Cyrius Fuel Subsystem Installation and Calibration Guide

Models CFS-150 and CFS-150M

Version 4

March 19, 2024

Developed by Transportation Laboratories

Version History

Version	Date	Revision Description
1	9/16/2015	Initial publication
2	8/23/2018	Format with SGS brand
3	4/15/2020	Retrofit to new template
4	3/19/2024	Rebrand to TRP Laboratories

Document Conventions

This document uses the following typographic and syntax conventions.

- Commands, command options, file names or any user-entered input appear in Courier type. Variables appear in Courier italic type.

  Example: Select the `cmdapp-`*`relVersion`*`-`*`buildVersion`*`.zip` file….

- User interface elements, such as field names, button names, menus, menu commands, and items in clickable dropdown lists, appear in Arial bold type.

  Example: **Type**: Click **Select Type** to display drop-down menu options.

- Cross-references are designated in Arial italics.

  Example: Refer to *Figure 1*…

- Click intra-document cross-references and page references to display the stated destination.

  Example: Refer to *Section 1 Overview* on page 1.

  The clickable cross-references in the preceding example are *1*, *Overview*, and on page 1.

CyFlex Documentation

CyFlex documentation is available at https://cyflex.com/. View **Help & Docs** topics or use the **Search** facility to find topics of interest.

Table of Contents

List of Figures

LIST OF TABLES

1 Overview

This document is a guide for installing and calibrating the Cyrius Fuel Subsystem (CFS) models CFS-150 and CFS-150M.

The CFS measures fuel consumption and is typically installed inside of a test cell. It conditions fuel temperature at the engine fuel inlet. Configuration options include a mobile cart on wheels, and a wall-mounted version. In the mobile configuration, the CFS automation cabinet mounts to a wheeled cart and includes a touch-screen interface powered by CyFlex. The wall-mounted unit is similar, but automated functions are integrated with a CyFlex test cell automation system.

Designed with safety as priority, the CFS is usually connected directly to external emergency stop circuitry, or to a facility safety system at the test cell. When external stop circuitry or the CFS-Stop on the front panel removes 24V from the subsystem, the valves, fuel heater and pump are turned off, rendering the system safe.

Everything needed for maintaining the engine fuel inlet temperature and protecting against fuel overflowing in the cabinet is included. The CFS controls fuel temperature for the engine supply and includes an overflow sensor in the fuel weighing bucket.

Figure 1: CFS Cabinet

1.1 Standard Features

Standard features for the Cyrius Fuel Subsystem include:

- Choice of operating configuration:
  - o Stand-alone subsystem with an embedded CyFlex automation computer system and a touch-screen interface

    or
  - o “Smart” subsystem integrated into a CyFlex test cell automation system

    Note:

    CyFlex software can manage all aspects of measuring fuel consumption and controlling engine inlet fuel temperature. The “smart” subsystem automation software may be added to a CyFlex General Purpose test procedure for automated control.
- Choice of packaging configuration:
  - o Wall-mounted unit

    or
  - o Mobile cart
- Subsystem components based on engine size:
  - o Design of the subsystem accommodates various sized engines – by changing subsystem component sizes to match maximum fuel consumption requirements
  - o Examples of subsystem components that are sized based on maximum consumption rating: fuel heater, heat exchanger, fuel pump, load cell, fuel weighing bucket size, etc.
- Mass flow calculation:
  - o Fuel flow measurements are direct mass flow rates, not volumetric flow rates
  - o Select the units of measurement displayed such as lb./hr., kg/sec, lb./min, or kg/min, among others.

1.2 Measurement Accuracy

The Cyrius Fuel Subsystem obtains accurate readings consistently, by utilizing the most effective measuring techniques from two different technologies:

- Coriolis flow
- Weighing fuel

Coriolis flow measurements are almost instantaneous, and accurate from 100% down to about 3% of full scale, but much less accurate for very low flows.

Weighing a volume of fuel as it is consumed provides accurate readings for steady state operating conditions, even at very low flows. However, this method is less suitable for fast response measurements (such as for transient test cycles).

The TRP Laboratories “smart” fuel flow measurement software automates conditioning the fuel temperature and measuring flow. Once fuel is flowing, the software chooses the best sensor technology based on the flow rate. Flow measurements use direct mass flow sensors, not volumetric flow sensor readings converted to mass flow measurements using calculated or measured fuel density.

The software also ensures user-specified reading uncertainty, applying statistical analysis to steady-state fuel measurements. If the steady-state flow reading does not achieve the user-specified uncertainty, either because the measurement times-out or the fuel weighing bucket runs low on fuel, the software reports the best available reading, along with the actual uncertainty achieved. The result is the minimum measurement time to achieve the desired uncertainty, or the best reading (and its uncertainty) achievable, given the available time or fuel weighing bucket capacity.

Table 1 shows specifications for a standard CFS.

Table 1: CFS Specifications

Sensors	Coriolis plus Load Cell Sensors	Details
Measurement Range	0 – 150.0 lb./hr. 0 – 1.134 kg/min	Wider or narrower ranges are available.
Accuracy	Coriolis fuel bucket makeup fuel sensor (for Real Time flow)	150 – 50 lb./hr. = 0.1% of reading 50 – 5 lb./hr. = 0.1% - 1% of reading (i.e. constant 0.05 lb./hr. accuracy) 5 – 0 lb./hr. = not recommended (0.05% of reading over 30:1 turndown sensor is optional)
	Load cell fuel bucket weight sensor (for steady state flow). Calibration weights supplied	Overall: 0.0375% full scale (RMS) Linearity: 0.03% FSO Hysteresis: 0.02% FSO Repeatability: 0.01% FSO Thermal: 0.0028% FSO/°C (RMS) Zero: 0.002% FSO/°C Span: 0.002% FSO/°C
Repeatability	0.035% FSO	---
Engine Supply Line Temperature Control	+/- 0.5°F (+/- 0.28°C) @ 104°F (40°C)	10 ft. S.S. over-braid insulated engine supply and return lines are included
Heater Size	1.5 kW	---
Engine Supply Line Pressure	< 3 psi	Optional: regulated supply 0 - 15 psi
Engine Return Line Pressure	< 1 psi	---

2 Installation Prerequisites

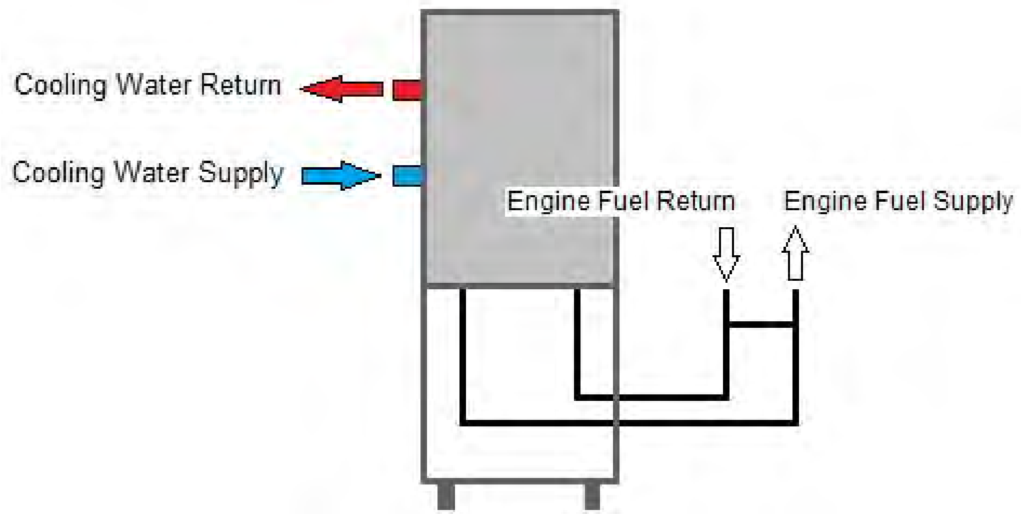
Comply with the instructions in the following sub-sections to ensure the facility is set up to accommodate the installation.

2.1 Connections

2.1.1 Mechanical Connections

Figure 2 illustrates the required water and fuel supply configuration.

Figure 2: Water and Fuel Supply Connections



Ensure the following mechanical connections are in place:

- Cooling water supply and return:
  - 3/8” Female NPT
  - Temperature <= 85 deg F; >= 35 deg F
  - Pressure >= 35 psig

  Note:

If chilled cooling water is used, adjust the cooling water pressure regulator down to approximately 10 psig in order to increase the control valve range and avoid over cooling the fuel.

- Fuel supply:
  - 1/2” Female NPT
  - Pressure >= 45 psig
  - Flow rate >= 1 GPM
- Engine fuel supply:
  - 3/8” Female NPT
- Engine fuel return:
  - 3/4” Female NPT

2.1.2 Electrical Connections

In addition to the required power supply for the CFS, several CFS I/O connections are available to the test cell. Refer to *Section 4.1 Electrical and I/O* on page 7 for related information.

- 120 VAC power source
- 0-10 V engine power analog input
- 0-10 V mass flow rate analog output
- Fuel reading request input
- Test cell E-stop input
- CFS running status output
- Fuel reading in progress output

2.2 Customer-Supplied Hardware, Fittings, and Hoses

The following are not supplied with the Cyrius Fuel Subsystem and should be on hand for the installation:

- Inputs, outputs, and relays to communicate with the CFS
- Hoses and fittings to connect the engine fuel supply and engine fuel return to the CFS hoses stand
- Keyboard and mouse

3 Safety

Important:

Always follow the safety practices and instructions at your facility when working with potentially dangerous materials and/or electricity.

Adhere to the following:

- Make sure power is disconnected at the source before making electrical connections to the CFS.
- The fuel over-temperature controller must not be set higher than 120 deg F. The flashpoint of some diesel fuels (exposed to air) is 126 deg F. The fuel is exposed to air while in the fuel bucket. If the fuel in the bucket exceeds 120 deg F, the CFS will automatically shut down.
- Follow the process described in this document for powering on the CFS, after initial installation or when moving it to a new test cell. Otherwise, components may be damaged.
- Empty and clean the fuel bucket before moving the CFS.

4 Identifying System Components

Refer to the sub-sections below to identify the major components of the Cyrius Fuel Subsystem (CFS) and wiring.

4.1 Electrical and I/O

Electrical and Input/Output connections for the CFS installation are described below:

- 120 VAC power source, standard outlet
  - Normal operation/average power consumption – 10 A
  - Startup and until fuel is heated to temperature – 15 A
- Fuel reading request input – set of dry contacts:
  - Manual control – momentary push button switch

    or
  - Automated control –
    - N.O. relay

      and
    - Digital output to control the relay
- Test Cell E-Stop request input – set of dry contacts from the test cell E-Stop circuit to the CFS panel
- CFS Running Status output – set of dry contacts from the CFS panel to the test cell monitoring system

  Note:

  While the fuel system is running, dry contacts in the CFS panel are closed. If the system shuts down, the contacts open. The CFS running status provides notification in case of a problem.
- Fuel Reading in Progress status output – set of dry contacts from the CFS panel to the test cell monitoring system

  Note: When a fuel measurement is taking place, the contacts in the CFS panel are closed. The contacts are open at all other times.
- Engine power 0-10 V analog input – from the test cell control system to the CFS panel

  Note:

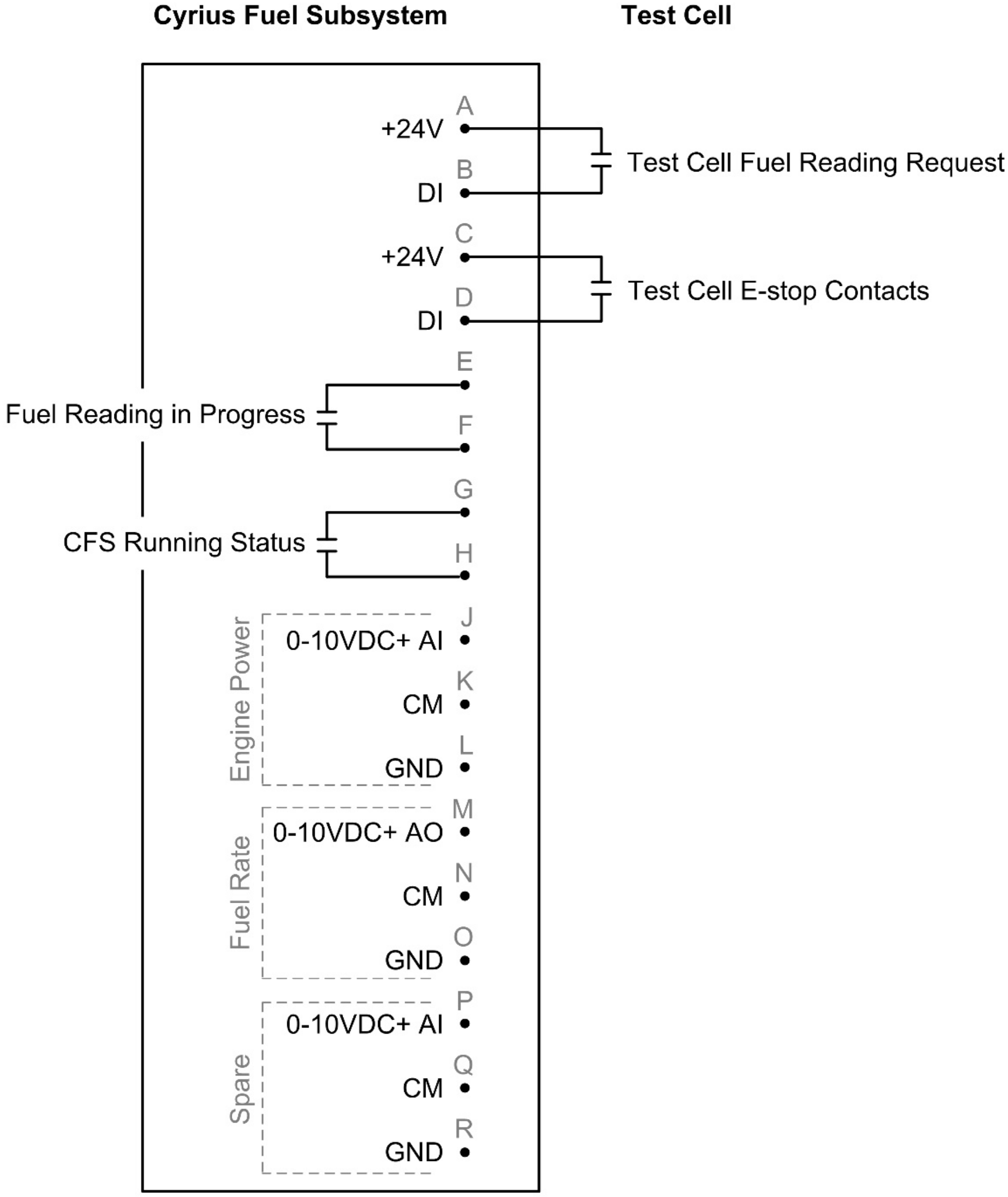
  Based on the engine power, the CFS can automatically select the most accurate mode for a measurement. This is optional, since a mode may be manually chosen at the touch-screen display.

Use a Deutsch connector to connect the I/O between the test cell and fuel system. The connector is located on the side of the CFS as in *Figure 4* on page 9. The fuel system includes a cable with “flying” leads, ready for connection to the test cell I/O.

Note:

It is best practice to use shielded twisted-pair cables for all signal wiring.

Figure 3: Deutsch Connector I/O



Notes:

CM = Common
DI = Digital Input
AO = Analog Output
GND = Ground
AI = Analog Input
Contacts rated at 5A 24VDC

Figure 4:Test Cell I/O interface Side-Mounted on the CFS Cabinet

Figure 5 on page 10 through *Figure 8* on page 13 identify additional components in the CFS cabinet.

Figure 5: Internal CFS Components

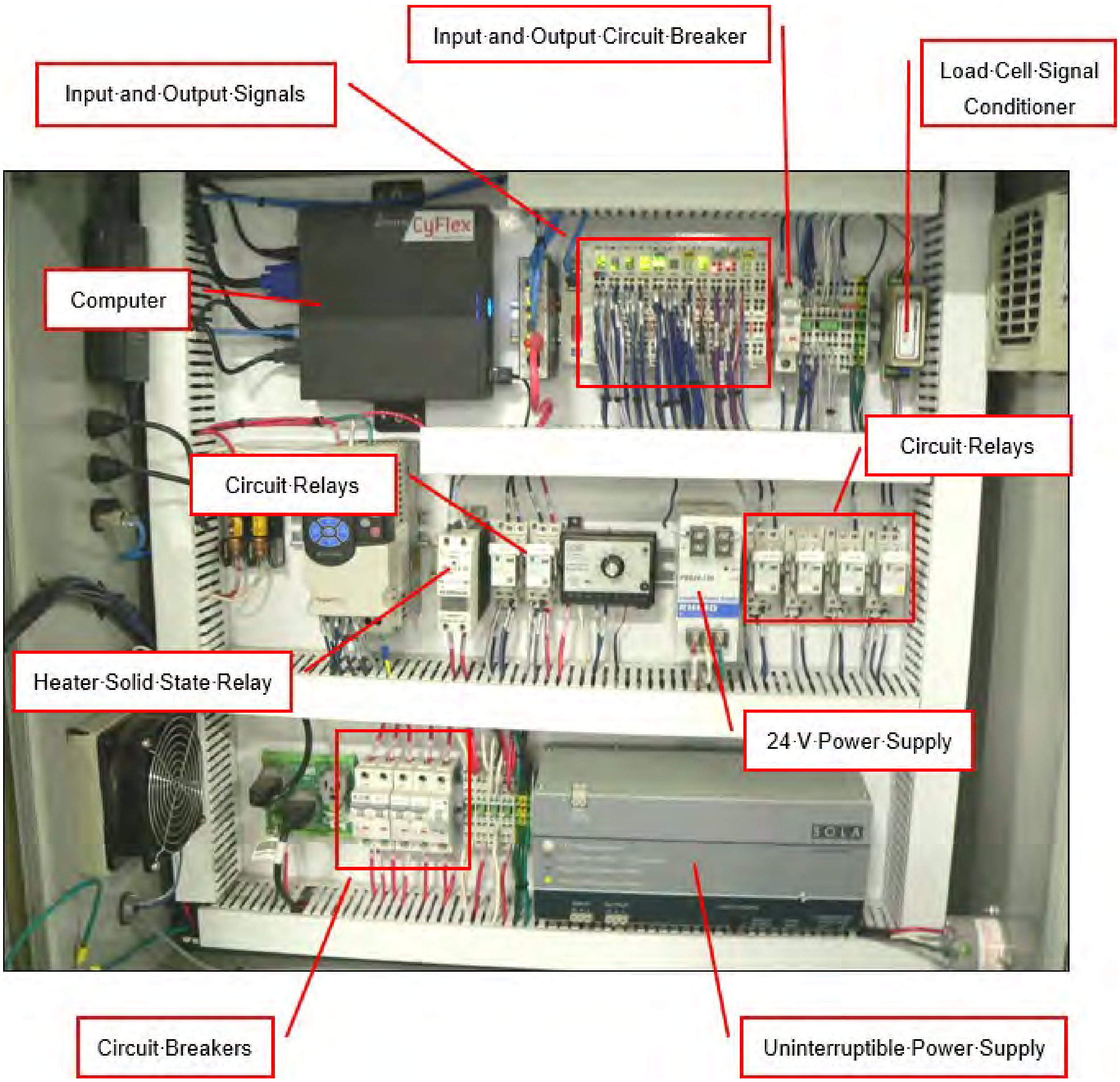
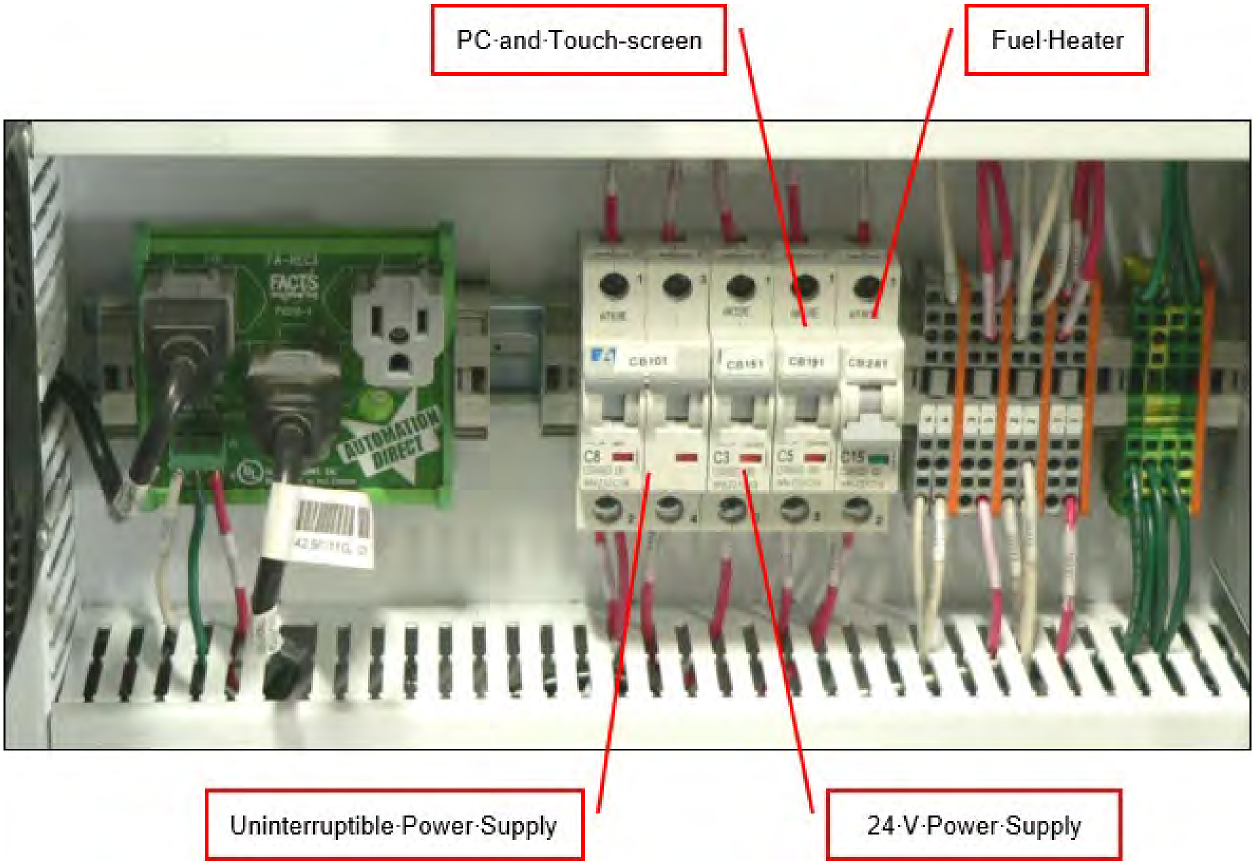


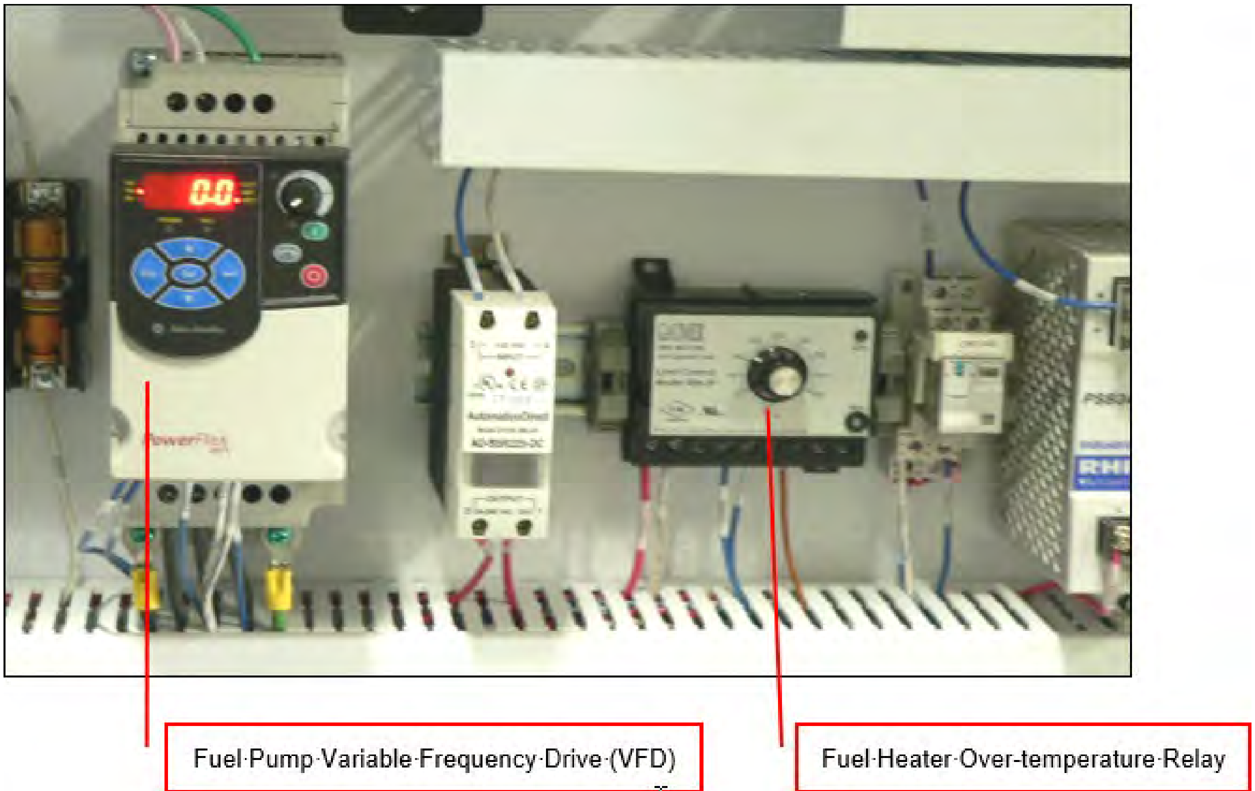
Figure 6: Circuit Breakers – Bottom Rack



Note:

The input and output circuit breaker is located on the top rack as shown in *Figure 5* on page 10.

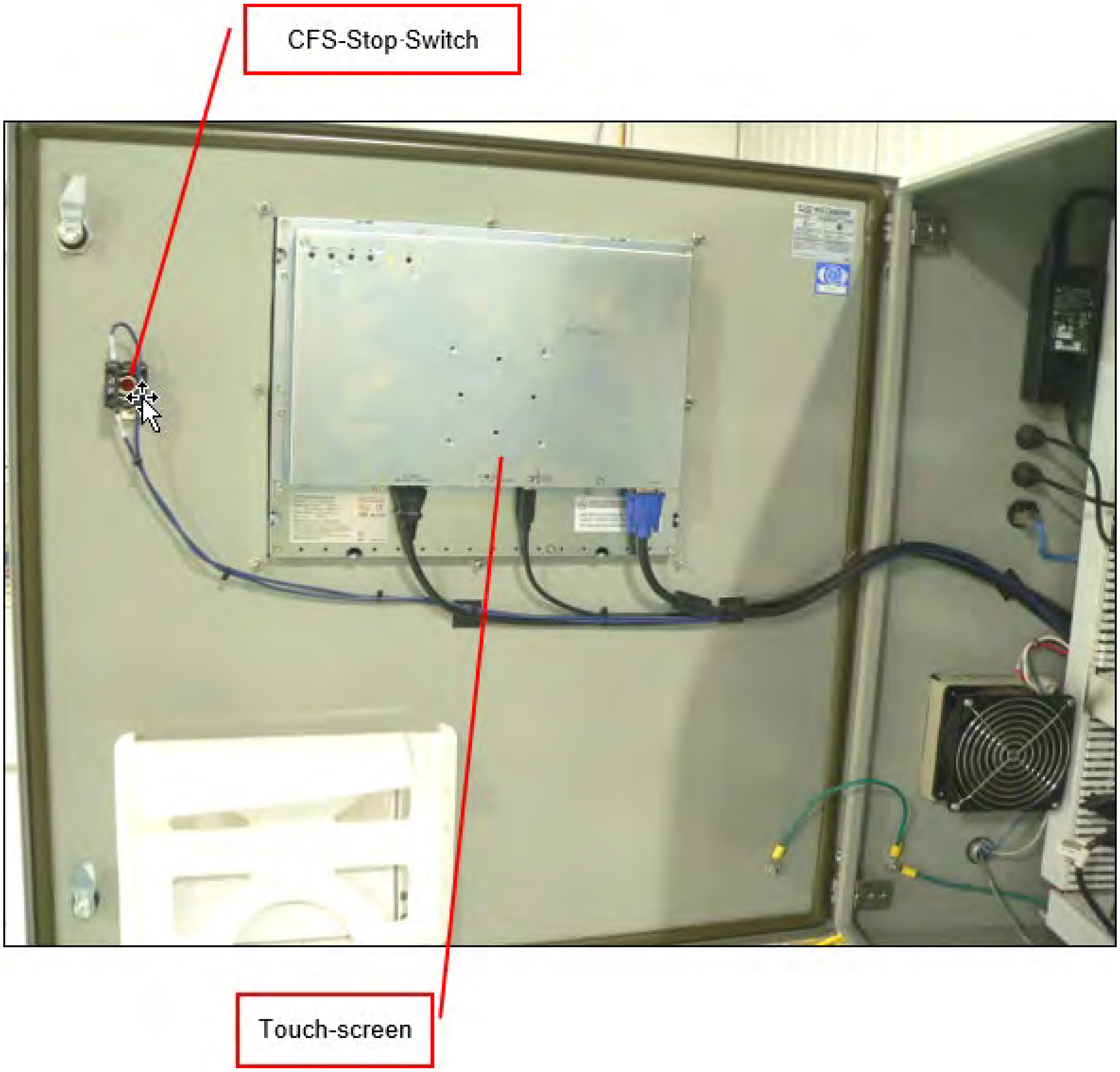
Figure 7: Adjustable Controls - Middle Rack



Note:

The variable frequency drive is controlled by software which overrides manual adjustments.

Figure 8: I/O Cabinet Rear Door



4.2 Fuel

This section describes components that make up the fuel flow measurement and fuel conditioning systems. Fuel temperature is controlled using an electric heater and a water-cooled heat exchanger.

- Coriolis meter
- Fuel pump
- Fuel bucket with a baffle system for removing air bubbles from the fuel
- Load cell
- Heat exchanger
- Fuel on/off valve
- Fuel flow control valve
- Fuel pressure regulator
- Water flow control valve
- Water pressure regulator

Figure 9: Coriolis Meter

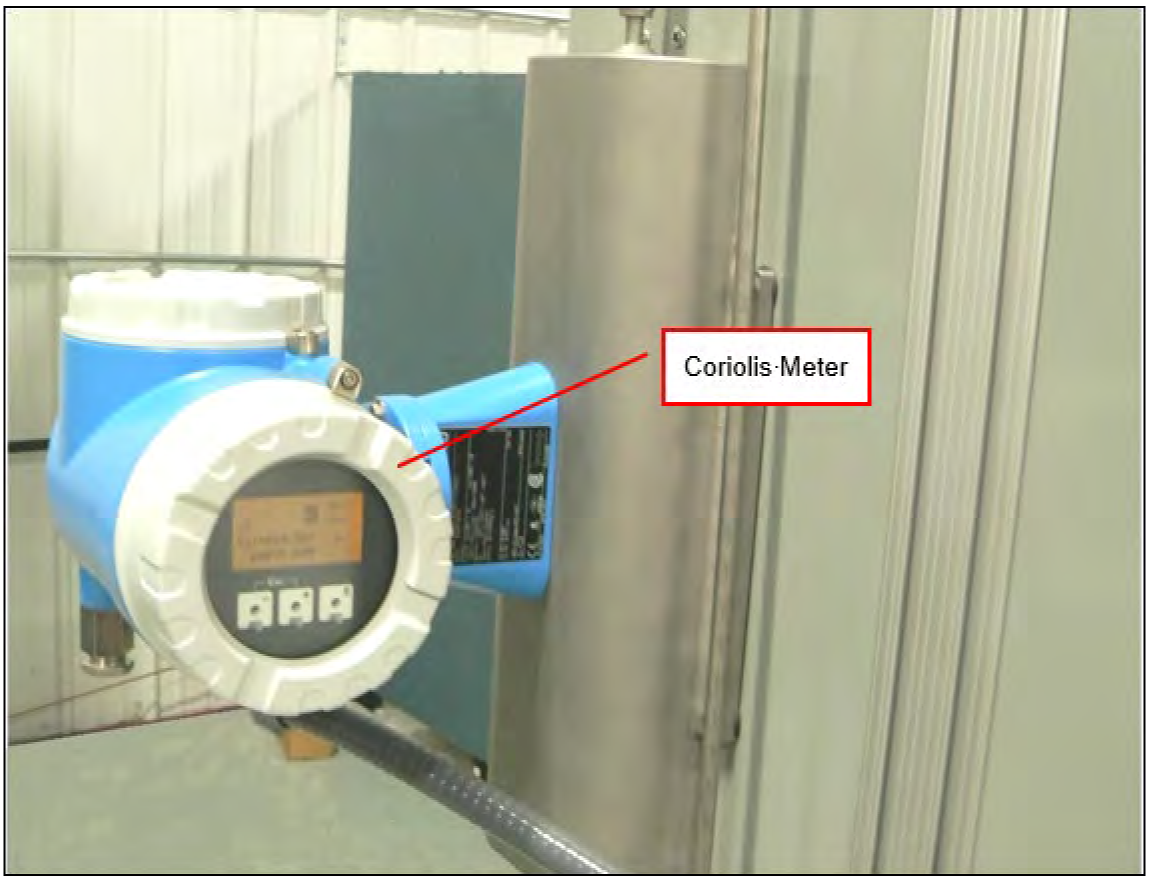
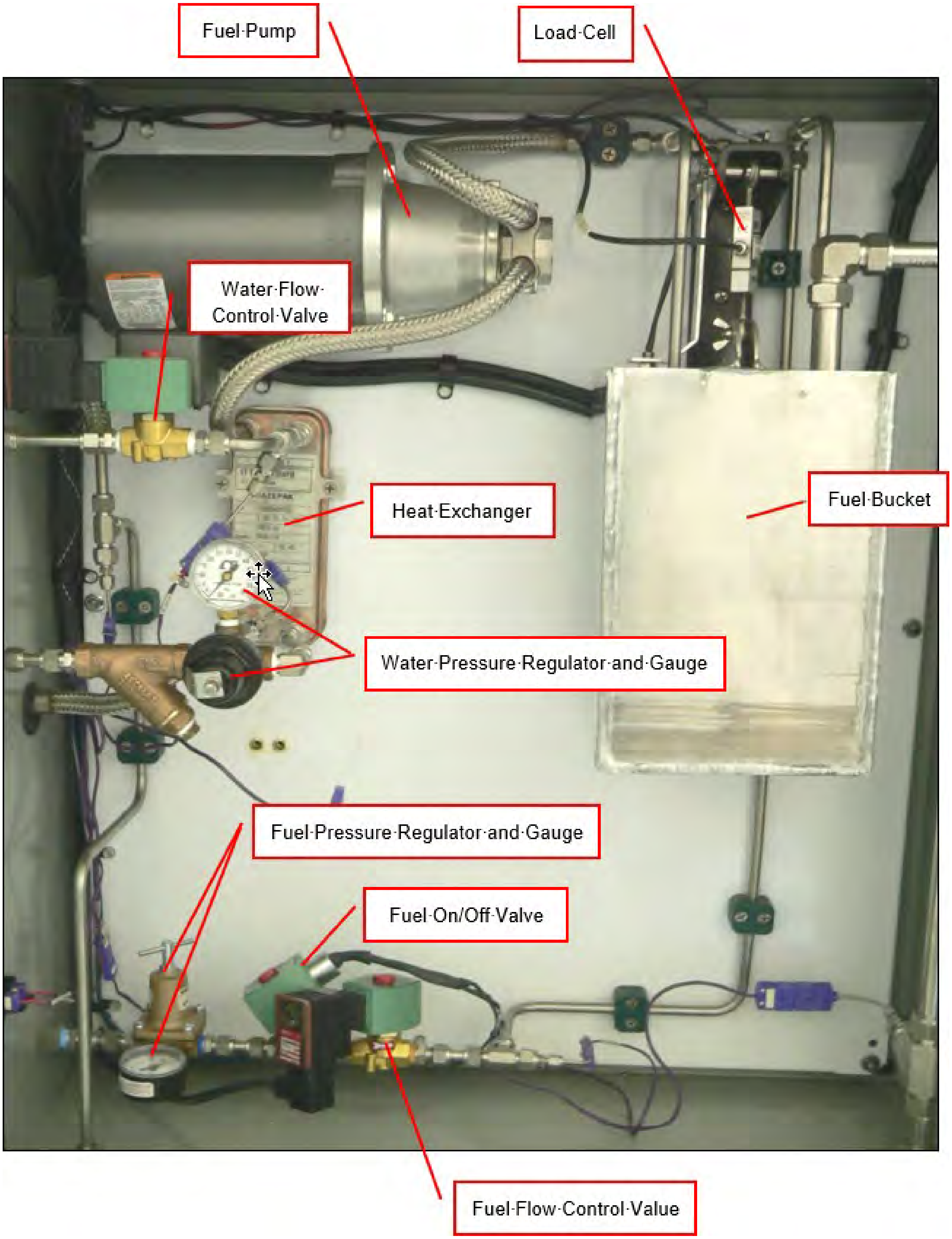


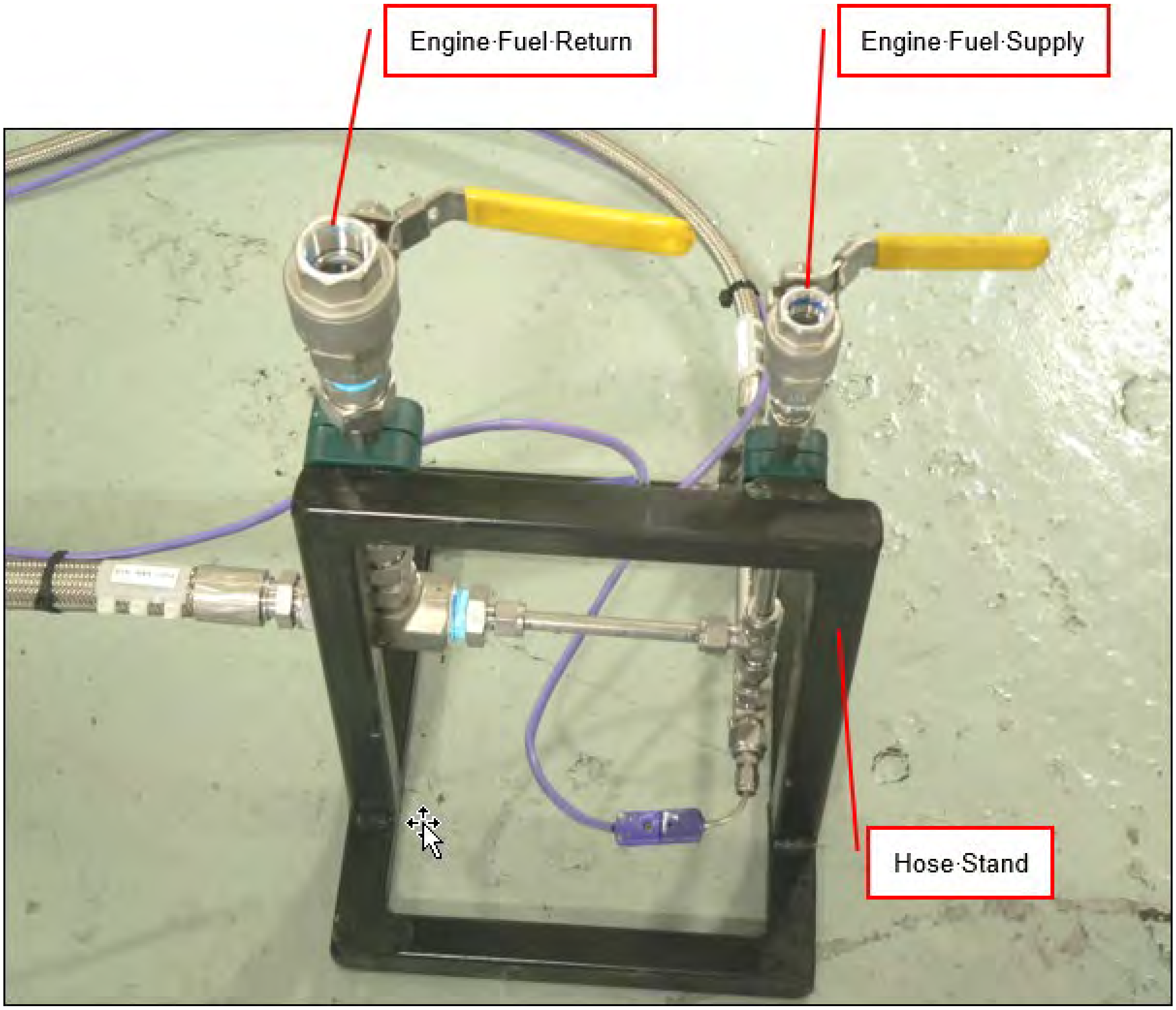
Figure 10: Fuel Flow Measurement and Fuel Conditioning Components



Connect the engine fuel supply and return lines at the hose stand provided with the CFS.

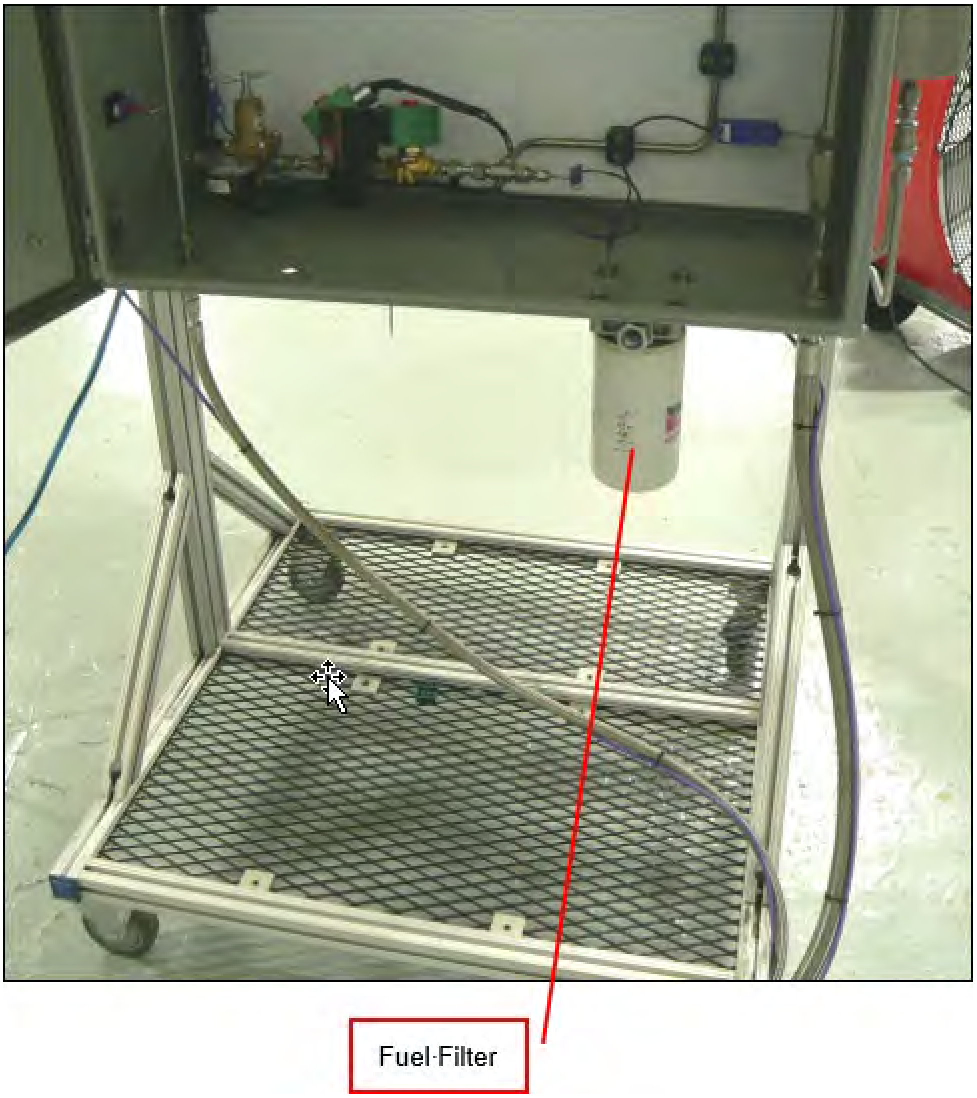
Mount the hose stand as close to the engine fuel inlet and return fittings as is practical (typically on the floor close to the engine) so that the interconnecting fuel lines are as short as practical for the best engine fuel inlet temperature control

Figure 11: Assembled Fuel Supply and Return Lines



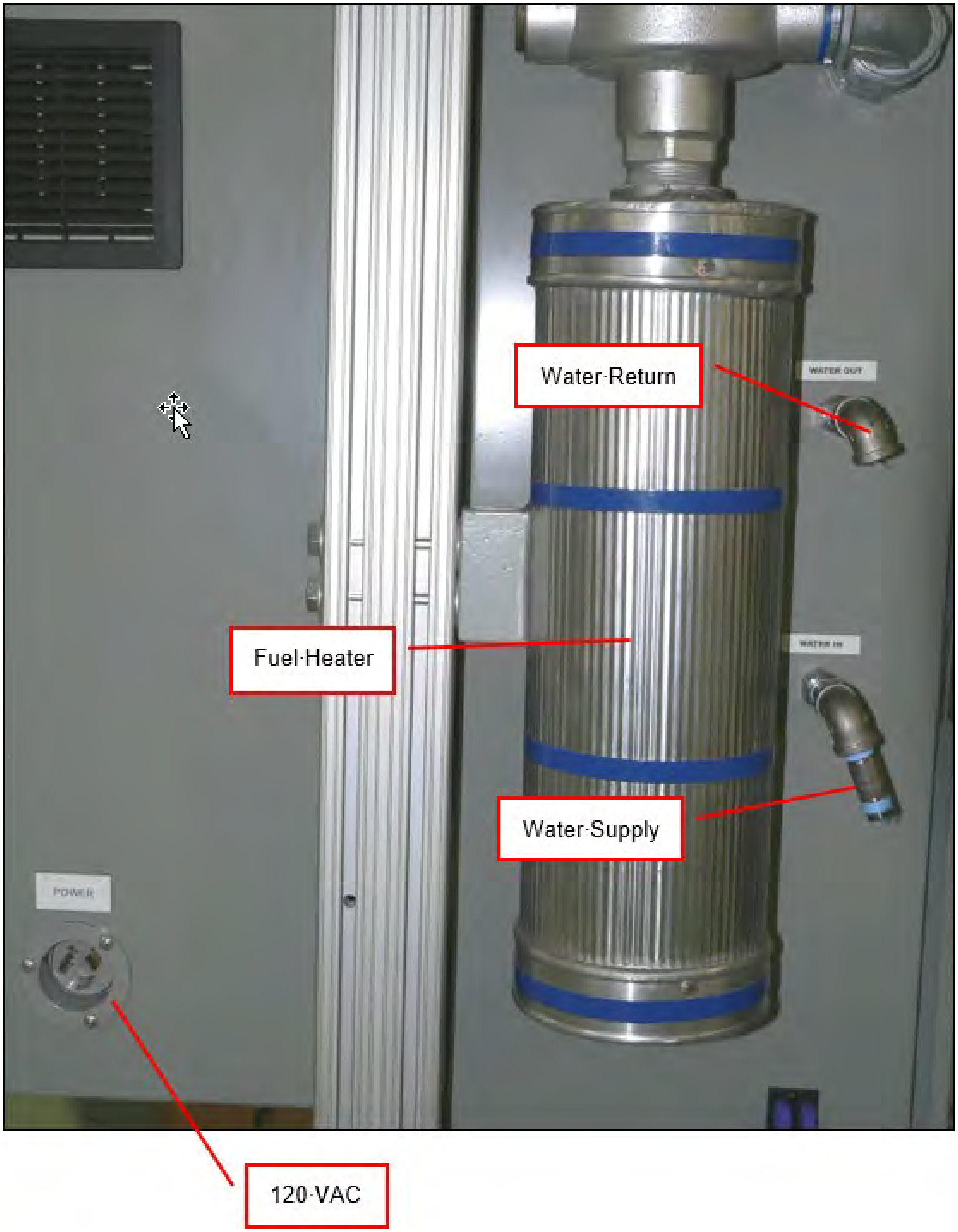
The filter for incoming fuel is located underneath the cabinet as in *Figure 12*.

Figure 12: Incoming Fuel Filter Location



Mount the fuel heater to the frame of the mobile CFS as in *Figure 13*:

Figure 13: Mounted Fuel Heater

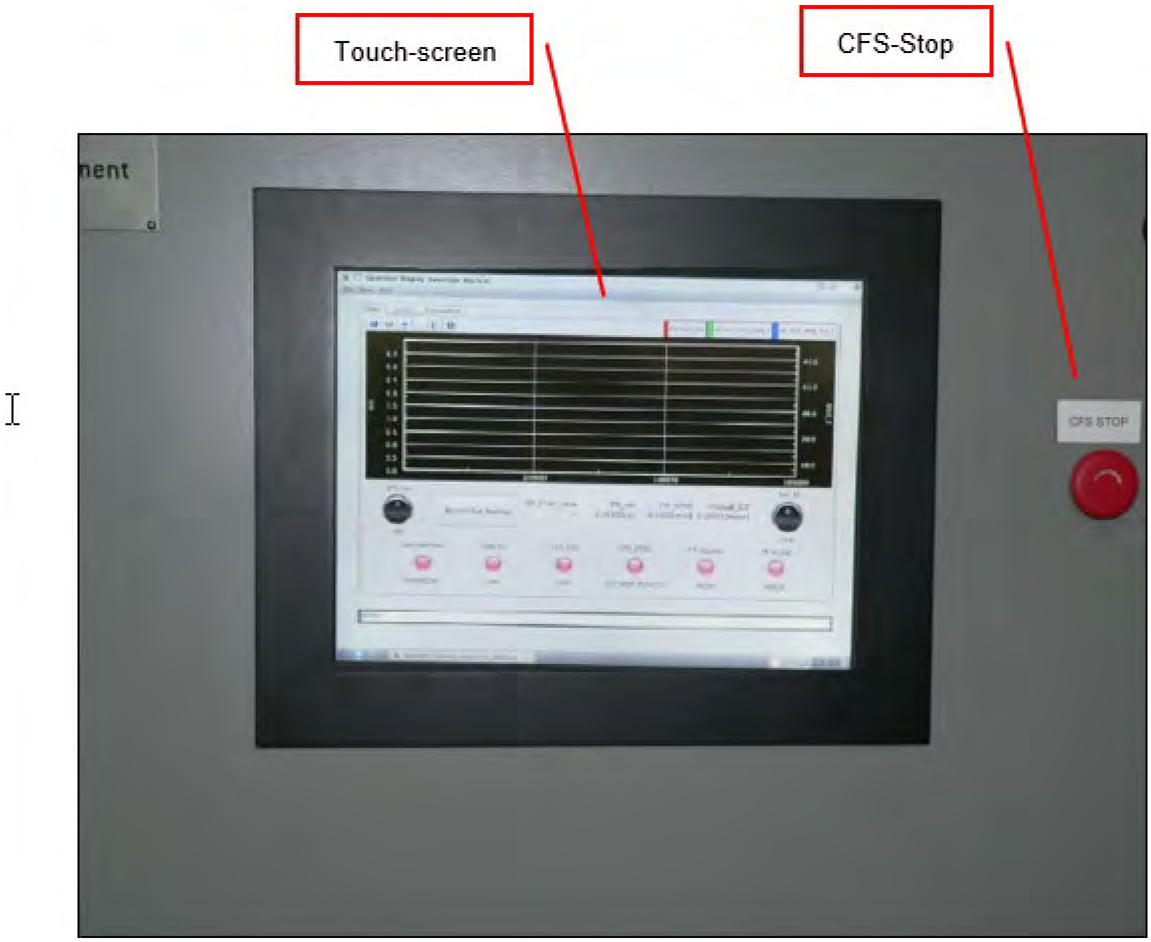


4.3 Operator Controls

Operator controls include:

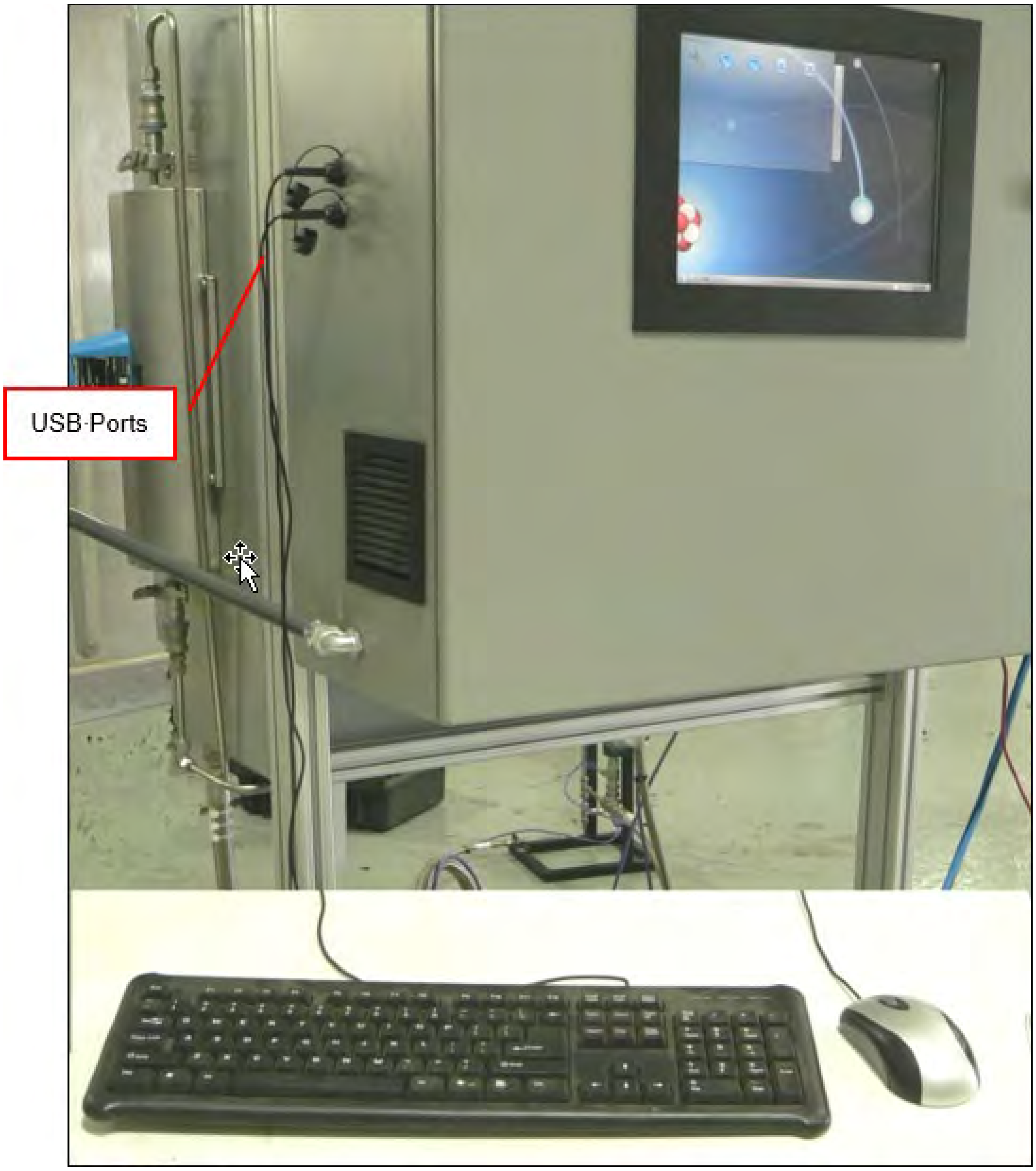
- Touch-screen (Human-Machine Interface)
- CyFlex (pre-installed system automation software)
- CFS-Stop
- Universal Serial Bus (USB) Ports
- Mouse and keyboard

Figure 14: Operator Touch Screen and CFS Stop Button



A user-supplied mouse and keyboard may be connected to the USB ports, for navigating the windows and utilities. *Figure 15* on page 20 shows the USB ports location.

Figure 15: USB Ports Location



5 Powering On the CFS

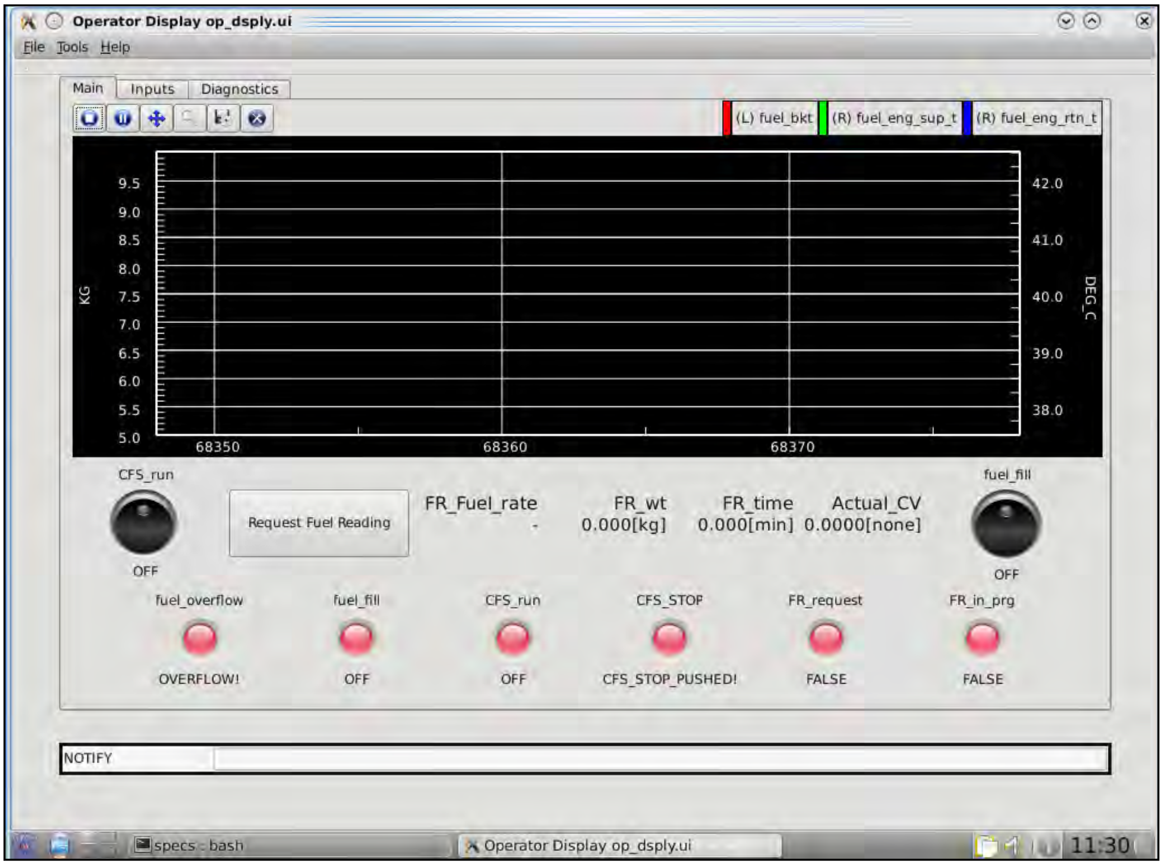
Execute the following steps to power-on the CFS:

1. Check all mechanical connections.
2. Ensure all of the circuit breakers inside of the CFS I/O cabinet are turned OFF.
3. Ensure the test cell I/O to Deutsch connector interface is properly connected.
4. Plug the power cord into the CFS.
5. Plug the power cord into a 120 VAC outlet of sufficient amperage capacity (15 A minimum).
6. Circuit breakers are identified in the section of this document called, Electrical and I/O. Turn on the circuit breakers in the following order:
    a. UPS – after switching on the UPS breaker, turn on the UPS by pressing and holding its power button for 3 seconds.
    b. PC and Touch-screen
    c. 24 V Power Supply
    d. Input and Output Circuit Breaker
    e. Fuel Heater

       Unless the CFS is moved to another location and needs to be installed again, this step for powering on the next time may be performed using only the UPS circuit breaker and the UPS power button.
7. Press the power button on the front of the computer to switch it on.

   CyFlex automatically starts after the operating system boots, The desktop appears briefly followed by the operator display as in *Figure 16* on page 22.

Figure 16: Start-up Operator Display



Navigate the screen using the touch-screen, or a mouse and keyboard connected to the cabinet's USB ports. Refer to *Figure 15* on page 20 for the USB ports location.

Note:

The operator display may be started from the desktop using the **Launch Operator Display** icon, or the bottom menu bar.

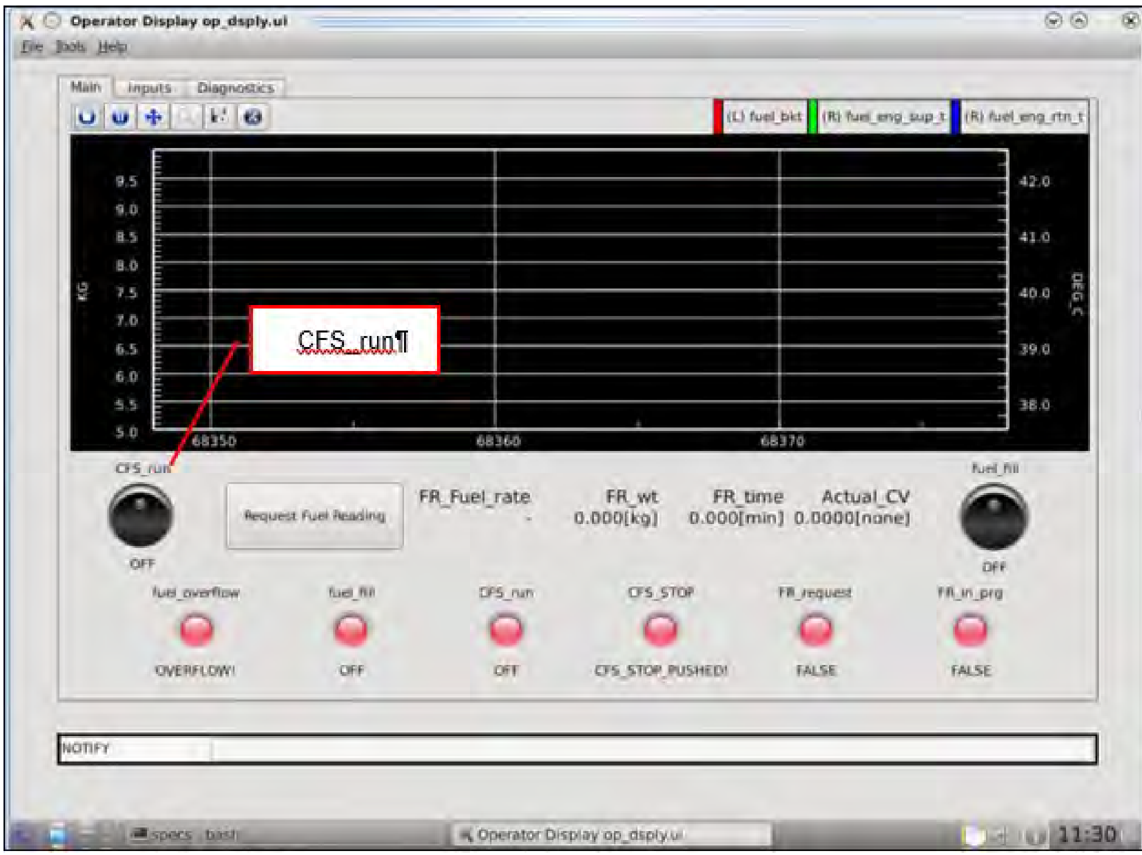
6 Calibrating the Load Cell

The load cell is an electronic weighing system and requires periodic calibration. The American Society for Testing and Materials (ASTM) recommends calibrating load cells annually," or more often where heavy usage or possible damage has occurred." Follow this practice and calibrate the CFS if it is moved to another test cell.

Execute the following steps to calibrate the load cell:

1. Connect a keyboard and mouse to the cabinet's USB ports.
2. From the operator display, select the **Main** tab.
3. Make sure the CFS is not running. The **CFS_run** button on the display should be **OFF**.
4. If the **CFS_run** button is **ON**, press the button to turn it **OFF** as in *Figure 17*.

Figure 17: Operator Display CFS-run OFF

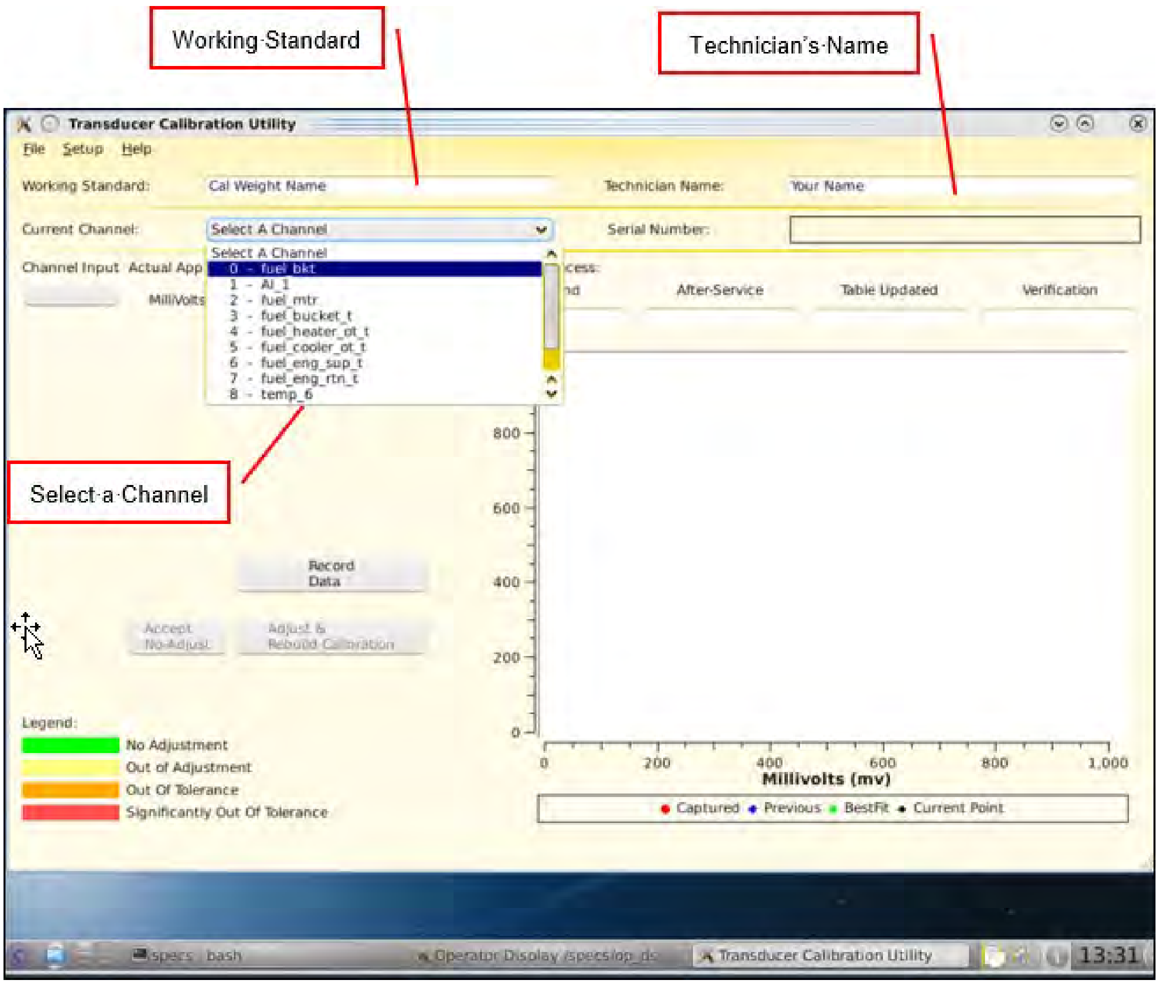


5. Close the engine fuel supply and engine return ball valves.
6. Remove the fuel bucket from the load cell.

   Caution: Avoid exerting excess compressive or tensile force on the load cell to prevent permanent damage.
7. Remove all fuel from the fuel bucket.
8. Clean the bucket with a paper towel.
9. Re-hang the bucket from the load cell.

10. Exit or minimize the operator display.
11. From the desktop window, double-click the **Calibration Utility** icon.
12. On the resulting **Transducer Calibration Utility** window, enter the **Technician Name** of the technician performing the calibration and the **Working Standard** as in *Figure 18*.

Figure 18: Working Standard and Technician Name



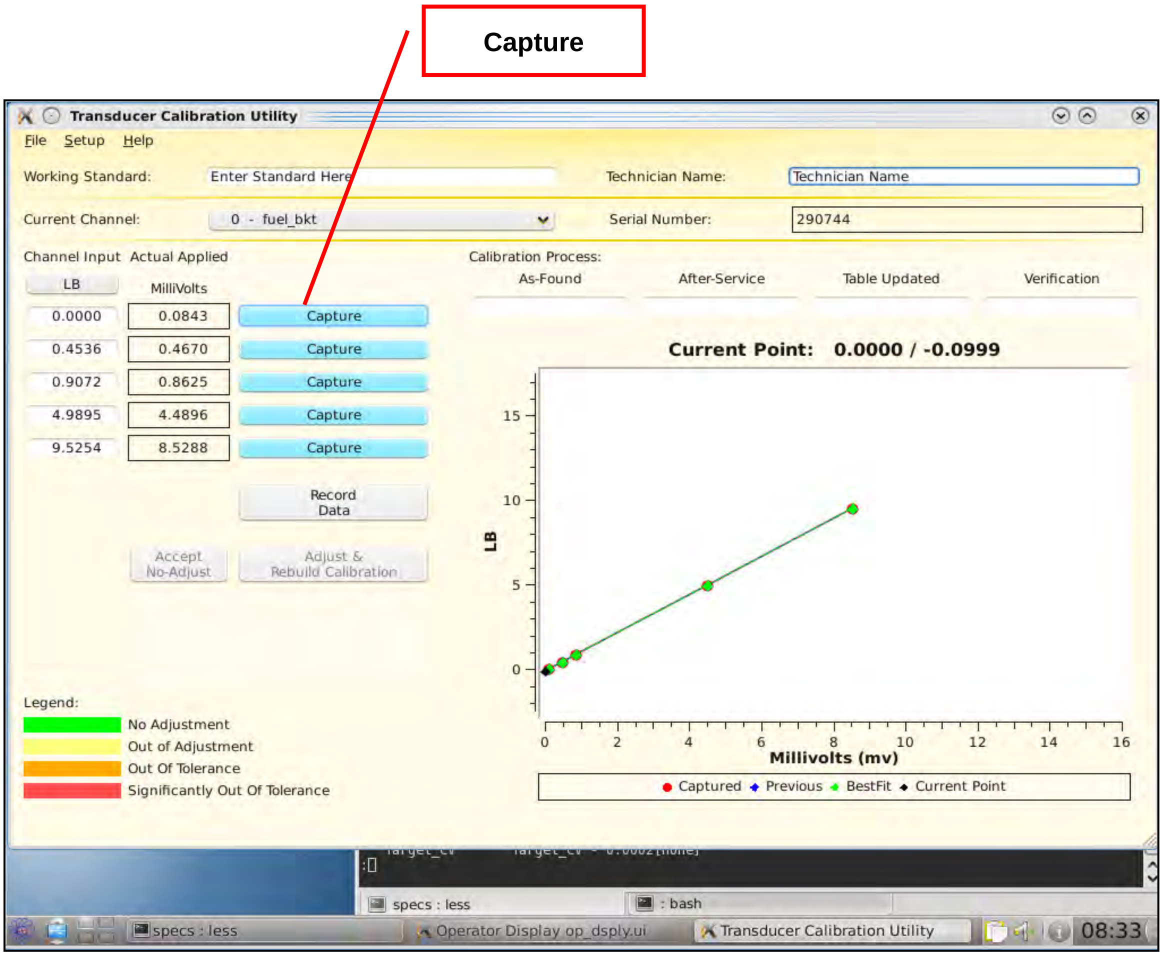
Notes:

The **Working Standard** is a name or number used to track calibration weights. Typically, the facility has a list of working standards for calibration weights. If calibration was done previously, the screen displays the prior used value.

13. Click on the **Select A Channel** drop-down menu and select **0 – fuel_bkt** as in *Figure 18*.

14. Once the value for the bucket stabilizes, click the **Capture** button located to the right of the **0.0000 LB** value as in *Figure 19*.

Figure 19: Capture Selection

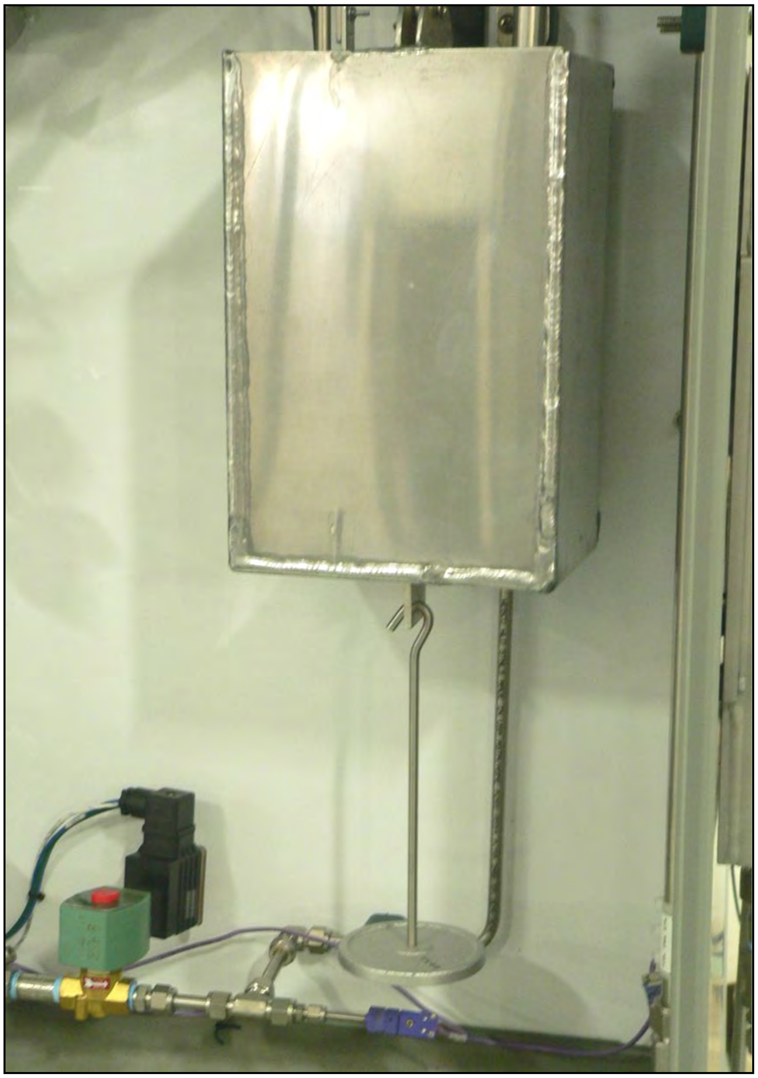


15. Suspend the hanger on the fuel bucket. Refer to *Figure 20*.

Note:

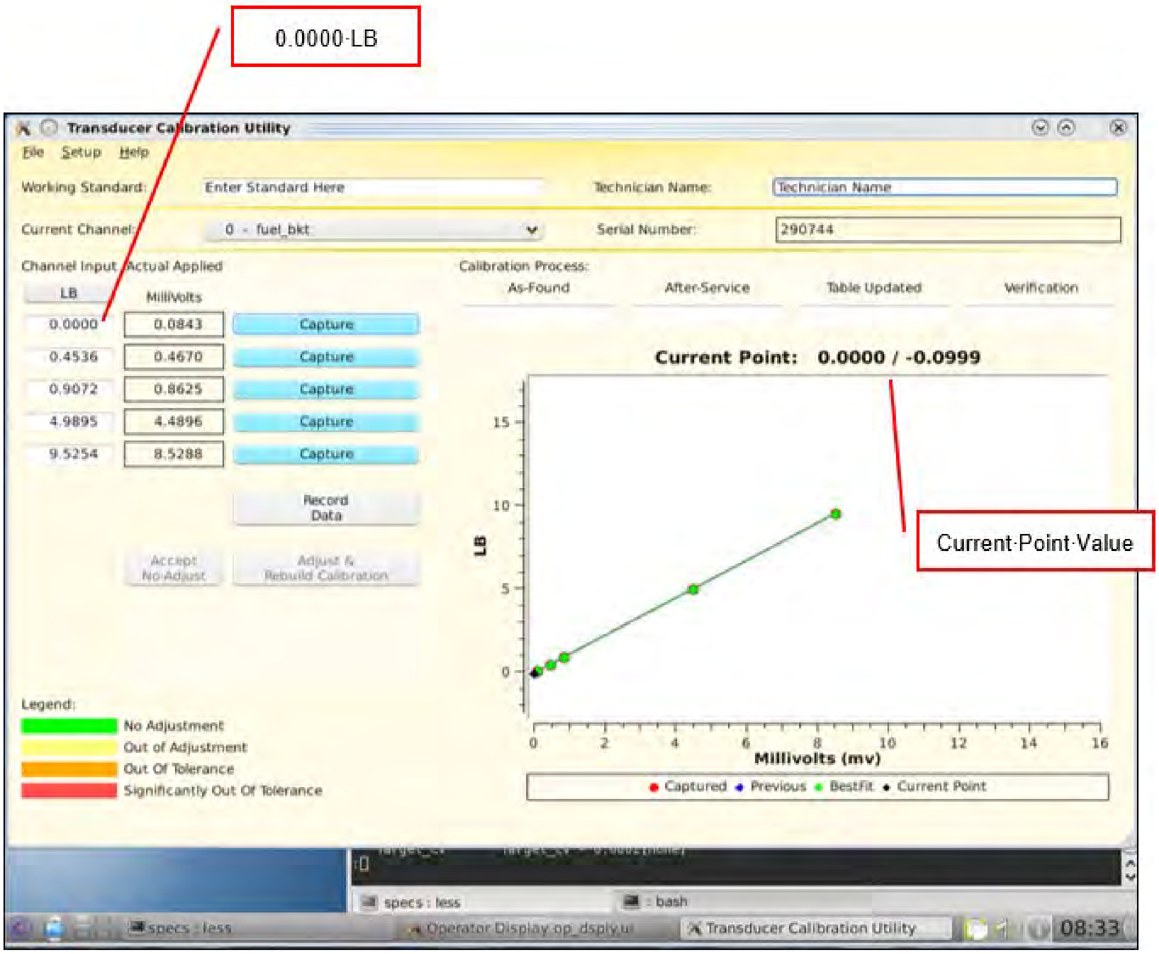
The hanger weighs 1 pound.

Figure 20: Fuel Bucket Hanger



16. Attach (3) 1 lb. weights to the hanger. The **Current Point** value will fluctuate as in *Figure 21*.

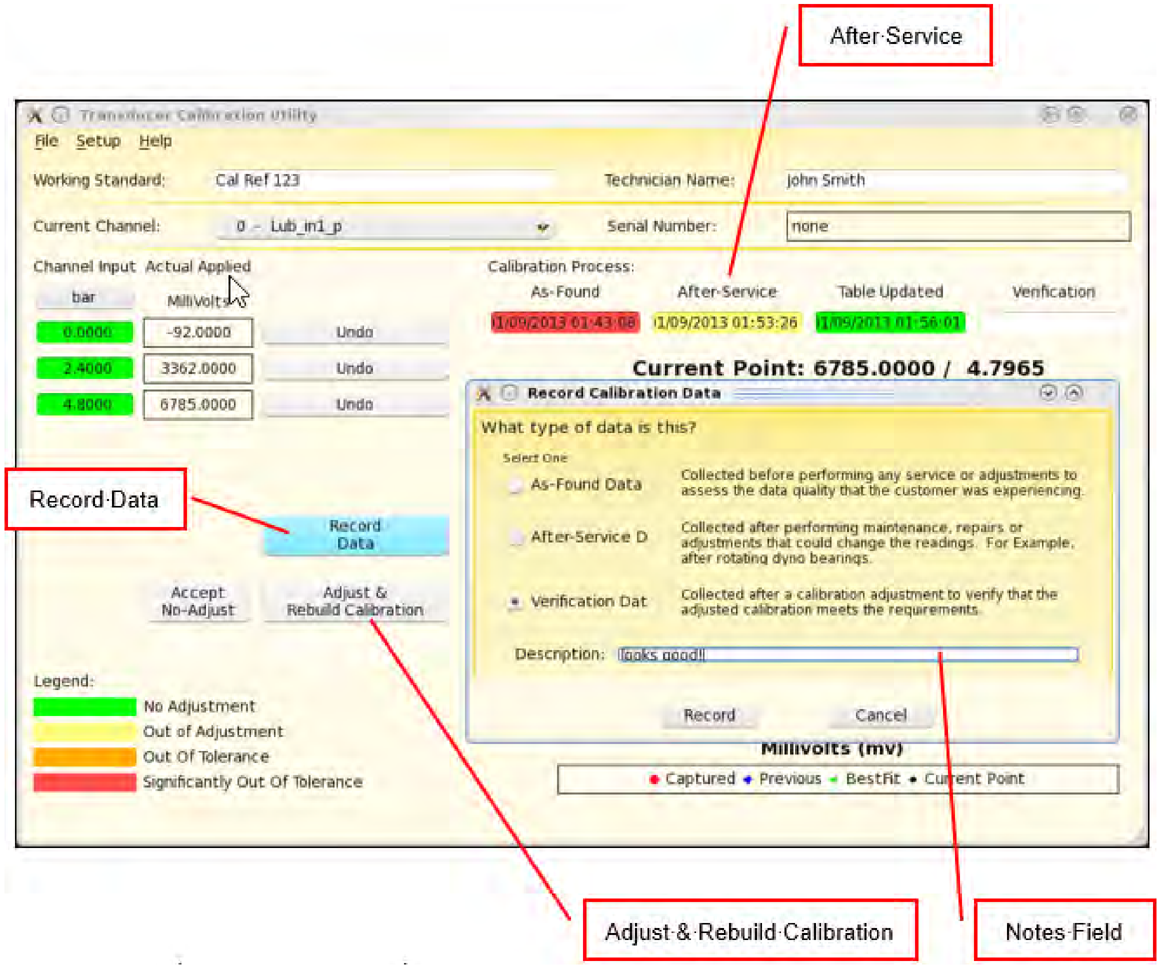
Figure 21: Current Point Value



17. When the value next to **Current Point** stabilizes, click the **Capture** button next to the value that corresponds to 4 lb.
18. Remove the (3) 1 lb. weights from the hanger.
19. Place a 5 lb. weight on the hanger, and (1) 1 lb. weight on the 5 lb. weight.
20. Once the current value stabilizes, capture this point as 7 pounds by clicking **Capture**.
21. Remove the weights from the hanger.
22. Place (1) 10 lb. weight on the hanger and (1) 1 lb. weight on the 10 lb. weight.
23. **Capture** this point as 12 pounds. (Remember that the hanger weighs 1 pound.)
24. Remove the weights from the hanger.
25. Hang the 10 lb. weight and the 5 lb. weight on the hanger.
26. **Capture** this point as 16 pounds.

27. Click the **Record** Data button as in *Figure 22*.

Figure 22: Post-Capture Selections



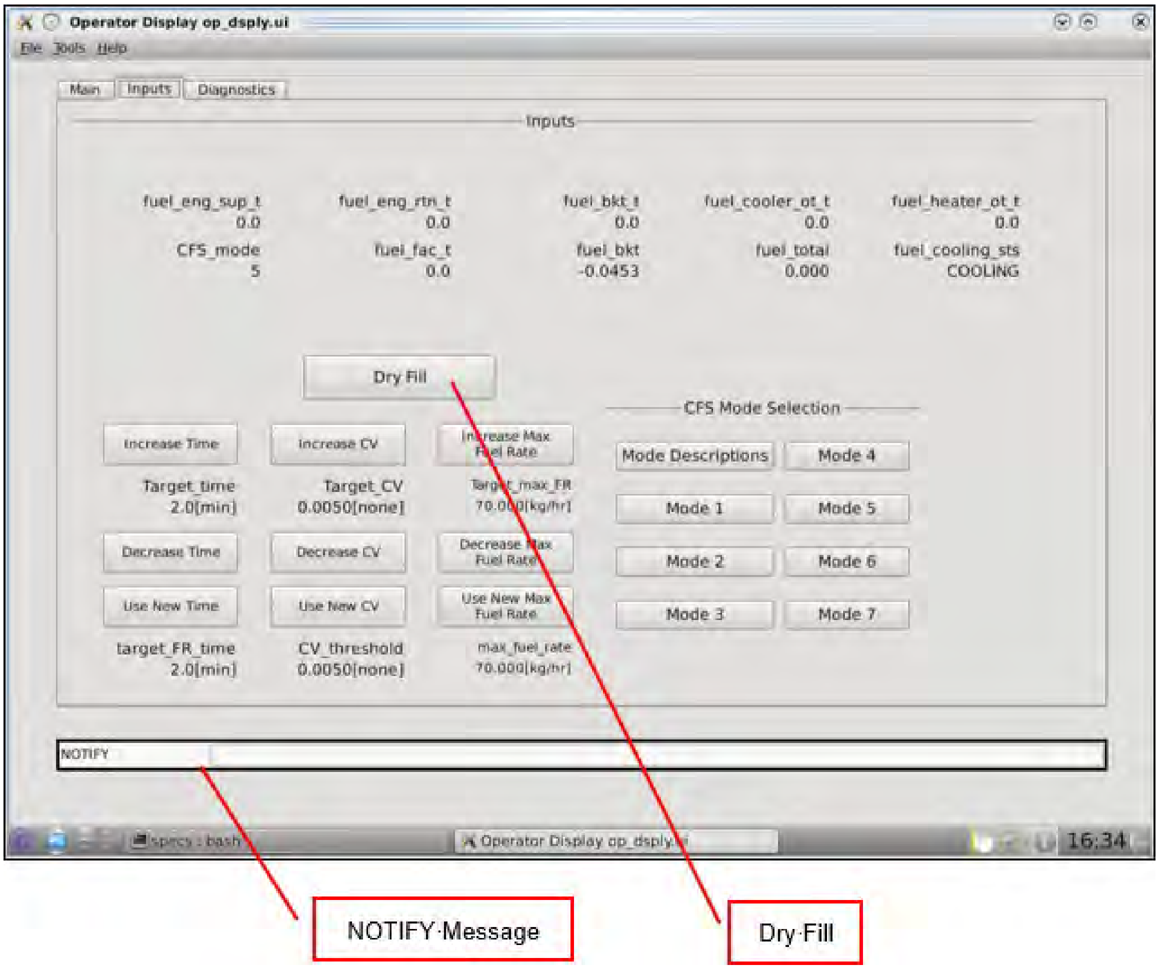
28. Select **After Service** as in *Figure 22*.
29. Enter any notes into the **Description** field as in *Figure 22*.
30. When finished, click the **Record Data** button as in *Figure 22*.
31. Click the **Adjust & Rebuild Calibration** button as in *Figure 22*.
32. Close the calibration utility.

7 Filling the Fuel Bucket

Execute the following steps to fill the fuel bucket when it is dry:

1. Make sure the CFS-stop is not depressed (not activated).
2. Confirm that a pressurized fuel supply line is connected to the CFS.
3. From the operator display, select the **Inputs** tab as in *Figure 23*.

Figure 23: Inputs Tab Selection



4. Click **Dry Fill** as in *Figure 23.*

   The **NOTIFY** message at the bottom of the display should state **Bucket filling!** The fuel bucket fills to the specified **fill_wt value**. The default weight limit is 19 lb. Refer to *Section 12 Understanding NOTIFY Messages* on page 37.

   When the fuel bucket finishes filling, the **NOTIFY** message changes to **Bucket has filled. CFS ready to start**. Refer to *Section 8 Running the CFS* on page 30.

8 Running the CFS

Before starting the CFS, fill the fuel bucket as described in *Section 7 Filling the Fuel Bucket* on page 29.

Execute the following steps to start the fuel pump and begin heating the fuel:

1. Open the **Main** tab on the operator display.
2. Press the **CFS_run** button on the display. This turns on the pump and begins heating the fuel to its temperature set point (104 deg F).

Warning: Do not set the fuel over-temperature controller higher than 120 deg F.

Recommendation: Change the fuel filter every 250-500 hours of normal use depending on the facility supply fuel cleanness.

Note:

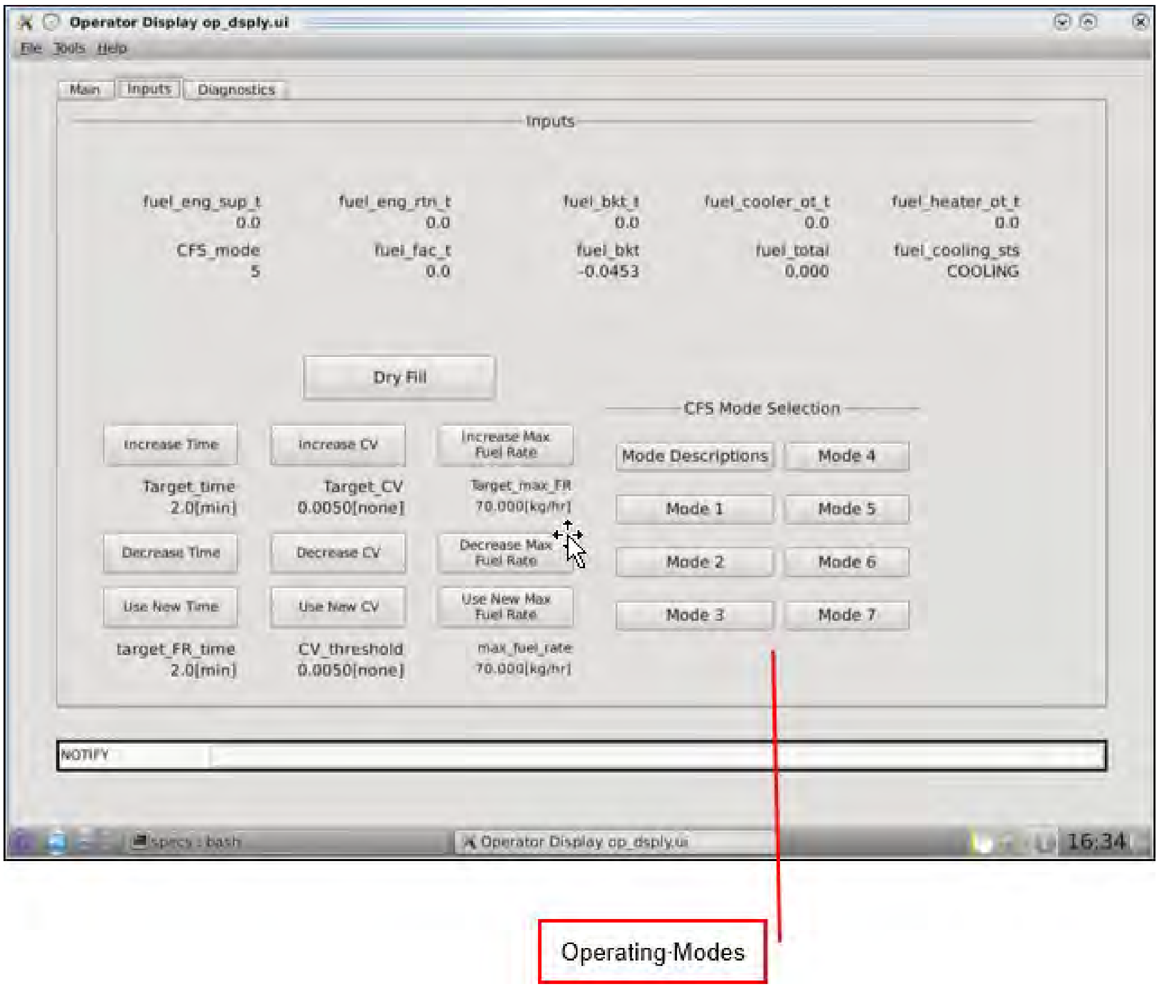
Using the fuel measurement system after start-up is beyond the scope of installation and calibration covered in this guide

9 Setting the Operating Mode

Execute the following steps to set the operating mode of the fuel measurement subsystem:

1. From the operator display, open the **Inputs** tab.
2. Determine which operating mode to use, based on the mode descriptions displayed by pressing the **Mode Descriptions** button.
3. Press the appropriate operating mode button as in *Figure 24*.

Figure 24: Operating Modes



10 Setting the Fuel Measurement Variables

Fuel measurement variables must be set before taking a reading. Once configured for a specific test, the variable values do not require setting again for subsequent, identical tests.

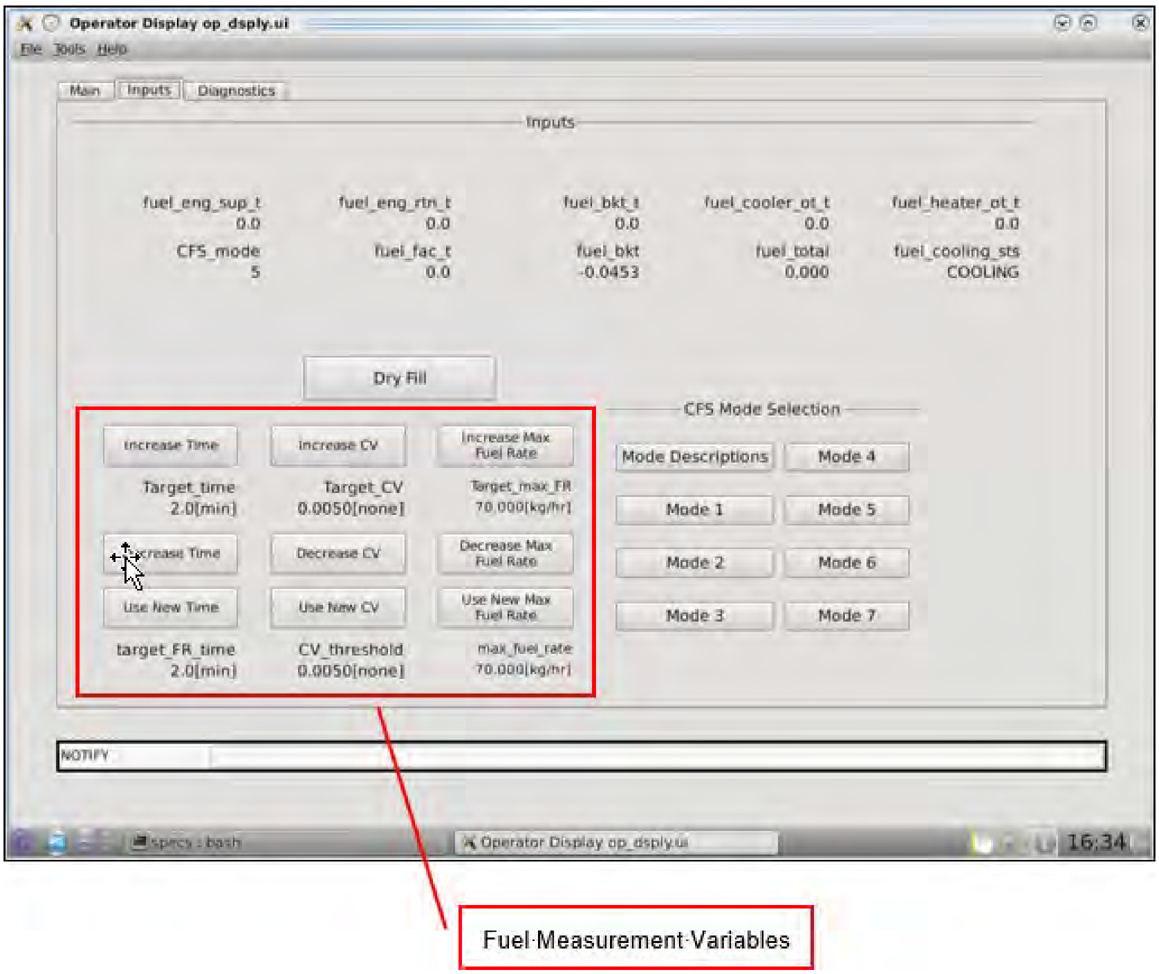
The following variables are user-adjustable at the operator display:

- **Fuel Reading Time**
- **CV Threshold**
- **Maximum Fuel Rate**

Execute the following steps to set fuel measurement variables:

1. From the operator display, click the **Inputs** tab. The values of variables may be changed and saved using the buttons shown in *Figure 25*.

Figure 25: Fuel Measurement Variables



2. Determine the saved value of a variable. The currently saved value appears below the **Use New <*variable name*>** button.

   The example in *Figure 26* shows the saved value for the fuel reading **Time** is 2.0 minutes.

Figure 26: Fuel Reading Time Variable Example

3. To change the value, use the **Increase <*variable name*>** and **Decrease <*variable name*>** buttons. The temporary value appears as shown above.

   Note:

   Until the value is adjusted, the temporary value and saved value are the same.

4. Save the temporary value by clicking the **Use New <*variable name*>** button.

Refer to *CyFlex Variables, Units, Computed Expressions* for more about variable types.

Table 2 lists Fuel measurement variables used in the CFS.

Table 2: CFS Fuel Measurement Variables

Variable Name	Type	Description
`Actual_CV`	Real	Actual coefficient of variation (CV) The CFS takes regular samples from the Coriolis meter, and adjusts the values with changes in the weight of the fuel bucket. While the Coriolis meter is relatively free from noise, vibrations may be present in the test cell – passing those to the load cell, while it is measuring the weight of the fuel bucket. Over time, these variations tend to average, so that a longer reading becomes more accurate than a shorter reading. If a fixed length of time is used for the fuel reading, it must be long enough to sufficiently deal with the vibrations from the test cell. An optional operating mode allows a reading to continue until a “quality” measurement is achieved. This allows shorter readings when vibrations are minimal and longer ones when they impact the measurement. In this optional mode, the fuel rate is calculated each time a sample is taken. When the coefficient of variation (CV) of

Variable Name	Type	Description
		these samples goes below the user-selected threshold, the reading is terminated. The coefficient of variation is the standard deviation of fuel measurement samples divided by the mean value. Basically, it shows the extent of variability in relation to the average reading. When using this mode, a maximum time value is set also, so the reading doesn't go on indefinitely.
`CV_threshold`	Real	Coefficient of variation (CV) threshold Refer to the description of CV above for `Actual_CV`.
`CFS_STOP`	Logical	CFS-Stop button depressed (circuit opens) This message also occurs if the CFS-Stop is connected to test cell E-stop dry contacts that open.
`CFS_mode`	Integer	Current CFS operating mode
`FR_Flow_rate`	Real	Fuel mass flow rate from the previous fuel reading
`FR_in_prg`	Logical	Fuel reading in progress or not `TRUE` = in progress `FALSE` = not in progress
`FR_request`	Logical	Fuel reading requested or not Once a fuel reading is requested and all stabilization requirements are met, a fuel reading begins. `FR_in_prg` changes to `TRUE` and `FR_request` changes to `FALSE`.
`FR_time`	Real	Time elapsed during the previous fuel reading
`FR_wt`	Real	Fuel weight (mass) used in the previous fuel reading
`fuel_bkt_wt`	Real	Weight of the fuel in the bucket
`fuel_bkt_t`	Real	Temperature of fuel coming from the bucket while the CFS is on. Note: The thermocouple measuring this temperature is not located inside of the bucket and represents the temperature inside of the bucket only when the pump is running.
`CFS_run`	Logical	CFS on or off
`fuel_cooler_ot_t`	Real	Temperature of fuel after passing through the heat exchanger If both fuel and water are going through the heat exchanger and fuel is not cooled enough, check whether the water strainer is clogged.
`fuel_cooling_sts`	Logical	This variable shows whether or not the fuel cooler is adequately cooling the fuel based on the temperature measurement after the heat exchanger.

Variable Name	Type	Description
`fuel_eng_rtn_t`	Real	Temperature of fuel returning from the engine
`fuel_eng_sup_t`	Real	Temperature of fuel supplied to the engine
`fuel_fac_t`	Real	Temperature of fuel entering the CFS
`fuel_fill`	Logical	State of solenoid valve for fuel supply to bucket – open or closed
`fuel_heater_ot_t`	Real	Temperature of fuel after it leaves the heater
`fuel_total`	Real	Indicates how much fuel has flowed through the Coriolis meter Note: Value resets upon restarting the CFS, per the default configuration
`fuel_overflow`	Logical	State of fuel bucket safety float switch – normal or overflow
`max_flow_rate`	Real	Maximum mass flow rate output
`NOTIFY`	String	Text message located at the bottom of the screen, notifying the user about the system or a fuel measurement.
`Target_CV`	Real	Target coefficient of variation (CV) Refer to the description of CV above for `Actual_CV`.
`target_FR_time`	Real	Target Fuel Reading time The CFS takes a fuel reading during this time interval.
`Target_max_FR`	Real	Temporary value while setting the maximum fuel rate output Once the adjusted value is acceptable, the user assigns this value to the `max_fuel_rate` variable.
`Target_time`	Real	Temporary value while setting the target fuel reading time Once satisfied with the adjusted value (time interval), the user assigns this value to the `target_FR_time` variable.

11 Powering Off the CFS

Execute the following steps to shut down the CFS:

1. Exit CyFlex.

   If CyFlex is running, double-click the **Stop CyFlex** icon on the desktop. CyFlex must be shut down before powering off the computer.

2. Shut down the computer.

3. Switch off the UPS circuit breaker.

   The UPS circuit breaker is located inside of the CFS cabinet, as pictured in *Section 4.1 Electrical and I/O* on page 7.

ⓘ ***Important:***

Clean the fuel bucket periodically and leave the cabinet door closed to keep out air-borne dirt, etc. If moving the CFS to a different test cell or changing to a different fuel, first drain the CFS. Accomplish this by turning the hose stand on its side over a suitable container and opening the ball valves to siphon fuel from the bucket and drain the hoses.

12 Understanding NOTIFY Messages

The purpose of the NOTIFY message is to inform of system status such as when the fuel bucket is full or a measurement variable entry is out of range. Messages appear in the text field at the bottom of the screen.

These may help in some cases with troubleshooting. *Table 3* lists suggested user actions in response to various NOTIFY messages.

Table 3: NOTIFY Messages and Suggested Responses

NOTIFY Message	Reason for Message	Suggested Action(s)
SET FUEL READING TIME GREATER THAN 0.1 MIN	Value entered for target fuel reading time (`target_FR_time`) is less than 0.1 minutes	Enter a value greater than 0.1 minutes.
SET FUEL READING CV GREATER THAN 0.0001	Value entered for target fuel reading coefficient of variability (`Target_CV`) is less than 0.0001	Enter a value greater than 0.0001
SET MAX FUEL RATE GREATER THAN 10 KG/HR	Value entered for maximum fuel rate is less than 10 Kg/hr.	Enter a value greater than 10 Kg/hr.
MAKE SURE PUMP IS ON AND HEATER ENABLED BEFORE REQUESTING READING	Request for fuel reading while the CFS is off	Turn on the CFS (press the `CFS_run` button) before taking a fuel reading.
CFS NOT STARTED!! CHECK CFS-STOP AND FUEL LEVEL	Attempt to turn on the CFS when: • Fuel level is too low, and/or • CFS-Stop is depressed	Check that: • Fuel tank is filled, and • CFS-Stop is not depressed Try starting the CFS again.
BUCKET FULL OR CFS-STOP PUSHED, NOT FILLING	Dry Fill button pressed when: • Fuel bucket contains fuel, and/or • CFS-Stop is depressed	If the bucket is empty: Pull out CFS-Stop knob Press Dry Fill button again.
BUCKET HAS FILLED. CFS READY TO START	Dry Fill button pressed: • Fuel bucket has filled, and • CFS ready to be started	Run the CFS.

NOTIFY Message	Reason for Message	Suggested Action(s)
HEAT EXCHANGER NOT COOLING. CHECK STRAINER AND WATER FLOW	• CFS is running, and • Fuel is not being adequately cooled coming out of the heat exchanger	Confirm: • At least 35 psi water pressure at the gauge before the heat exchanger • All water valves in the system are open • Temperature of water flowing through system is <=85 deg F If all of the above are true, then: • The water strainer is clogged and not allowing flow, or • The heat exchanger is due for replacement **Note:** Clean the strainer to verify flow before replacing the heat exchanger.