# IoT Test Stand: Standard Operating Procedure

Ryan Hogan, Engineering Intern, Summer 2025

## Overview

This documentation was made to help operators using the automated test stand. The dashboard and control panel should be accessible on the iPad connected to the column stand. Use the following documentation when being trained on the new system and to help troubleshoot when problems may occur. More documentation and files can be found on github.com/ryanjhogan7/IoT\_Test\_Stand.

## Major Parts List

|  |  |
| --- | --- |
| **PART** | **LINK** |
| ESP32-DEVKIT-C | [ESP32-C6-DEVKITC-1-N8](https://www.digikey.com/en/products/detail/espressif-systems/ESP32-C6-DEVKITC-1-N8/17728861) |
| Flow Meter | [DMA20-AAAAA1 Endress+Hauser | Industrial Automation and Controls | DigiKey](https://www.digikey.com/en/products/detail/endress-hauser/DMA20-AAAAA1/17140769?gclsrc=aw.ds&gad_source=1&gad_campaignid=20243136172&gclid=CjwKCAjw4K3DBhBqEiwAYtG_9Nic6GV5G9iVCKkkcvaqPpTFLpSUF5Qw7qQC18XumS8sreTEZRJqrxoCE4MQAvD_BwE) |
| Pressure Gauges | [Cole-Parmer High-Accuracy Digital Gauge, 0 to 100 psig, 4-Digit LCD from Cole-Parmer](https://www.coleparmer.com/i/cole-parmer-high-accuracy-digital-gauge-0-to-100-psig-4-digit-lcd/6834906) |
| Solenoid Valve | [Parker 2-Way Normally Closed, 1/4" NPT General Purpose Solenoid Valves | Parker NA](https://ph.parker.com/us/en/product-list/2way-valve-nc-onequarterin-fcdn) |

## Features

### Calibration

Calibrating the sensors is done by setting a constant value (either pause test to get constant pressure or open solenoid to get constant flow) and then inputting that value into the calibration screen. The general limits for the flow meter is 0-1L/min and the pressure gauges are 0-90psi. These can be configured differently and calibrated accordingly. The limits for the pressure gauge can be set according to the data sheet linked in /documentation/ and the flow meter can be changed on the app in the iPad. This can be done according to the data sheet for the flow meter also in /documentation/.

### Data Export

The data export feature allows operators to download data via .csv file. This export will have various meta data as well as the data points collected.

### System Configuration

The system configuration window allows operators to set update intervals, the pressure threshold and set up the ESP32 with an IP address. The pressure threshold will determine when the test stops, and it is recommended to stay at 20 psi.

### Pause/Start/Reset Test

The pause/start/reset buttons allow operators to control the status of the current test. When pausing the test, the valve will close, and data collection will pause. The collected data will not clear until the reset button is clicked. If paused, the test will have the ability to be resumed with no clearing of data.

## How to Operate: Step by Step

### Connecting with ESP32

Connect with the ESP32 by typing in the IP address and clicking connect. Be sure that the computer/iPad connecting is also on the PRENGIOT Wi-Fi or else connection will not work. The IP address for the current ESP32 is 10.107.6.162. This will change every time you unplug the board from the wall. Please keep a paper next to the stand showing the current IP address. If you need to access the IP, please look at FAQs for instructions.

### Pre-Test Setup (10 minutes)

1. System Check
   * Verify power connections
   * Check sensor connections
   * Confirm valve connection
   * Power on ESP32
2. Web Interface
   * Navigate to ESP32 IP in browser
   * Verify "Connected" status
   * Set pressure threshold (5-100 PSI)
   * Configure update interval (0.5-600 seconds)

### Test Setup (15 minutes)

1. Sample Preparation
   * Install test filter in flow path
   * Connect inlet/outlet pressure sensors
   * Position flow sensor
   * Verify leak-free connections
2. Calibration
   * Use calibration menu for sensors
   * Apply known constant values for calibration point
   * Verify accuracy within ±2% (flow), ±1% (pressure)
   * Save calibration to EEPROM

### Test Execution

1. Start Test
   * Click "Start Test" in web interface
   * Verify valve opens and flow begins
   * Monitor initial readings for stability
   * Confirm data logging is active
2. Monitor Test (Up to 72 hours)
   * Check system every 4-8 hours
   * Verify stable flow and pressure readings
   * Monitor real-time charts and data
   * Watch for threshold warnings

### Test Completion (10 minutes)

1. Stop and Export
   * Click "Stop Test" when complete
   * Verify valve closes automatically
   * Export data via CSV download
   * Click "Reset" to clear system
2. Shutdown
   * Disconnect test sample
   * Clean flow path components
   * Power down system
   * Archive test data and documentation

### Quality Checkpoints

#### Before Test:

* All sensors online
* Valve operates properly
* WiFi connected
* Configuration saved

#### During Test:

* Stable flow rate
* Data logging continuous
* No error messages

#### After Test:

* Data exported successfully
* Equipment cleaned
* Test documented

## Maintenance

### Sensor Calibration

Contact other engineers for help with flow meter and pressure gauge calibration. This should be done every 12 months and marked on the sensor when completed.

## FAQs/Troubleshooting

### How do I find the ESP32 IP Address?

The IP address should be 10.107.6.162. If this is not working, you will need to download the backend software and run this on Arduino IDE (<https://www.arduino.cc/en/software/>) while connected to the board via USB-C cable. When you compile and run the code, the IP address will be printed on the serial monitor in the Arduino IDE.

### Why can’t I connect to the ESP32?

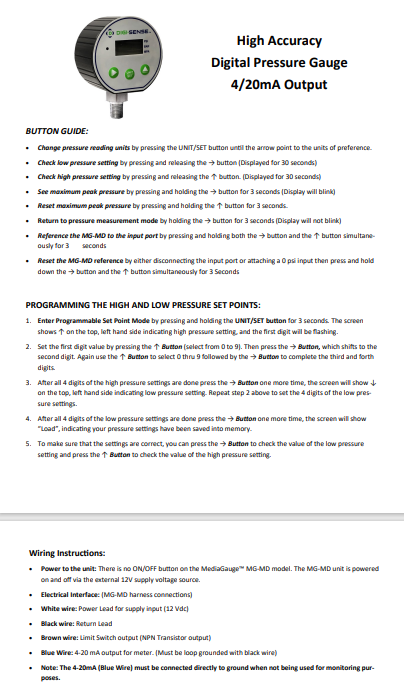
You need to be on the PNRENGIOT Wi-Fi to connect to the ESP32. If you do not have the password for this Wi-Fi, please contact IT (Greg Schraufnagel) for password.

### I have other questions that are not answered on this document. Where should I go?

The first option would be to ask Claude.ai, ChatGPT, or Copilot. These tools can get you far if you feed pdfs and code files from Ryan’s github (github.com/ryanjhogan7/iot\_test\_stand). The second option would be to give Ryan a text or a call at 847-997-2701. He would be more than willing to answer a question or get on the phone with you to help troubleshoot the problem you may be having.

## Appendix

### Document A: Pressure Gauge Documentation



### Document B: Flow Meter Documentation (<https://tinyurl.com/PicoMagIODoc>)

Diagram of a device plug

AI-generated content may be incorrect.

A close-up of a box

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A white box with black text

AI-generated content may be incorrect.

A diagram of a circuit

AI-generated content may be incorrect.

A screenshot of a computer

AI-generated content may be incorrect.

A graph of a function

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### Document C: How Does the System Work?

The communication flow begins when the ESP32-C6 establishes a WiFi connection to the local network and starts an HTTP web server listening on port 80. Browser clients connect to the ESP32 using its IP address, initiating a client-server relationship where the ESP32 serves API endpoints for real-time control and monitoring.

Real-time data acquisition occurs through continuous analog-to-digital conversion on three dedicated GPIO pins (1, 2, 5), where the ESP32 samples pressure and flow sensors at 12-bit resolution. Raw voltage readings undergo scaling transformations using configurable ranges (0.66V-3.30V) to convert sensor outputs into engineering units.

During active test operations, the browser establishes a dual-rate polling system: 500ms polling for smooth real-time display updates, with configurable data logging intervals from 0.5-600 seconds. Each request triggers immediate sensor readings, pressure differential calculations, and volume integration, packaged into structured JSON responses.

The ESP32 maintains test state including elapsed time, cumulative volume, and continuous safety threshold monitoring. When pressure limits are exceeded, the system automatically closes the solenoid valve via GPIO 10 control and transitions to a paused state.

Configuration changes flow through POST requests containing parameters like pressure thresholds and sensor scaling factors. The ESP32 updates internal variables immediately, though current implementation doesn't persist settings across power cycles.

The system supports multiple simultaneous client connections, each receiving independent data streams. Emergency stop functionality operates through immediate HTTP POST requests with rapid hardware response. Data export is handled client-side, where JavaScript processes the real-time JSON data streams into CSV format or clipboard-ready tables for analysis.