Drop

When performing a drop, it is important to follow appropriate testing procedures.

Standard testing procedures are available in the Performing a Clegg Impact Test section on page 15. Each drop score is listed in order and can have comments added by tapping the drop value.

NOTE: Depending on the desired protocol, multiple drops may need to be associated with a single Drop location.

VIEWING RESULTS

One of the biggest improvements of the Clegg Control app is that previous scores are stored in the app database.

Saving Session Scores

The Clegg Control app saves the session after each drop is recorded. The current session can be exited by tapping the FINISH button in the upper right of the Run session screen. A finished session cannot have additional drops added in the Advanced Testing mode but is allowed on the Quick Testing mode.

Viewing Previous Scores

1. Because of the difference in record keeping, each testing type follows specific methods to view scores.

- Quick test: Enter Start and End dates and tap FILTER
- Advanced: Tap VIEW on the desired Drop site

2. Previous sessions are listed by date and time. Select a session (date/time) by tapping the VIEW button for the desired session.

3. Drop locations are listed with the Peak or Average score and any conditions or comments concerning that specific location.

4. All drop scores for a specific location are available by tapping the SHOW button (at right). After showing the scores, tapping the HIDE button will hide the scores.

- Drops are listed by number and contain a score as well as any comments concerning that specific drop.
- Units shown are based on the current app settings. Details for the app settings are available in the Getting Started section on page 23.
- Each drop can optionally have comments recorded by tapping the value and entering them into the provided text box. 26

SHOW MAP

The SHOW MAP button appears when viewing results for either a Quick test or Advanced test session. It displays a map with markers at all drop locations for which GPS coordinates were obtained. Tapping on a marker brings up details about the drop including the result, time, and GPS accuracy for the drop. A button in the lower right corner allows switching between a “Satellite” or “Street” view for the map.

EXPORTING DATA

Two distinct ways to export data are available:

- Selecting EXPORT DATA from the menu exports all stored results in CSV format.
- Tapping the EXPORT DATA button when viewing results for a Quick or Advanced

Test session exports data for the current session in CSV format. App Settings contains the setting Export Preference for selecting whether to include all drops or only the peak value in the CSV file.

NOTE: The default application for handling exported files can be selected by following the instructions for updating default applications for your operating system.