# Torsional Machine GUI – User Guide

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Developed by: Jonas Cooper, Joshua McCoy, John Taylor

## 1. Overview

This guide is intended for users of the Low-Cost Torsional Testing Machine GUI. It explains how to operate the software to control tests, collect data, and manage outputs effectively.

## 2. System Requirements

- Operating System: Windows 10 (64-bit) or newer
- Hardware: PC or Laptop with USB-A port
- Connection: USB to Arduino Uno

## 3. Key Features

GUI Controls:
- Set Angle of Twist, Speed of Rotation, and Direction (CW/CCW)
- Manually enter Calibration Factor
- Start, Stop, and Tare the test
- Real-time data display: Angle, Torque, Time
- Switch between Table View and Graph View
- Export results as a .csv file

## 4. How to Download the Application

1. Go to the OneDrive link: TorsionalMachineGUI
2. Open the "**dist**" folder
3. Download the executable file: *TorsionalMachineGUI.exe*
4. Run the file on a compatible Windows machine
5. Microsoft Defender may flag the file due to being Unpublished. If so, please continue for the application to launch.

## 5. Using the GUI

### Step 1: Launching the Application

Double-click the application executable to open the GUI. The Arduino Status Indicator (LED) should turn green upon successful connection.

### Step 2: Input Test Parameters

1. Angle of Twist: Enter the target angle (in degrees).
2. Speed of Rotation: Enter a value between 1.5 and 71 degrees/min. Values outside this range will prompt an error.
3. Direction of Twist: Select Clockwise (CW) or Counterclockwise (CCW).
4. Calibration Factor: Manually enter if recalibration is necessary.
5. Click the Set button to confirm values.

### Step 3: Sensor Tare

Press the Tare Torque button to calibrate the torque sensor to 0.01 N·m.

Note: The torque sensor has a physical upper limit of 150 N·m, but the software enforces a safety cap of 145 N·m. No torque reading or test condition should exceed this value.

### Step 4: Start Test

Press the Start Test button to begin. The system starts recording:
- Angle (deg)
- Torque (N·m)
- Time (s)

### Step 5: Monitor Live Results

Choose Graph View to visualize:
- Angle vs. Torque
- Time vs. Torque

Use Switch to Table to view raw data in a table format, updating every 400 ms.

### Step 6: End Test

Press the Stop Test button to cease motor activity and stop data collection.

## 6. Saving and Resetting Data

### Save Data

Click the Save Data button.
Enter file name and save location in the dialog window.
Data is saved as a .csv file (compatible with Microsoft Excel 2024).
A confirmation message will display upon successful save.

### Clear Table/Graph

Press the Erase Table/Graph button to remove current session data.
Warning: This action is irreversible.

## 7. Validation Rules & Constraints

| Parameter | Constraint |
|---|---|
| Torque | Max 145 N·m (Sensor limit: 150 N·m) |
| Speed of Rotation | 1.5 to 71 degrees/min |
| Data Save Format | .csv |
| Data Logging Interval | Every 400 ms |

## 8. Typical Workflow

1. Launch GUI
2. Enter parameters
3. Tare sensor
4. Start test
5. Monitor results
6. Stop test
7. Save or clear data

## 9. Troubleshooting Tips

- Connection Fails: Ensure USB cable is properly connected. Replug if needed.
- Invalid Input: GUI will prompt errors for values outside allowable ranges.
- No Graph/Table Update: Ensure test is started and connection to Arduino is active.
- Cannot Save File: Verify the destination path has write permissions.

## 10. Safety & Security Notes

- Application only accesses local file systems when saving files.
- Avoid abrupt USB disconnection during tests.
- System must be used under supervision as per department protocols.