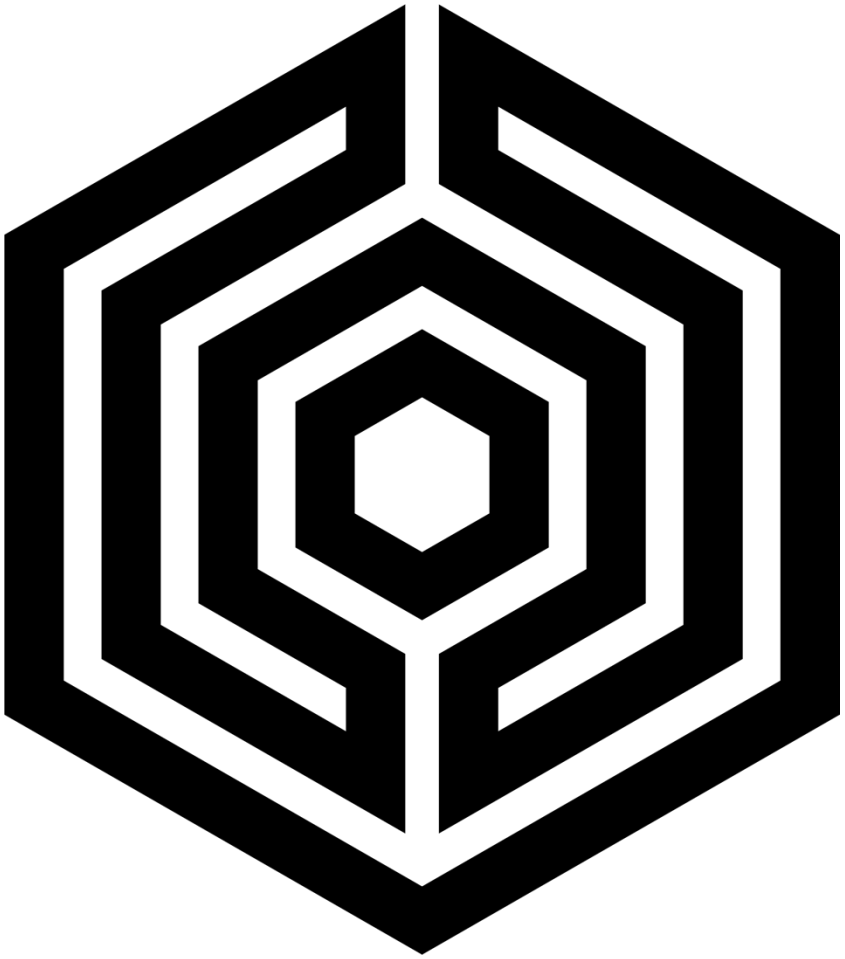

CHUCK

Bolting Data Processor

Operations Manual (v.3)

HEX TECHNOLOGY
2022

Contents

Video Guide to Setup **1**

Welcome to CHUCK **2**

Hardware Check: Procuring Bolts for CHUCK *2*

Required Equipment for Use *2*

Unboxing Your CHUCK *3*

Powering Up Your CHUCK *3*

Installing CHUCK to Your Bolting Skid *4*

Important Note About Paint *4*

Setting Up CHUCK's Software **5**

Connect to CHUCK *5*

Getting Started in the Software *5*

Status Setup *6*

Using CHUCK **7**

Navigation Buttons *7*

Configure Your CHUCK *7*

Bay Setup *11*

Calibrating, Connecting and Zeroing Your Bolts *12*
A. Connect Cables to Brain 13
B. Calibrate Cables and Brain 14
C. Connecting Cables to Studs 14

When to Calibrate (And Why it Matters) *15*
D. Dealing with Stud Failures 16

Shutting Down *16*

Using CHUCK with Flanges **19**

Pro Tip: Zeroing and Elastic Interaction *20*

Using CHUCK with a Torque Stand **21**

Torque Stand Quick Reference *22*

Datalogger **23**

Create Study *23*

Start Study *24*

Running Studies *24*

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Running Elsewhere (Possible Zombies) *24*

Completed *25*

Software Update **27**

Video Guide to Setup

In addition to the written manual, you can follow these step-by-step guides to unboxing your CHUCK, connecting it to your training skid, and performing the initial software setup. Click on the links to view our video library.

1. Unboxing CHUCK: What's Inside
2. Connecting CHUCK to the Grounding Wire
3. Connecting CHUCK to the Training Skid
4. Connecting the Server to CHUCK and the Skid
5. CHUCK's Cable Bays: An Overview
6. Connecting CHUCK to Cables and Bolts
7. CHUCK Initial Software Setup

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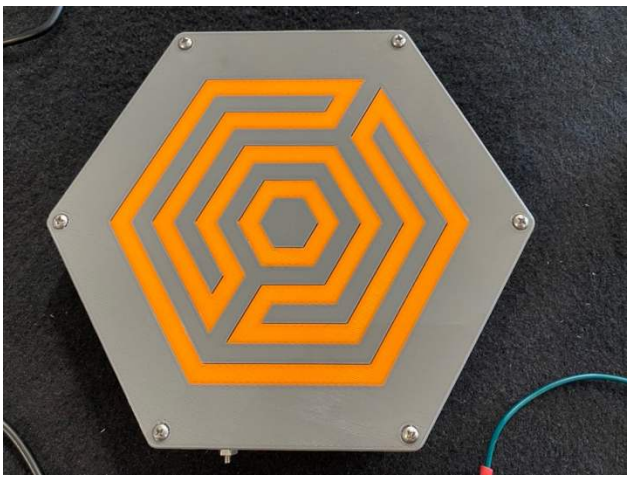
Welcome to CHUCK



CHUCK pairs with instrumented bolts to provide accurate bolt load readings in real time.

These readings are useful for training and testing personnel involved with the assembly of bolted flange joints.

With CHUCK, the complicated physics of bolting become clear as day, with each reading displayed clearly on any wi-fi enabled laptop, smartphone or tablet.

The following guide walks you through the setup and use of CHUCK.

CHUCK is available in two configurations. The original version can communicate with up to 16 instrumented studs with four bays having four ports each. We also have a 24-port version with six bays of four ports each to communicate with up to 24 instrumented studs.

Hardware Check: Procuring Bolts for CHUCK

CHUCK must be paired with instrumented bolts from manufacturer James Walker.

The unit is compatible with certain studs sized from 5/8” to 1-1/2”. (Additional sizes available upon request.)

If you have not already, contact James Walker representative John Carr at john.carr@jameswalker.biz to order your bolts.

Required Equipment for Use

- CHUCK data processor (contents listed below, see “Unboxing Your CHUCK”)
- Instrumented bolts (4 to 24 bolts total, size range 5/8” to 1-1/2”).
- Matching nuts for bolts
- RG-316 coaxial with SMB connectors
- Flange compatible with bolt configuration
- Torque stand unit (optional) (requires four 3/4” bolts)

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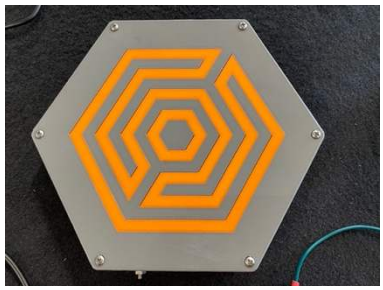
Unboxing Your CHUCK

The package you receive will contain 6 items:

<table>
<tr>
<td> 
CHUCK Brain
(Hexagonal box)</td>
<td>
Server
(Black box)</td>
<td>
Ground Wire</td>
</tr>
<tr>
<td>
Micro B USB Cable</td>
<td>
Power Supply with USB-C connector</td>
<td>
Four (4) #10 machine screws for mounting CHUCK Brain. (Packaged in red bubble wrap.)</td>
</tr>
</table>

You will find a label on the underside of the CHUCK Brain with the WiFi network name, the WiFi password, and the CHUCK serial number. You will need those items to connect to your CHUCK.

If you discover an item is missing, contact help@hextechnology.com.

Powering Up Your CHUCK

1. Connect the CHUCK Brain to Server using USB cable.
    a. Connect the USB cable to the Chuck Brain using the Micro B USB port centered on one edge of the box.
    b. Connect the other end of the USB cable to any of the four USB ports on the Chuck Server.
2. Power up Server and Brain.
    a. Connect the power supply cable to the USB-C port on the side of the Server.

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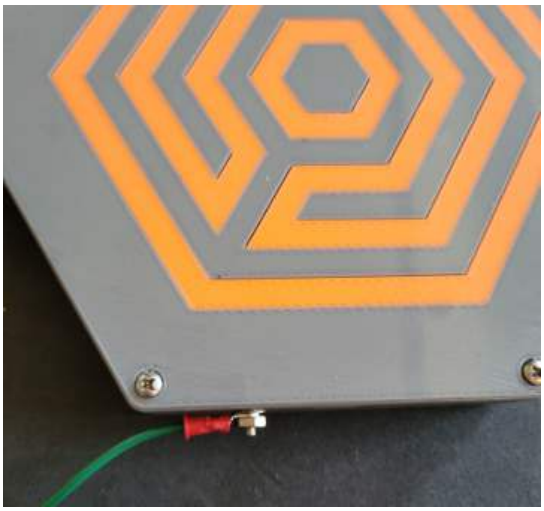
   b. Plug power supply into a wall socket. (CHUCK comes with a universal power supply that will operate on 120 VAC 60 Hz power or 240 VAC 50 Hz power.)
3. Ground the CHUCK Brain.
   a. Connect ground wire to grounding stud on CHUCK Brain (shown, right).
   b. Connect opposite end of ground wire to an appropriate grounding point. The ring terminal is sized for the #10 machine screws that are used to mount the CHUCK Brain. We recommend you ground at one of the mounting screws.



IMPORTANT: CHUCK box MUST be grounded to a point that is electrically connected to the flange containing the instrumented bolts. Failure to establish a ground connection will result in erratic bolt stress readings.

Installing CHUCK to Your Bolting Skid

Both the CHUCK Brain and its companion server can be attached to your skid.

If you've fabricated your skid according to the spec provided by Hex Technology, there will be mounting brackets for both the CHUCK Brain and Server.

Important Note About Paint

Each stud must be electrically connected to the ground stud on the Chuck Brain. Often, when the skid is assembled and painted, the electrical connection between the studs and skid is interrupted by paint. This is particularly common when connecting the torque stand to the skid using a "trailer receiver".

Before connecting studs to the brain, use an Ohm meter to measure continuity between each stud and the ground stud on the brain. (Do this with no load on the studs.) **All studs must have continuity to the ground stud for correct operation.** If you read more than 100 Ohms for any stud, remove paint, and tighten mechanical connections.

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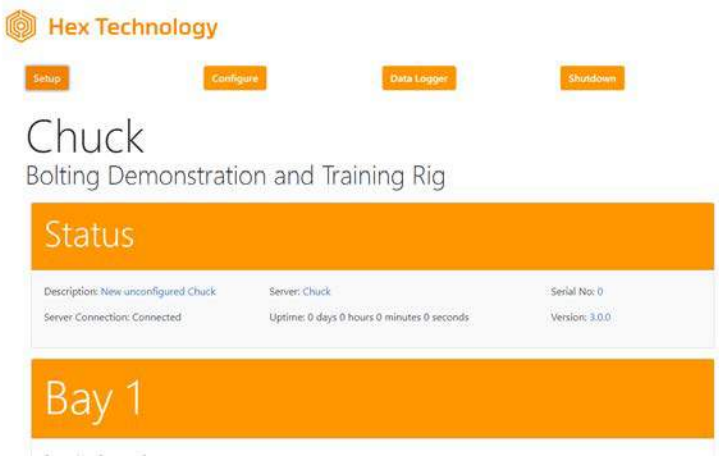
Setting Up CHUCK's Software

For the following steps, you will need a Wi-Fi enabled laptop.

Connect to CHUCK

1. Connect your laptop to Chuck:
    a. Find the label attached to the underside of the CHUCK Brain with the WiFi Network ID (usually "Chuck") and password.
    b. From your laptop's wi-fi selector (or the "Network Preferences"), look for the CHUCK wireless network.
    c. To connect, enter the WiFi password.
2. Open your internet browser.
3. Type "http://chuck/" into the navigation bar.
    a. Note: On some computers and browsers, you won't need to type the "http://".
    b. Some computers and browsers will think you are searching for a friend named "Chuck." If you have that problem, key in the Server IP address (http://192.168.4.1) into the navigation bar.
    c. You will arrive at CHUCK's user interface:



CHUCK User Interface.

Getting Started in the Software

You'll see the user interface consists of 3 main areas:

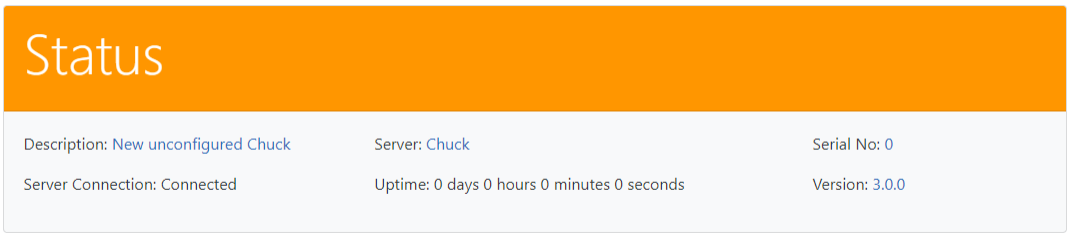
1) Top navigation buttons

2) A “Status” section presenting server address and serial number
3) A section showing four to six Bays (Bay 1, Bay 2, etc.)

We will discuss each of those items later. During startup, your first step is to provide the necessary information in the Status window.

Status Setup

The “Status” block provides 6 pieces of information on how your CHUCK is operating.



An example of the information you’ll see in CHUCK’s Status Bar.

During the initial setup, you need to:

1. Click on “Description,” then enter a short name for your CHUCK. The name can be anything you like, using any characters or capitalization you wish.
2. The “Server” field is pre-set with “Chuck.” If you had to enter the IP address in the browser’s navigation bar when connecting, you’ll need to enter that instead.
3. The Serial No field needs to match the serial number that you will find on a sticker on the CHUCK Brain. Click on the “0” and enter the serial number.
4. The Server Connection field tells you if the address you entered in the Server field (number 2, above) is working.
5. The Uptime field will begin counting up about 30 seconds after you enter the correct server name and serial number. This is your indication that your system is working properly.
6. The Version field shows the version of CHUCK software you are using, and after connection to your CHUCK Brain, the firmware version of the Brain. These are useful to know if you are talking to Hex technical support.

That completes the initial connection and configuration.

Congratulations! You are now ready to begin training and testing with CHUCK.

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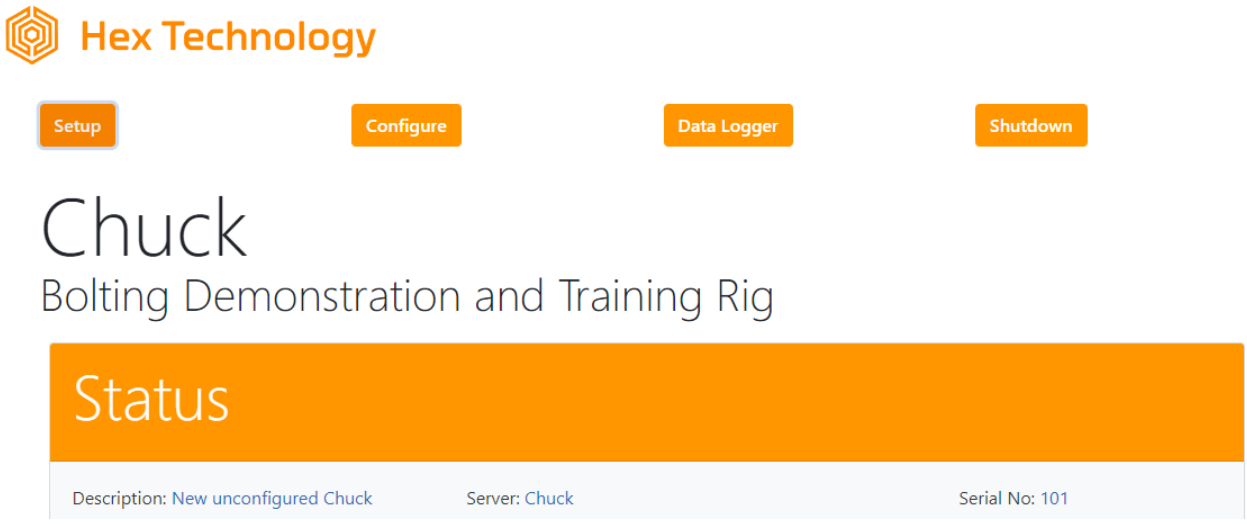
Using CHUCK

Navigation Buttons

The navigation buttons along the top of the screen allow you to navigate through CHUCK's various menus and utilities.



The "Setup" button is highlighted to indicate that is the active page.

When you first start up, you will see four buttons:

- Setup
- Configure
- Datalogger
- Shutdown

As you configure your CHUCK, you will see additional buttons appear between Datalogger and Shutdown labeled with the names of three "stations" you have assigned to bays. Those stations can be configured on the Configure page.

Configure Your CHUCK

Click on "Configure" to access the Configuration Page.

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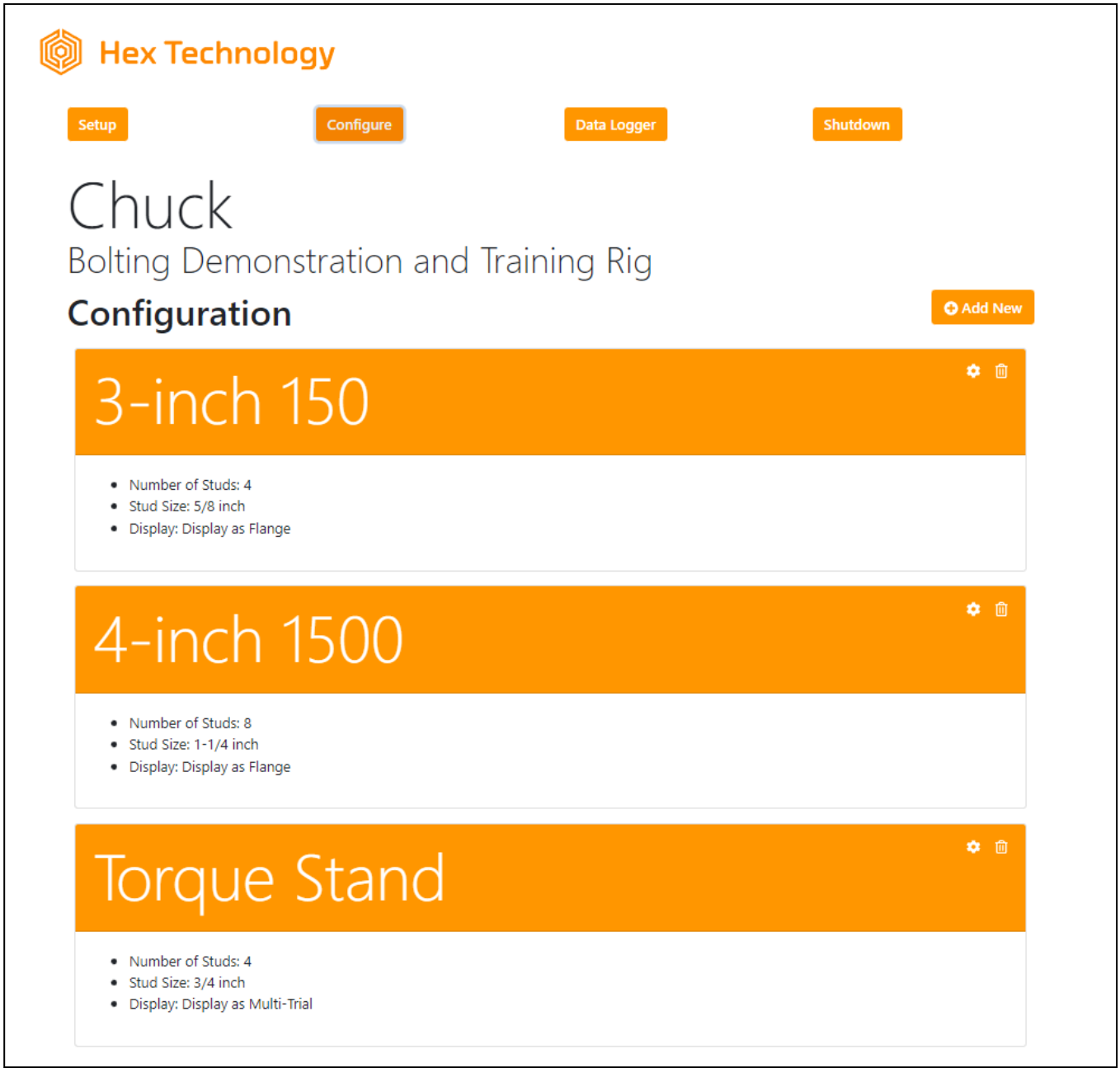

You can configure your system to measure bolt load on multiple flange assemblies. Those assemblies are called “Stations.”

CHUCK comes pre-loaded with configuration for a 3-inch 150# flange, a 4-inch 1500# flange, and a “Torque Stand.” If you want to use a different configuration, you can add, edit, and delete the stations on the configuration screen.

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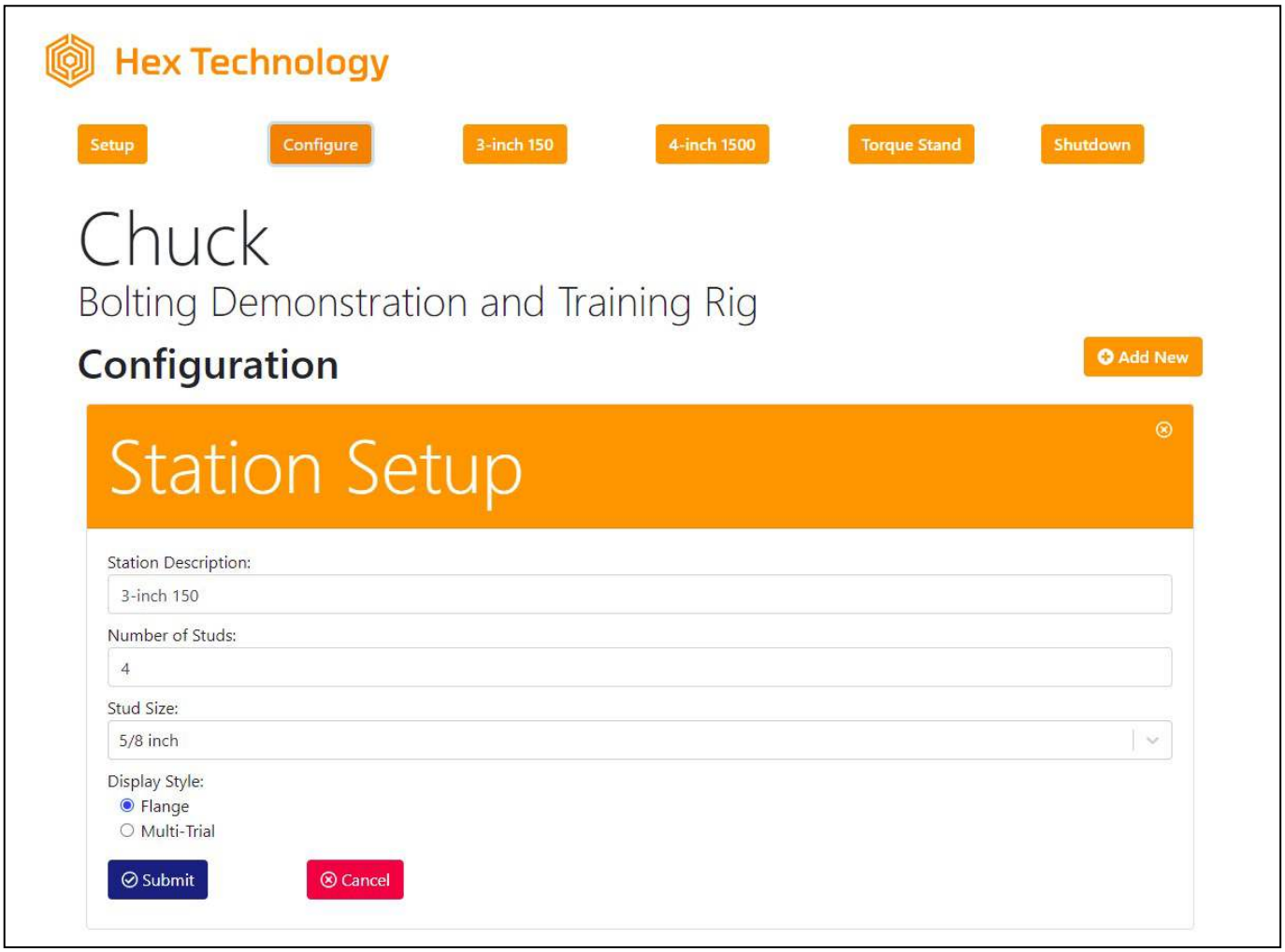
To change a station's configuration, click the cog icon (⚙) in the upper right corner. You will arrive at a Station Setup window:



In Station Setup, you can adjust…

- **Station Description**, which is the text in the navigation button at the top of the page
- **Number of studs**: Up to 16 studs maximum
- **Size of studs**: Currently supports 5/8", 3/4", or 1-1/4".
- **Data display style**: Flange or Multi-Trial
    - **Flange** means the Station's data display page will show a flange diagram along with columns showing the bolt load on each stud. The columns will change in real time as bolt loads change.
    - **Multi-Trial** is for use with the Torque Stand, or four 3/4" bolts in a fixed arrangement so there is no elastic interaction or flange rotation involved in the assembly. A Multi-Trial station allows up to five successive assemblies to be stored within a single screen (shown below), which is helpful for comparing the effect of good vs. bad assembly practices.

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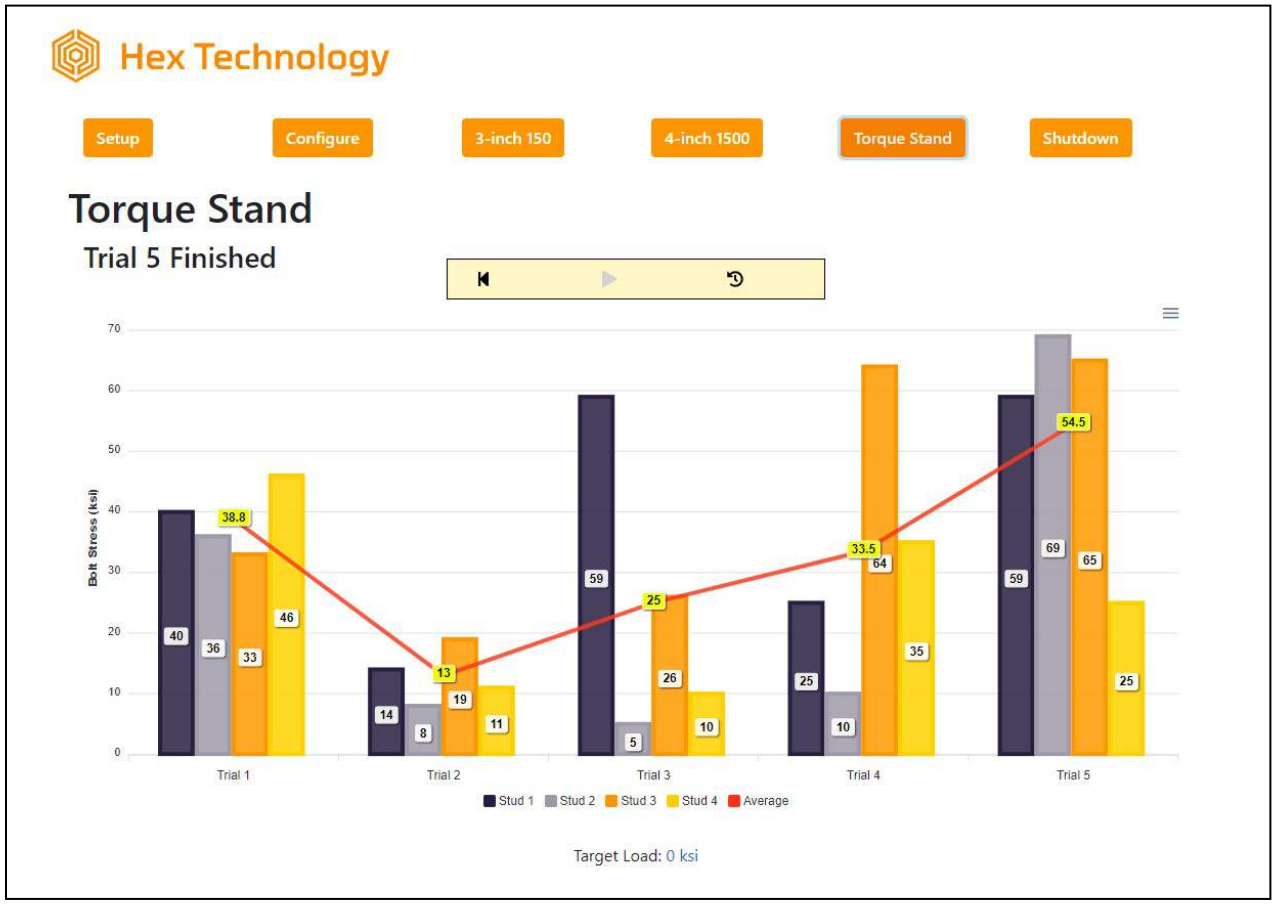
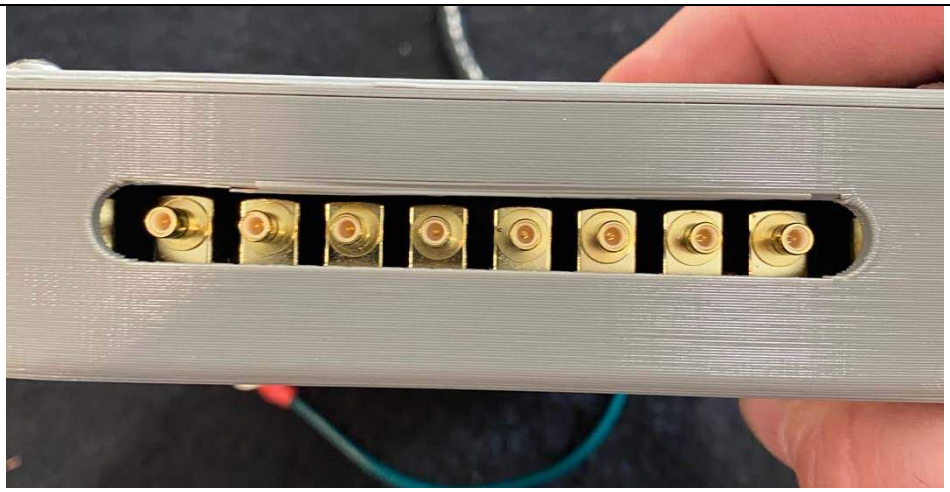


More about how to use the Multi-Trial system is included below (SEE SECTION: “Using CHUCK with a Torque Stand”).

Once you have configured a Station, click “Setup.” Setup is where you’ll go to assign ports on the CHUCK Brain to studs within the flange or torque stand you’ve configured.

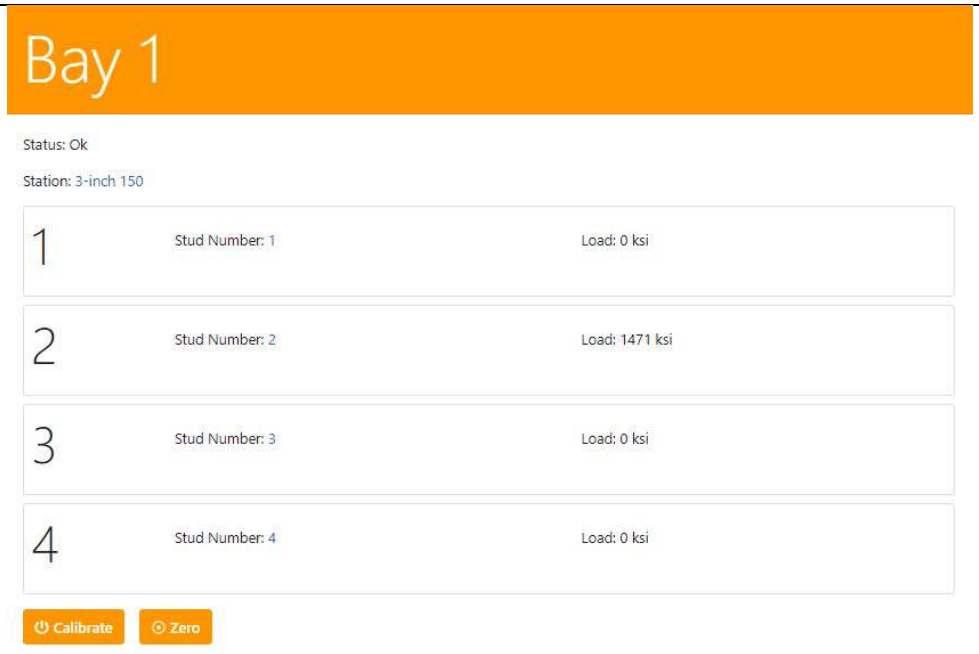
Bay Setup

The CHUCK Brain has four sets of coaxial connectors within each Bay.



Two *Bays are shown above. The four coaxial connectors to the left are one Bay, and the four on the right are the other Bay.*

You'll use the "Setup" page within CHUCK's software to tell the unit which ports connect with which studs.



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Each Bay contains…

- **A "Status" field**. Reads "Ok" if CHUCK Brain is on, connected to the Server, and working properly. Otherwise, it will read "Not Connected."
- **A Station** assigned to the bay. Click on the Station name to get a dropdown allowing you to select any of the Stations configured on the Configuration page.
- **Four Numbered Sections**, one for each of the ports. Here, you can define the stud number that port relates to.

Click on the number to change it. You will generally number these 1-4.

For an eight-bolt flange, you simply assign two bays to the same station and number the bolts 1-4 on one bay and 5-8 on the second bay. Twelve and 16-bolt flanges can be set up in the same way. With the 24-port version of the CHUCK Brain, the setup screen will include Bay 5 and Bay 6 areas so that 20-bolt and 24-bolt flanges can be configured.

To the right, you will see the current bolt load measured on each port. Until you've completed setup, the number will be invalid. But after everything is configured and connected, it will show the current bolt load.

Calibrating, Connecting and Zeroing Your Bolts

This section describes how you'll go about connecting your CHUCK Brain to the instrumented bolts. The first step is connecting cable bundles to the Brain unit only.

IMPORTANT NOTE: Do not connect cables to bolts until after calibration is complete.

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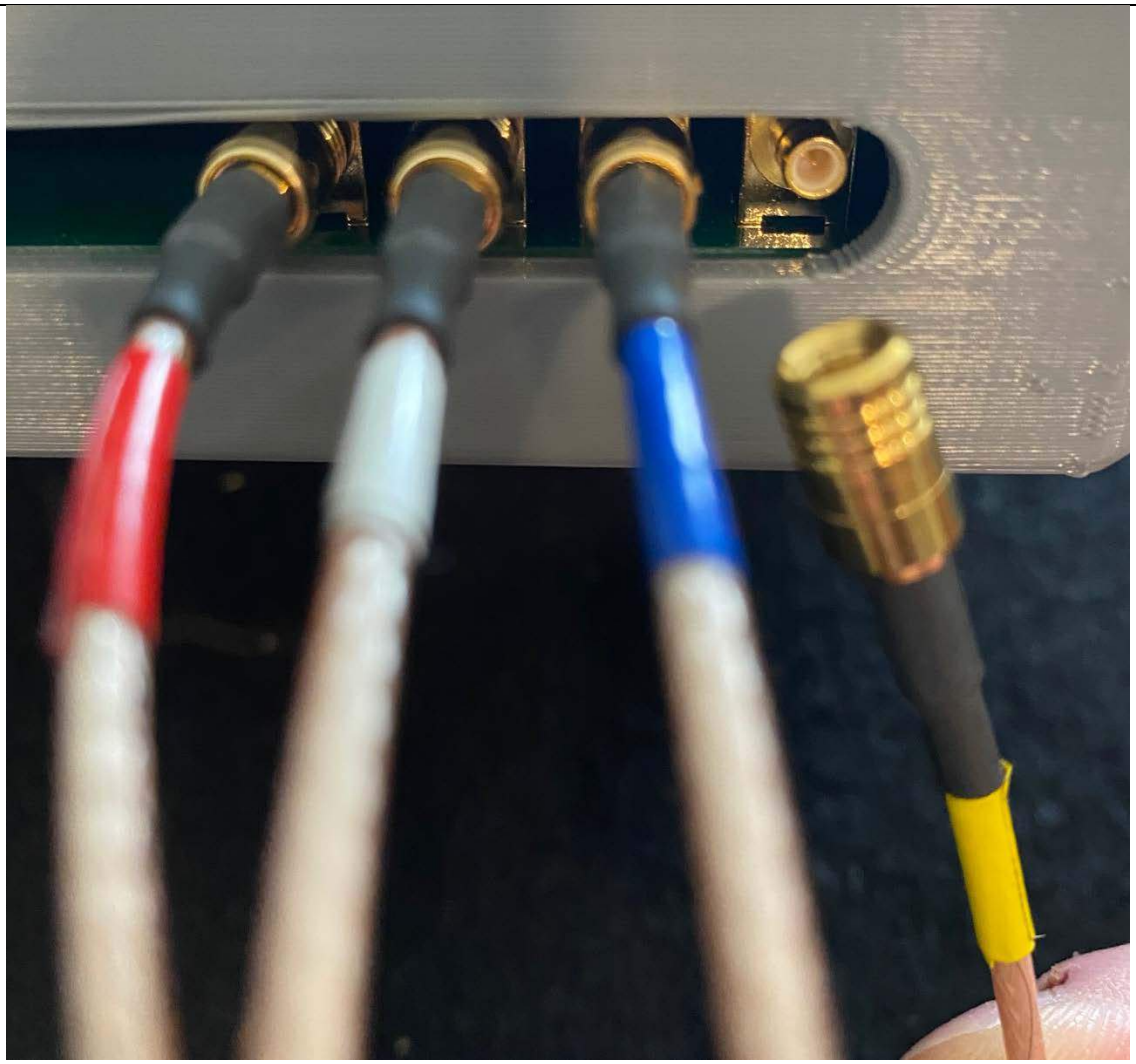
A. Connect Cables to Brain

Each cable bundle contains four coaxial cables marked red, white, blue, and yellow.

We recommend using following sequence when connecting cables to the numbered ports:

1. Red
2. White
3. Blue
4. Yellow



Attach red cable to connector #1, white to connector #2, blue to connector #3, and yellow to connector #4.

Once cables are attached to ports on the CHUCK Brain, but *not yet attached to the bolts*, you must calibrate the Brain.

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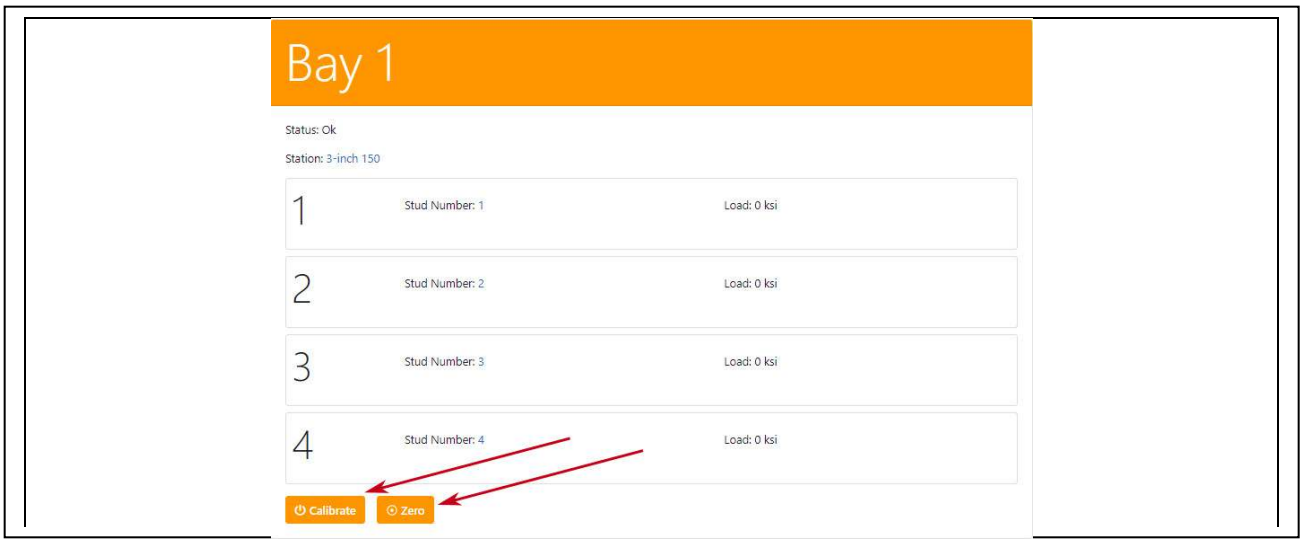
B. Calibrate Cables and Brain

Return to your laptop and navigate to the Setup page.

You'll see "Calibrate" and "Zero" buttons in the lower left corner for each bay.

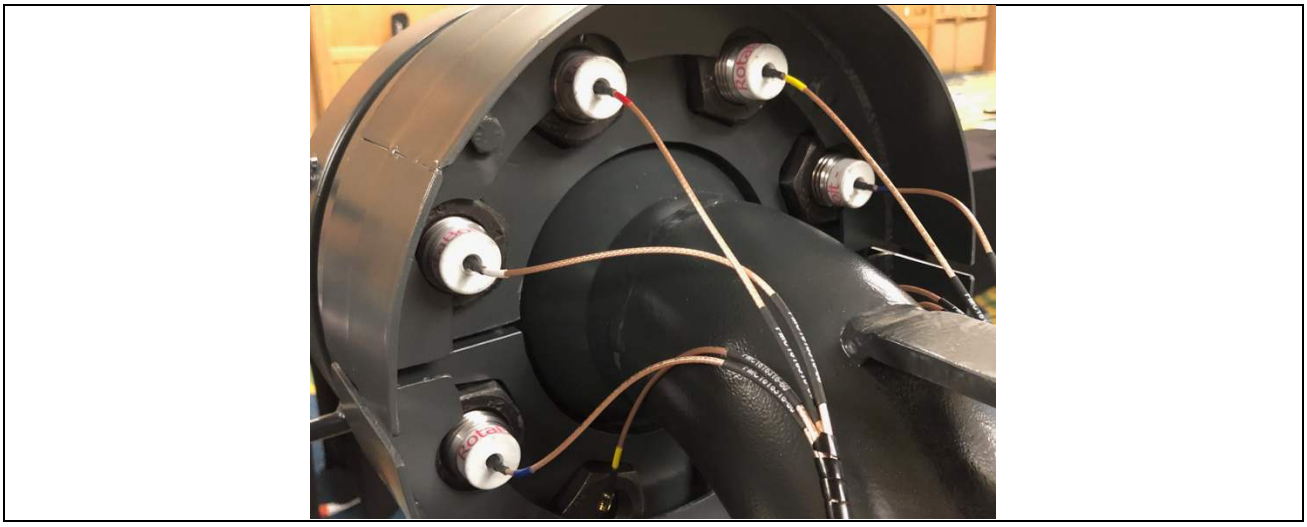


Click "**Calibrate**."

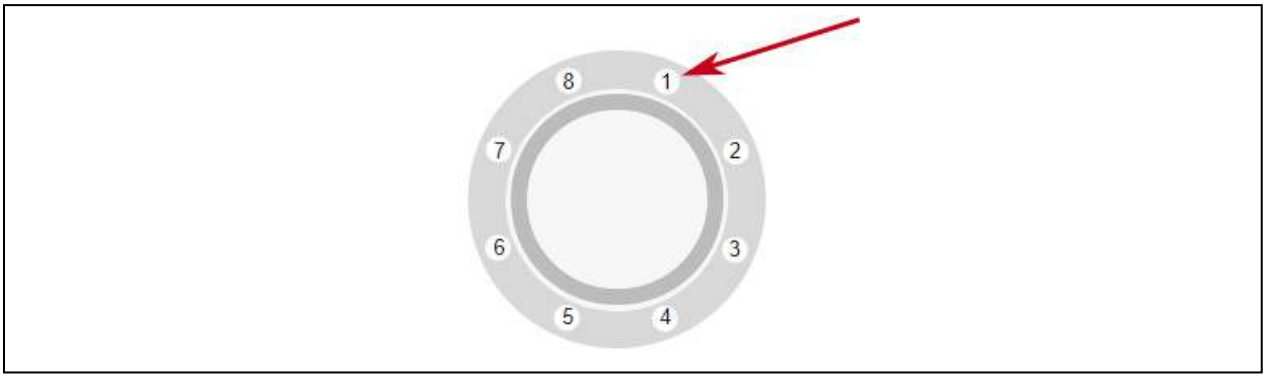
You will see a spinner for a few seconds. Once the spinner is gone, calibration is complete.

C. Connecting Cables to Studs

After calibrating each Bay, connect cables to the studs.



Connect the cable from Port 1 to the stud you consider Stud 1. Generally, this is the first stud clockwise from the top when looking at the front of the flange.



For the Torque Stand, we recommend Stud 1 be the left-most stud.

Once cables are connected to studs, return to the CHUCK interface on your computer and press the “Zero” button.

You need to use the Zero button each time you connect instrumented studs to the CHUCK Brain, or any time you see bolt load drift off zero for an unloaded stud.

When to Calibrate (And Why it Matters)

When you press “Calibrate,” the CHUCK Brain measures the effect of its internal circuitry and the connected coaxial cable. So long as you do not disconnect the coaxial cable from the CHUCK Brain, you will not have to press calibrate again.

However, it is important that you recalibrate whenever you change the connection between the port and the cable.

And remember: **Only** calibrate when cables are attached to the Brain but not to a bolt.

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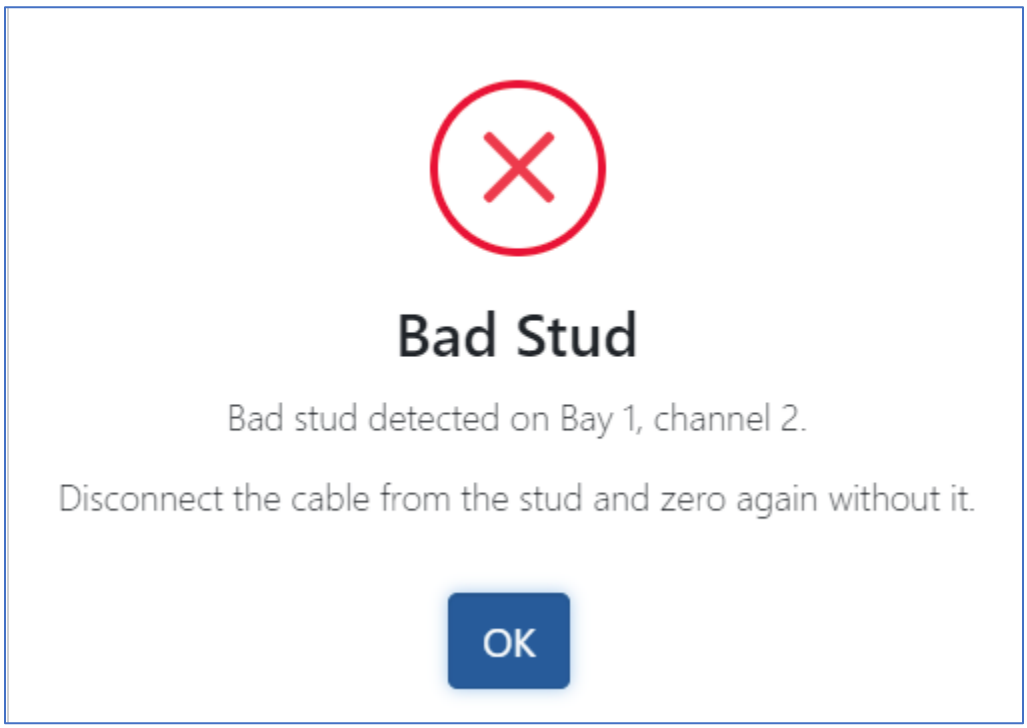
D. Dealing with Stud Failures

It is possible for a stud's sensing element to fail causing it to read exceptionally high loads and give an error when you press the zero button. If this happens, you will see an error message that looks like this.



The error message will provide a clue as to which stud has failed. However, a failure of one stud can affect readings on adjacent studs. If you disconnect the stud listed in the message (Bay 1, channel 2 in the above message) and then you get the error on an adjacent stud, disconnect that stud as well and repeat. When you stop getting the error, try reconnecting the first stud you disconnected and zeroing again. Once you have isolated the offending stud, you can replace that stud and continue.

Shutting Down

When your day's work with CHUCK is complete, we recommend you press the Shutdown button on the navigation bar to allow CHUCK to shutdown gracefully before unplugging the server.

When you press the shutdown button, you will see an "Are you sure?" prompt. Press the OK button, and then it's safe to unplug the server.

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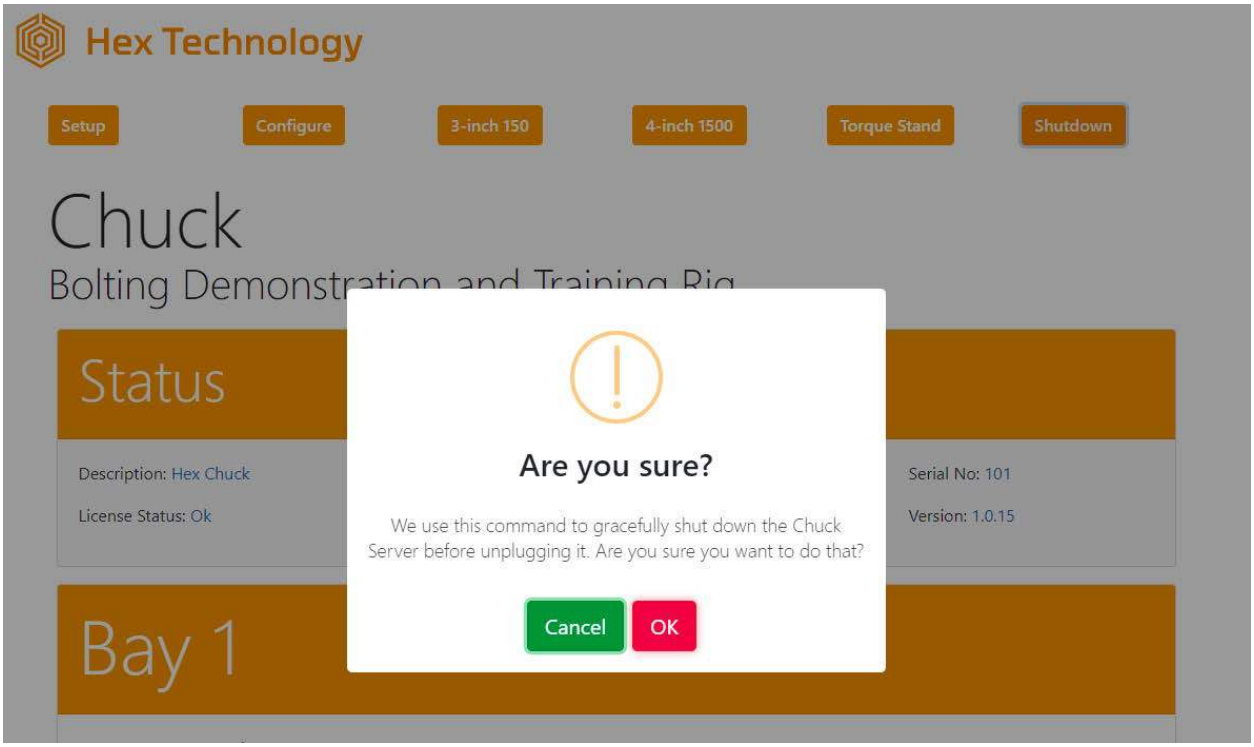
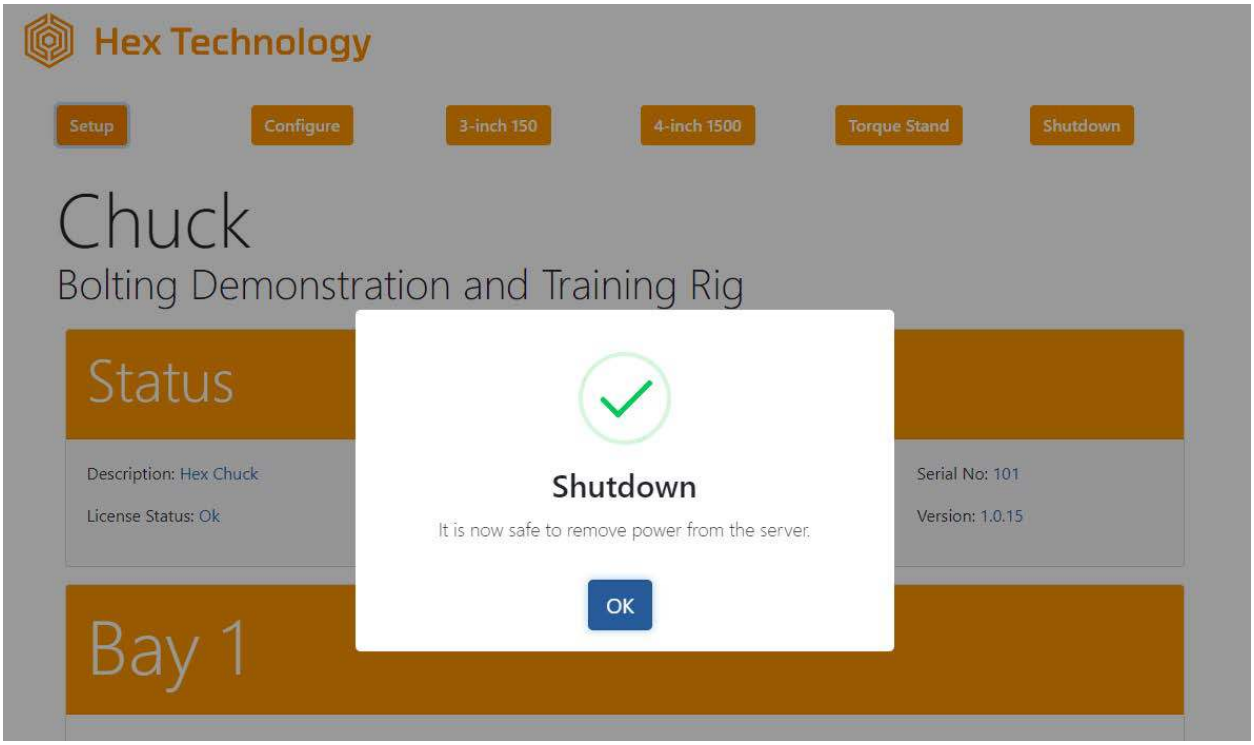


Clicking OK will show the Shutdown box and cause the server to shut down.



After a few seconds, you will see the “Server” indication in the status box change from “Connected” to “Not Connected” as an indication that the server has stopped.

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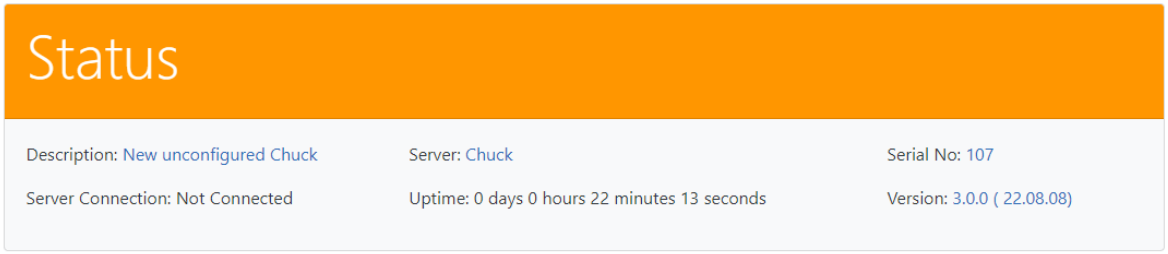
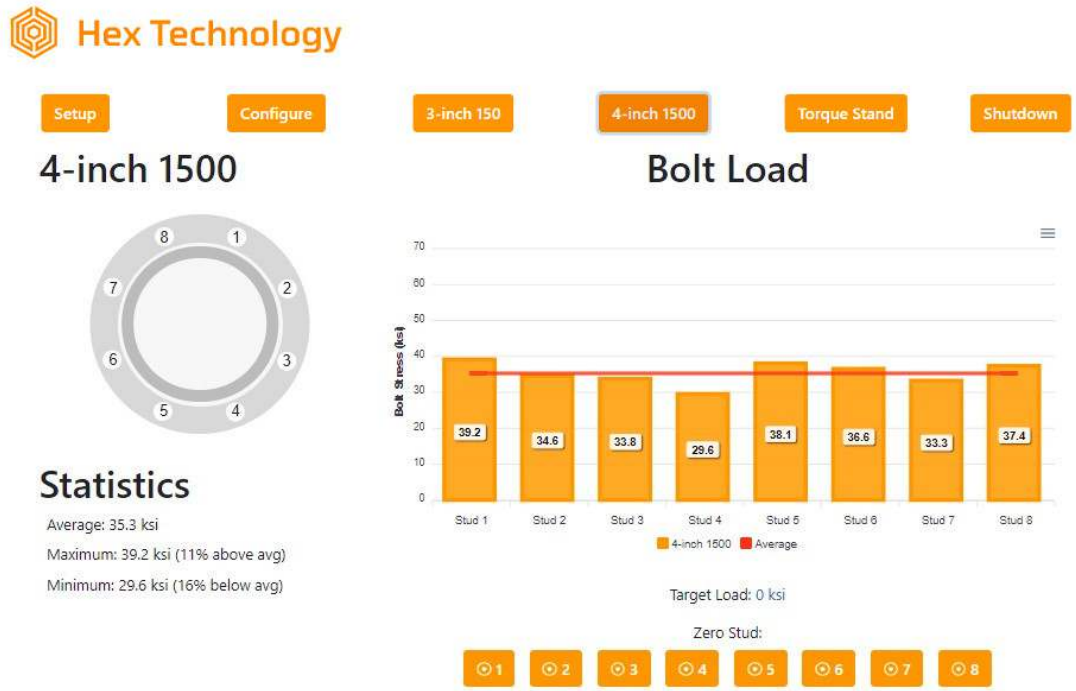


Once you say OK to the “Are you Sure” notification, it is safe to unplug the server.

Using CHUCK with Flanges

With flanges, CHUCK provides a real-time graphic display of bolt load.

Flanges can range in size from 4-bolt to 16-bolt or 24-bolt (depending on the model of Brain). Once you have the software configured, using the system is as simple as navigating to the page for the flange, applying torque in the pattern of your choosing, and viewing the results.



Example Flange reading. The stud with the greatest bolt load has 39.2 ksi, which is 11% above average bolt load. Likewise, the stud with the least bolt load has 29.6 ksi, which is 16% below average.

The load on each stud appears as a bar with a number indicating the bolt load value inside.

The average load on all the studs will appear as a red horizontal bar through the columns.

Values for the minimum, maximum, and average load on the flange will be listed at left.

If desired, you can download the graph as a picture (in .png or .svg format) or download the final load values in .csv format. To access these options, use the three-bar menu icon (☰) in the upper right corner of the graph.

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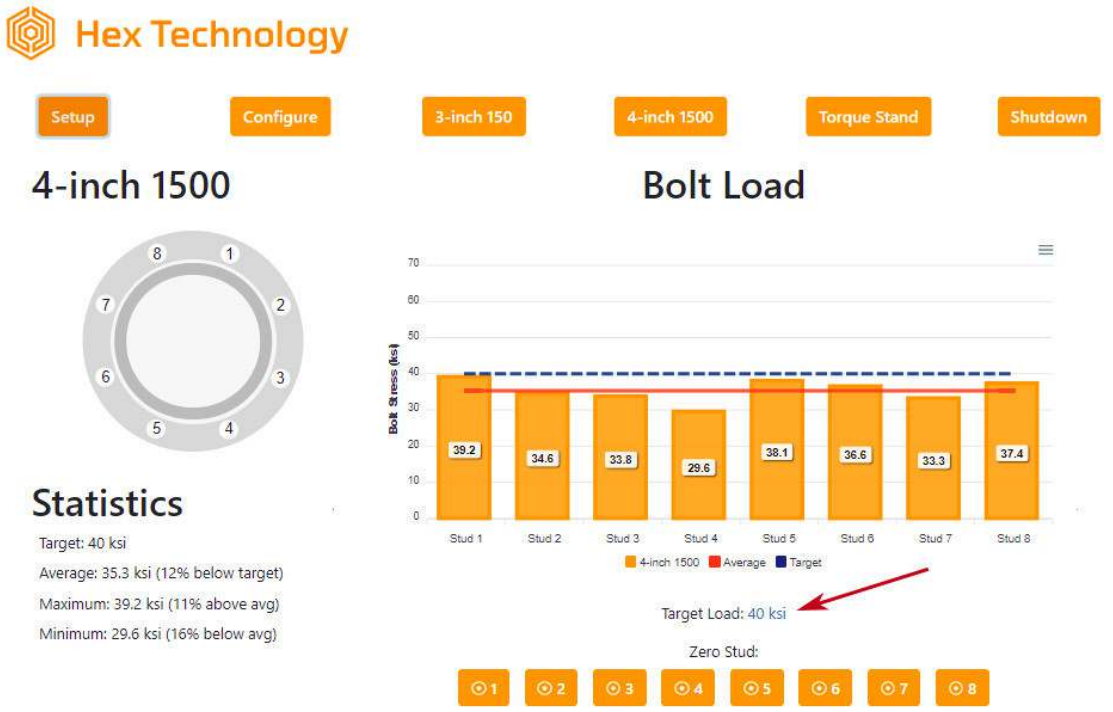
Pro Tip: Zeroing and Elastic Interaction

Before applying load to the bolts, if you notice any are not producing a zero (“0”) reading, you can zero that bolt within the User Interface. Press the button corresponding to that bolt beneath the “Zero Stud” heading at the bottom of the page.

After you start applying load, you will see load appear on bolts that have not yet been torqued. These loads are due to elastic interaction and are real. Don’t zero them.

Within the Flange screen, you can enter a target bolt load at any time by clicking the Target Load number. This will make the target load appear as a dashed blue line across the graph. The Statistics table will show how much the average load deviates from the target.



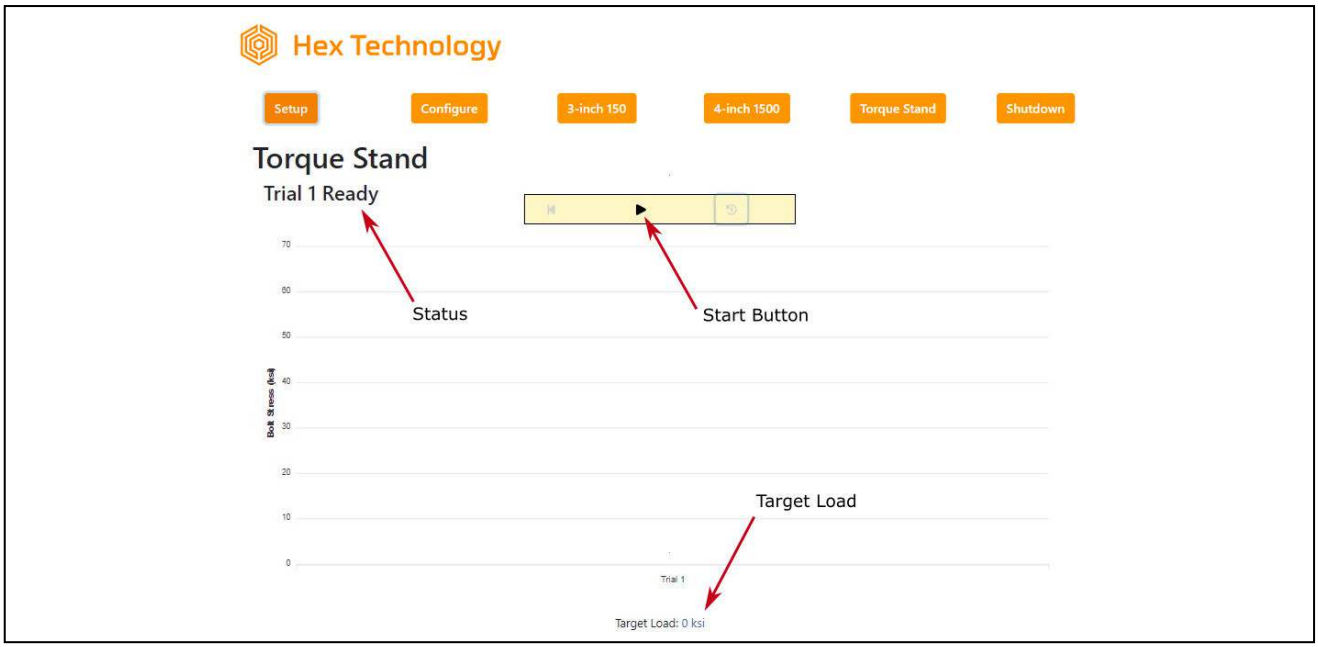
Example Flange reading with target. *The target was 40 ksi and the average was 12% below the target.*

Using CHUCK with a Torque Stand

The torque stand allows you to record up to 5 trials in a single test.

Having multiple trials lets you illustrate differences in bolt load that can result from different assembly processes, such as proper/improper lubrication, tool selection, or tool use/misuse.

At the “Torque Stand” page (shown below), you will see an empty graph along with a notice that Trial 1 is ready. You’ll also see a start button.



The Torque Stand allows you to enter a target torque, which will show up as a blue line on the graph.

When you are ready to begin a trial, press the start (▸) button. You will see a spinner while the system zeros the studs.

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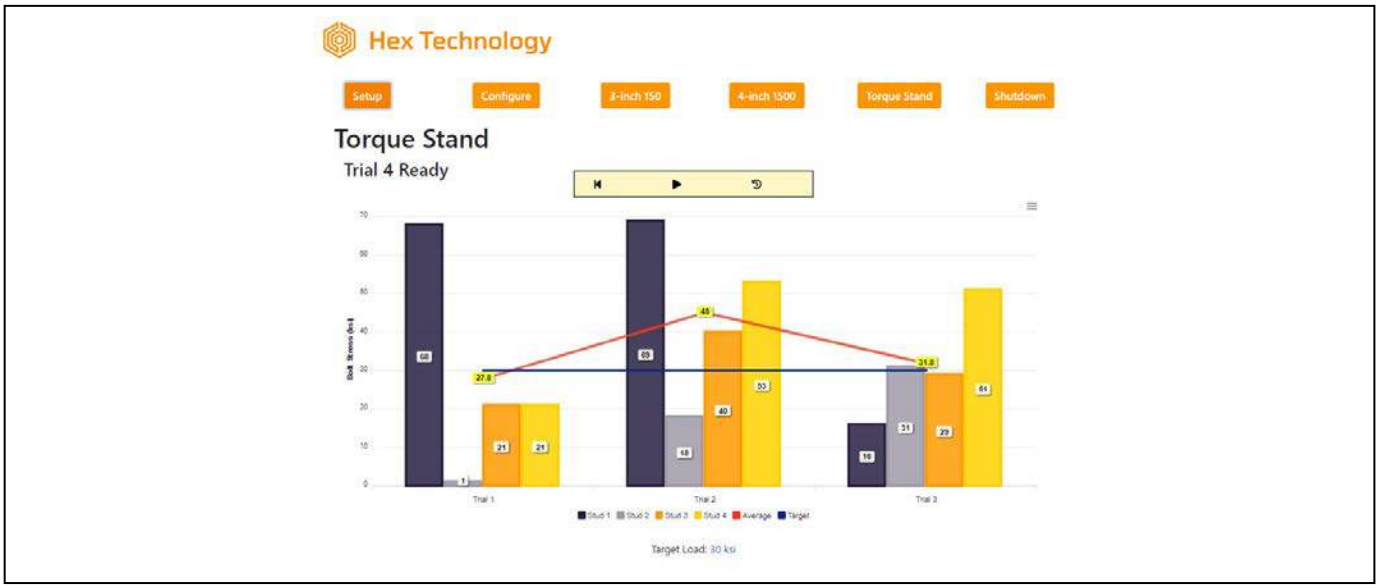
Once zeroing is complete, the status will change to “Trial 1 Running” and the start button will change to a pause button (⏸).

Begin tightening studs. The load on each bolt will display in real time along with an average for all four bolts in that trial.



Once you have finished applying torque to all studs, press the pause (⏸) button to save the values measured within that trial.

Press the start button (⏵) to begin the next trial. Repeat to record up to five trials.

The controls on the page also include a back button (⏮), that you can use to repeat a trial, and a reset button (↺) that you can use to clear the screen and start a new operation at Trial 1.

Torque Stand Quick Reference

- Press “Play” (⏵) to start a trial.
- Apply torque to bolts.
- Press “Pause” (⏸) to stop the trial and record the bolt readings.
- Press “Play” (⏵) to start a new trial.
- Repeat for up to five (5) trials.
- To adjust or redo a trial, Press the “Back” (⏮) button.

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Datalogger

New in Version 3 is a datalogger feature. Many end users requested a way to record the bolt loads during assembly training or for longer term relaxation studies. CHUCK is now capable of recording loads on all bolts connected to a single flange at specific intervals and logging those loads to a spreadsheet.

The one consideration to keep in mind is that the data is logged by the computer that start the study. That browser window must stay open and not navigate away from the Chuck app during a study. Otherwise, the data collection will stop.

The datalogger process includes creating a study, starting and stopping the study, and downloading the data.

Create Study

The datalogger page includes a button to click to create a study. Clicking that button brings up the study configuration box:

The title and description for the study can be anything you want. They are for your reference. In the Station box select one of the flanges that is set up on your CHUCK. The frequency defines how often the data is collected. For a long-term study, you might want to collect data every 5 minutes (300 seconds), whereas for a snapshot of one assembly you might want to collect as often as 0.5 seconds. When your study is complete, you will get a spreadsheet with the minimum, maximum, and average values over each interval.

For example, if you set the study to collect data every 5 minutes, the computer will monitor bolt load continuously, and then after 5 minutes, calculate and save the minimum, maximum, and average values for that set of data. Then the computer will begin again for another five minutes. In the end, you will have a set of data points every five minutes for the duration of the study.

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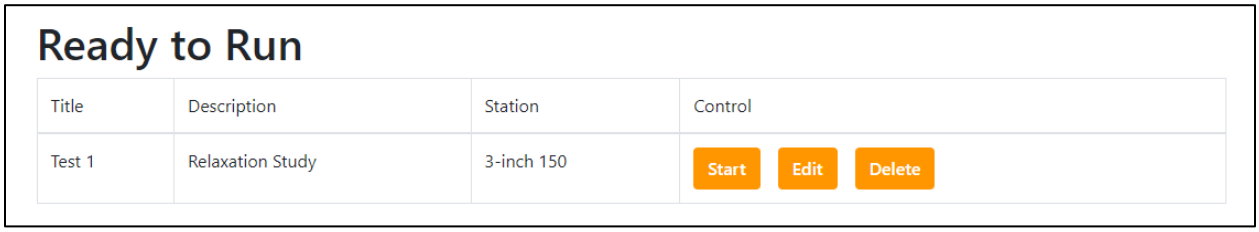
Start Study

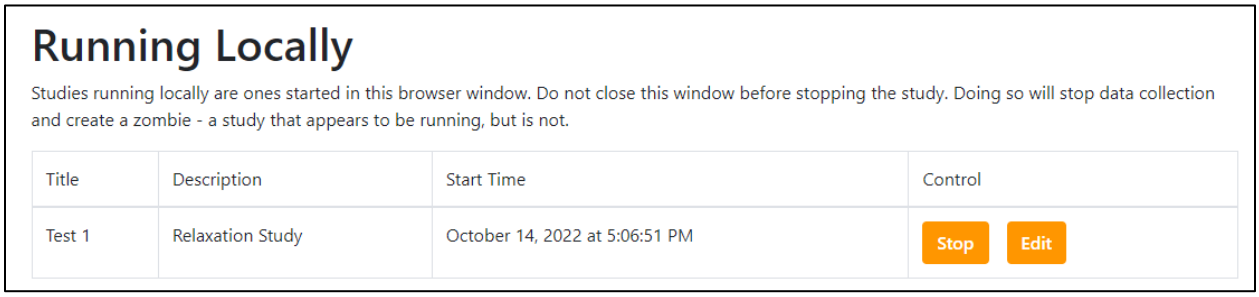
Once you have configured the study and clicked submit, you will see the study in the Ready to Run section.



You can click the start button to start the study, click edit button to return to the configuration box and change details, or click the delete button to discard the study.

Running Studies

When you start a study, you will see its details in the Running Locally section of the page.



When you are finished with the study, you can click the Stop button. Clicking the Edit button will allow you to change the Title or Description of a running study.

Running Elsewhere (Possible Zombies)

If you connect a second computer to the CHUCK network and start the CHUCK app while a study is running, you will see that study in the Running Elsewhere box:

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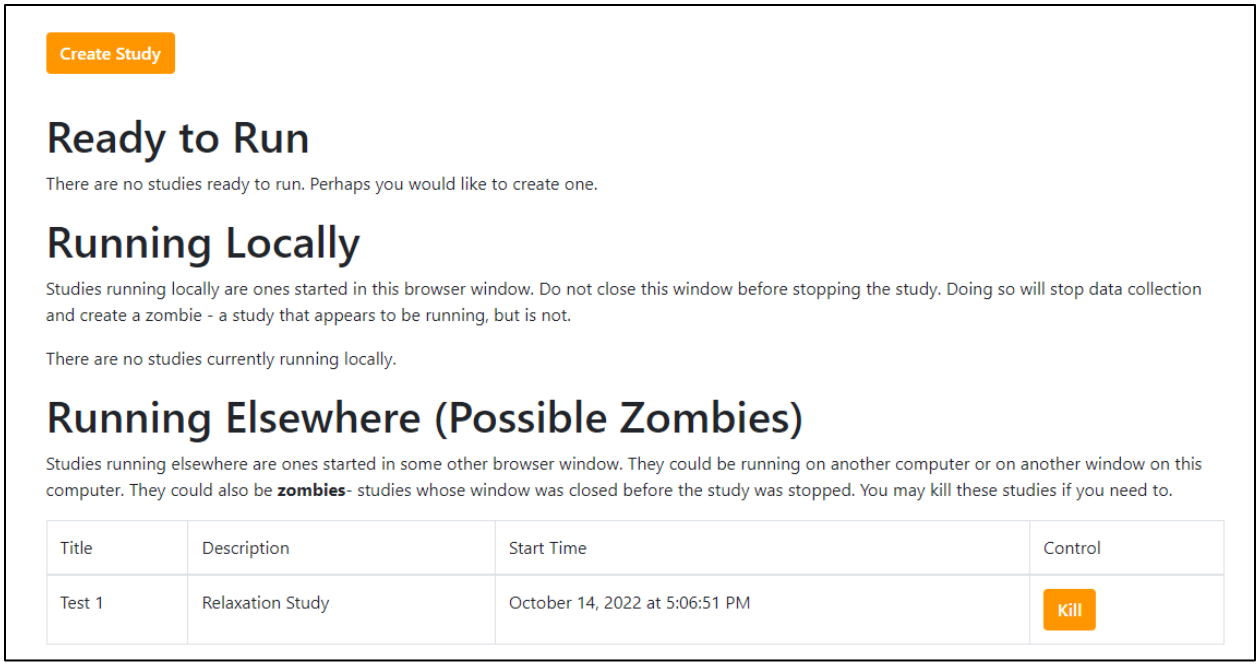


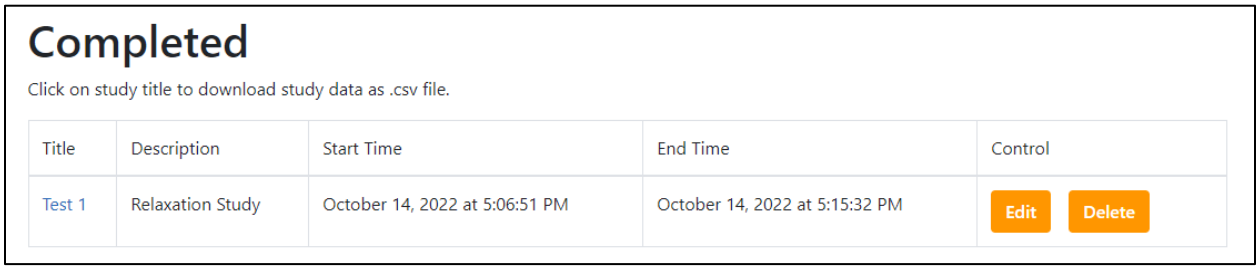
The computer that started the study will still see it in the Running Locally box, but all others will see it in the Running Elsewhere box.

But what about Zombies? The computer where the study is running locally has the control to stop the study. If that user closes the browser window or navigates away from the CHUCK app (or hits refresh), the study will no longer be running. It will show up in the Running Elsewhere box. At that point, the only thing a user can do is to kill the zombie with the Kill button.

Completed

A study will continue collecting data until it is stopped, until the user closes the browser window or navigates away from the CHUCK app (or hits refresh), or until it is killed.

Once it is stopped or killed, the study will show up in the completed studies area. From there the study data can be retrieved by clicking on the study title.

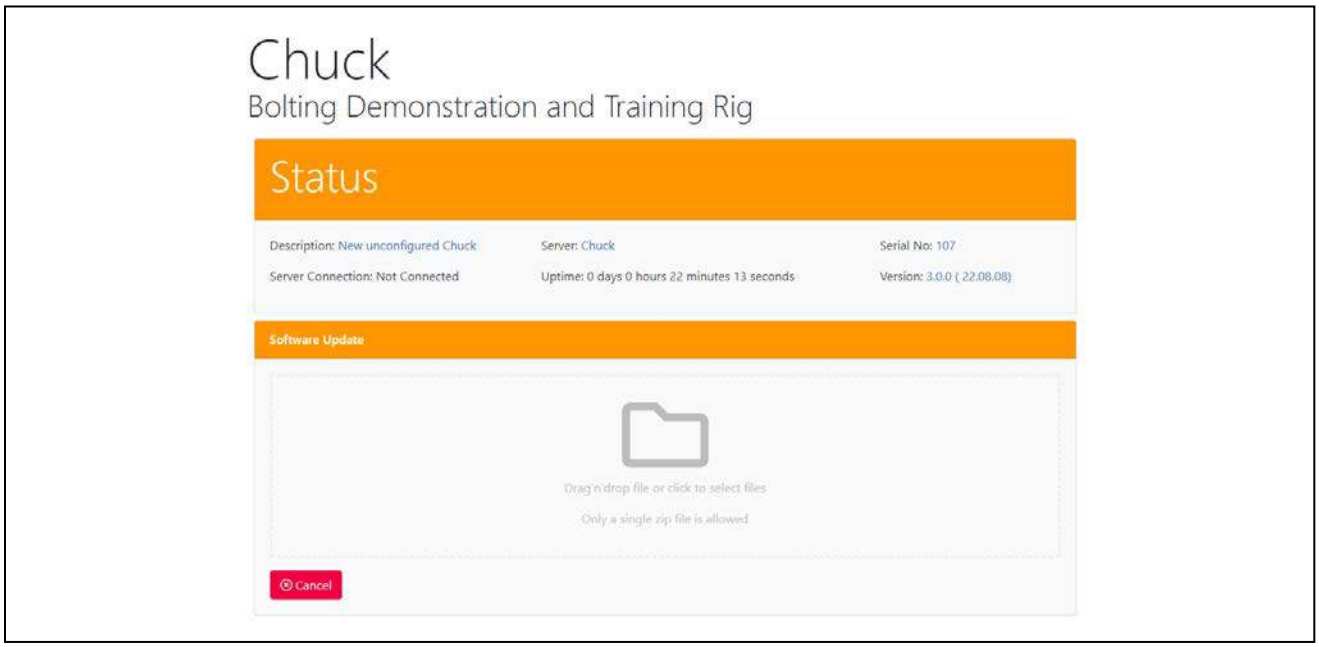


The Edit button will allow the user to change the title or description of the study. The delete button will delete the study permanently from the server. Of course any spreadsheet version of the study that has been downloaded will not be affected.

Software Update

From time to time, Hex Technology may offer software updates to improve performance, add features, or fix bugs. When that happens, Hex may email you a zip file containing a software upgrade for you to install. If you download the software upgrade zip file and have it on the laptop connected to CHUCK, installing the software upgrade is easy.

Go to the Setup screen and click on the Version number in the Status box. This will bring up the Software Update box:



Simply drag the file into the browser window and drop on the file folder icon. In response, you will see a blue Upload button. Click that and you will be instructed to wait 30 seconds and refresh your browser window. That completes the update.

The update zip file is cryptographically signed by Hex Technology, and CHUCK checks that signature before installing the software. If the check fails, CHUCK will not update. This provides protection against someone sending you a bogus update and getting you to install it.

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