

Gen M1 Fuel Consumption Meter

Installation, Operation, and Maintenance Guide

Table of Contents

- General Information
- Safety Information
- General Description
- Planning the Installation
- Installation
- Startup
- Testing
- Operation
- Maintenance
- Troubleshooting
- Spare Parts
- Warranty and Service
- Appendix 1: Controller Instructions
- Appendix 2: Modbus Instructions
- Appendix 3: Functional Description
- Appendix 4: Meter Manual
- Appendix 5: Panel Schematic

General Information

Notice

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Damage Claims

Thoroughly examine all components and units as soon as they are received. If damaged, write a complete and detailed description of the damage on the face of the freight bill. The carriers agent must verify the inspection and sign the description. Immediately notify the delivering carrier of damage or loss. This notification may be given either in person or by telephone. Written confirmation must be mailed within 48 hours. Risk of loss, or damage to merchandise belongs with the buyer. It is the buyers responsibility to file a claim with the carrier involved. Immediately advise Earthsafe of the problem so that we may assist you.

Safety Information

Intended Use. Controls and instrumentation are intended for use with diesel exhaust fluid (DEF) systems for emergency power generators. The control module and any connected sensors or devices are intended for operation only within ordinary electrical areas. Use of the module and connected sensors or devices within hazardous electrical areas is prohibited.

Intellectual Property

The equipment and software described herein are the property of Earthsafe Systems, Inc. and are protected by various trademarks and patents.

Safety Information

Safety Notice:

Improper installation, operation, or maintenance may cause serious injury or death and/or result in damage to the unit and/or other equipment. Earthsafe's warranty does not cover failure due to improper installation, operation, or maintenance.

This information must be fully read before beginning installation, operation, or maintenance of equipment and must be kept with equipment. Equipment must be installed, operated, and maintained only by suitably trained and qualified persons.

General Safety Instructions

The following safety instructions must be followed and adhered to at all times.

Before opening any tank fitting, pipe system, pump, or valve be sure that:

- Any pressure in the chamber has been completely vented through the appropriate openings or connections.
- The electrical system means has been "locked out" or otherwise been made non-operational so that it cannot be started while work is being done on the equipment.
- You have obtained appropriate material safety data sheet (MSDS) and understand and follow all precautions appropriate for the safe handling of the material.

Install pressure gauges/sensors at piping and pump connections to the equipment to monitor pressures.

Use extreme caution when lifting the tank and associated equipment. Suitable lifting devices should be used when appropriate.

Avoid contact with hot areas of the tank, pump or equipment. Certain operating conditions, temperature control devices, improper installation, improper operation, and improper maintenance can all cause high temperatures on the pump or equipment.

Protect tanks, pumps and piping systems with pressure relief devices.

The equipment must be installed in a manner that allows safe access for routine maintenance and for inspection during operation to check for leakage and monitor operation.

General Description

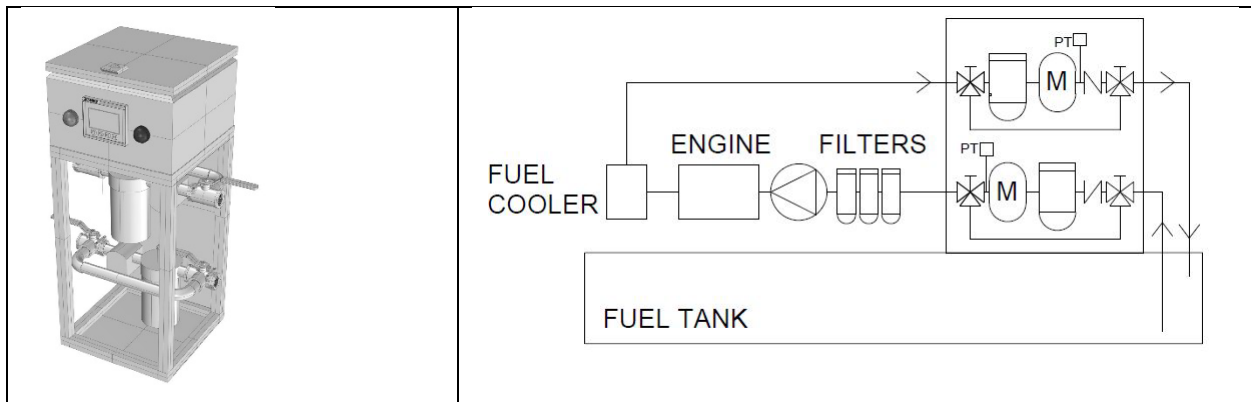
The M1-FCM Fuel Consumption Meter is designed for precision measurement of fuel flows to and from engines used in power systems. Diesel Engines operate to flow fuel from the fuel tank to the engine with a return flow of unused fuel back to the tank.

The M1-FCM system is designed for precision metering of fuel flows to and back from the engine with the net consumption being the difference.

The difficulty of the application is that the return flow fuel temperature is usually much higher than the supply flow temperature. Since diesel fuel volume is sensitive to temperature changes, precision measurement must include temperature compensation.

A second difficulty is that the precision is not a point in time, but generally a run event that can be of minutes or hours or days duration. This means that small errors in measurement can accumulate to grossly inaccurate conclusions.

Physical Description



1. Enclosure: Lightweight, Compact Open Enclosure for Protection
2. Containment: Base Assembly Liquid Tight to Catch Leaks
3. Control Panel: Electronic Controller and HMI with Motor Starters
4. Strainers: Strainer Upstream of Meters for Protection
5. Hose or Pipe Connections: Supply and Return Connections to Fuel Tank and Engine.
6. Meters: Precision Meters with Temperature Sensors

Planning the Installation

Location

1. Location: Locate the Unit between the generator engine and fuel tank.
2. Accessibility: The Unit should be located where it is accessible for inspection, maintenance, and repair.

Piping

1. Size the supply piping to minimize frictional head loss based on the design flow.
2. Be sure the inside of the pipe is clean before connecting to the Unit.
3. Be sure allowance is made for expansion and contraction of the piping so the tank connections are not stressed by the piping.

Installation

1. Remove packaging and inspect for shipping damage. Note any shipping damage on the shipping ticket and notify Earthsafe within 24 hours of receipt.
2. Set unit at installation location. Use proper handling procedures to avoid damage to the unit.
3. Install anchor bolts at 4 corners. Use 3/8 IN minimum diameter bolts or as required.
4. Connect power to unit control panel. Reference specific installation instructions and wiring diagrams for the control panel.
5. Connect hoses or piping to inlet and outlet. Confirm that field piping is independently supported to avoid stress on the Unit piping connections.

Startup

1. Visually inspect unit installation and associated equipment and piping for proper installation and absence of physical damage.
2. Confirm the electrical connections are correct and that the supplied voltage matches the unit electrical requirements. Confirm that the electrical circuit for the unit is rated for the required Amp capacity.
3. Confirm that all hose and pipe connections are liquid tight.
4. Prime the supply and return piping with diesel fuel to eliminate any trapped air. Operate the meter bypass valves momentarily to remove any air from the bypass.
5. Start generator engine to confirm engine operation without restriction.
6. Confirm temperature and flow readings on the controller display.

Testing

1. Record the generator tank fuel level and convert to gallons. Operate engine for 5 minutes or more, and record time. Check generator fuel tank level and convert to gallons. Calculate fuel consumption and GPH.
2. Compare calculated fuel consumption to meter reading.

- Use the Calibration screen on the controller to adjust actual versus recorded readings.

Startup Checklist

Item	Description	Confirm
1	Visual inspection of unit and associated equipment for no damage	
2	Unit and associated equipment are clean and clear of debris	
3	Unit is securely anchored at 4 points	
4	Associated piping is supported and does not cause stress on inlet - outlet fittings.	
5	Hose and pipe fittings are liquid tight.	
6	Electrical connections are properly installed. All electrical devices are in a safe de-energized condition until startup of this equipment is performed in accordance with written instructions.	
7	All required safety items are complete and available in the tank area including personal protective equipment (PPE), MSDS sheets, spill cleanup material. All required safety training has been performed.	
8	Prime unit with diesel fuel to displace any air.	
9	Operate generator to confirm engine operation without restriction.	
10	Calculate Min. 5 Minute fuel consumption and calibrate meter from control panel function as needed.	

Operation and Maintenance

- Visually inspect unit periodically for signs of leakage or damage.
- Visually inspect unit exterior for dirt or engine fluids. Wipe clean as necessary.
- Observe operation of the unit in engine run mode for normal engine operation.

Troubleshooting

Observation	Troubleshooting
Generator Engine High Suction or High Discharge Pressure	<ul style="list-style-type: none"> Operate 3 Way Valves to bypass meters Check strainers for debris and clean Open Meter Cover and confirm chamber is clean and gears move freely. Clean if Needed Re-Prime unit to eliminate any air
Consumption Readings Differ from Fuel Tank Calculations	<ul style="list-style-type: none"> Perform Testing Procedure noted above and correct the calibration value
Control Panel Display Not Functional	<ul style="list-style-type: none"> Confirm Power to Unit Confirm Green Power and Run light active on the internal PLC Check Wire terminations for Screen to PLC
Gallons Consumption not being Recorded or Temperature readings not accurate	<ul style="list-style-type: none"> Check wire terminations on Control Panel Terminal Block.

Spare Parts

Spare Parts: Available from Earthsafe.

Technical Support

Contact Earthsafe at
tech@earthsafe.com
(312) 226-7600
www.earthsafe.com

2300 Wisconsin Ave., Ste 317
Downers Grove, IL 60515

Warranty Statement

Earthsafe Systems, Inc. warrants the M1 Fuel Consumption Meter to be the kind and quality described in specification provided herein and to be free from defects in material or workmanship under normal service for a period of 1 year after shipment. Earthsafe obligations under this warranty shall be limited to repair or replacement, at the option of Earthsafe, of parts deemed to be defective upon inspection by Earthsafe. User is responsible for transportation of parts or assemblies to Earthsafe or its authorized repair location where the repairs are to be performed.

The provisions of the warranty shall not apply to any equipment, part, or accessory which (a) has been improperly specified by buyer, (b) has been improperly stored or handled prior to placing in service, (c) has been damaged or loosened during shipment, (d) has been improperly mounted or connected, (e) has not been operated within the equipment specifications, or (f) has been improperly maintained.

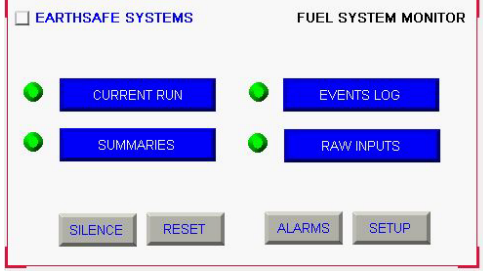
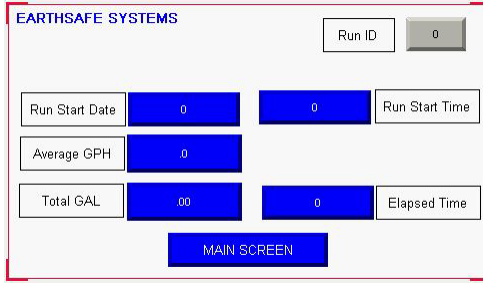
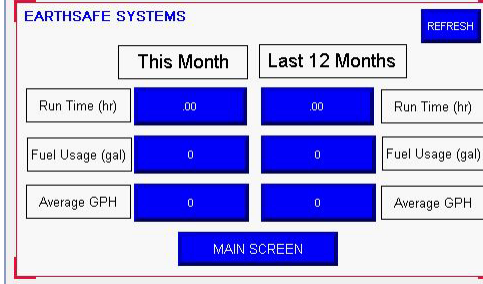
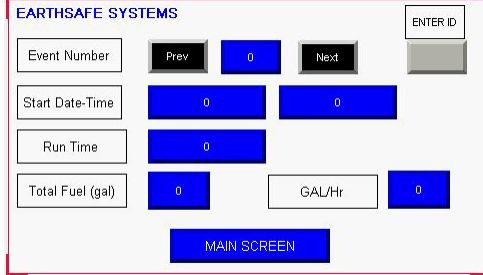
Earthsafe reserves the right to reject warranty claims of any kind for equipment for which it has not received full payment.

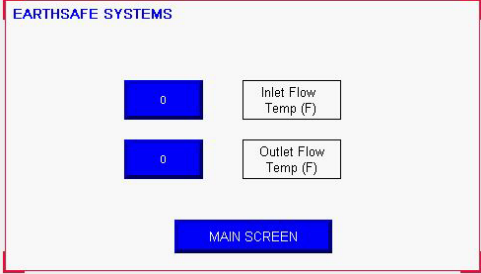
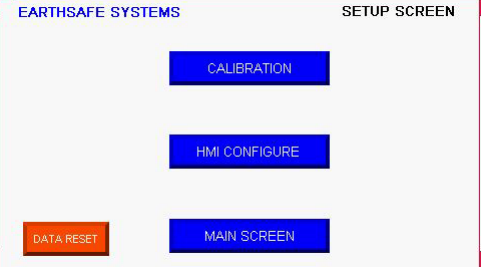
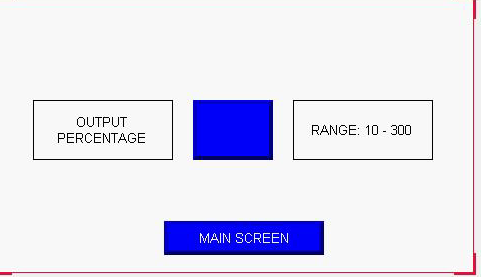
This warranty is in lieu of all other warranties, express or implied, and all other obligations or liabilities on the part of Earthsafe. Earthsafe assumes no responsibility or liability for any special, incidental, or consequential damage.

Appendix: Controller Instructions

The M1 FCP Controller has an Allen Bradley Micro-PLC with HMI to control and monitor the operation.

The Panel has allowances for Alarm Light, Horn, and Silence pushbutton for certain applications. However in the standard measurement mode, these are not used.

HMI Screen	Description
	<p>Main Screen: Navigation to Information</p>
	<p>Current Run: When flow is sensed from a generator start, a new ID is automatically assigned. The Data indicated is recorded for the ID in the PLC internal database.</p>
	<p>Summaries: Press the REFRESH button to view current data.</p>
	<p>Events Log: The controller records up to 100 events in sequence. Data for prior events can be viewed by pressing the PREV and NEXT pushbuttons.</p>

	<p>Raw Inputs: Readings of Temperature Sensors to confirm function.</p>
	<p>Setup Screen: Calibration navigates to that screen. HMI Configure navigates to HMI back end</p> <p>Data Reset: Deletes the existing Event IDs, to allow accumulation of next 100 events.</p>
	<p>Calibration Screen:</p> <p>Default value is 100. Input number to adjust fuel consumption versus actual measured. For example if measured is 5% greater than indicated on unit, then enter 105.</p>

Appendix: Modbus Instructions

The Serial Port on the PLC is setup as: Modbus RTU Slave, Unit Address 10, RS-485 / 8N1 / Baud = 19200.

The Modbus Registers are setup as follows:

40001 Current Run Unique ID

40002 Current Run Consumption (GAL)

40003 Current Run Gallon Average Consumption (GPH)

Appendix: Functional Description

The Earthsafe M1-FCM measures generator diesel fuel consumption. The unit is installed between the engine fuel tank and engine fuel inlet. Fuel flowing to the engine (Supply or FOS) is measured through an oval gear meter with temperature compensation. Return flow of excess fuel (Return or FOR) back to the fuel tank is measured with a like meter with temperature compensation.

The difference between the flow to the engine, and excess flow returning is the fuel consumption. Temperature compensation is required because the excess fuel returned is significantly higher in temperature compared to the fuel supply, as the fuel picks up heat flowing through the engine fuel system.

When fuel flow is detected by the meter, a run event is created in the logic controller. Start and Stop time are recorded. Flow is measured, temperature compensated, and recorded for the event FOS and FOR. The current fuel consumption rate (GPH) is calculated and displayed.

At the end of the run event the fuel consumption, run start time, run time, and average flow rate are recorded for the event. Up to 100 events are recorded and stored in the controller.

Appendix: Meter Manual

Appendix: Control Panel Schematic