MIRENCO™

You cannot manage what you cannot measure

Fuel-Tracker

Fuel Management Solution

Installation & Calibration Guide

206 May Street
Radcliffe, Iowa
800-423-9903

V1.0ag

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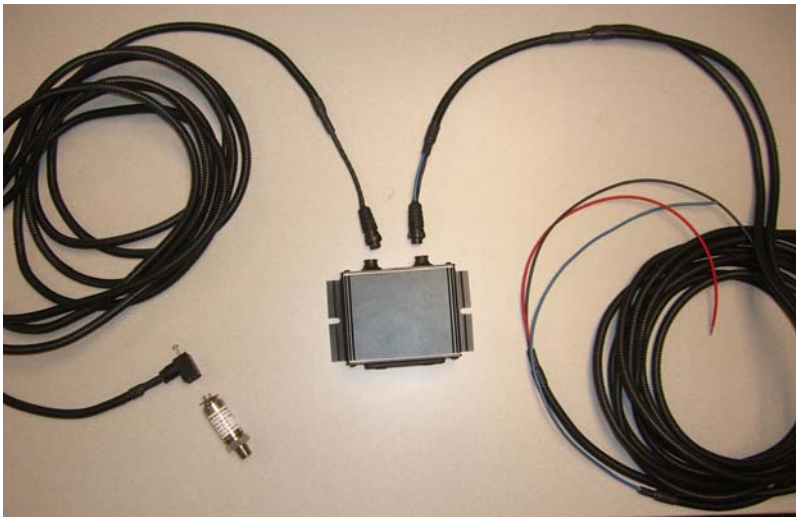


Fuel-Tracker System Overview

Mirenco's Fuel-Tracker system provides real time fuel usage data through the GlobalTRACS and JDLink systems. Fuel-Tracker systems use a diesel engine's intake air pressure to determine the engines real time fuel consumption. The Fuel-Tracker system is compatible with all turbo diesel engines that have a GlobalTRACS or JDLink system installed.

The Fuel-Tracker system totalizes the fuel usage up to the set unit of measure and then sends a signal to the GlobalTRACS or JDLink unit. The Fuel-Tracker unit will send a signal for every quart, half gallon or gallon of fuel used. The unit of measure is set during calibration and may be restricted by engine size.

Fuel-Tracker Specifications

Panel Meter:

Display:	5 digit LCD 0.48" (12.2 mm) high digits Transmissive LCD with optimized viewing angle
Power:	Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. 85 mA current draw @ 9 VDC
Construction:	This unit is rated for NEMA 4 requirements for indoor use.
Operating range:	-35 to 75º C
Storage Temperature:	-35 to 85º C
Altitude:	Up to 2000 meters
Operating Humidity:	0 to 85% max. relative humidity (non-condensing)

Pressure Transducer:

Case:	Stainless steel
Pressure Port:	1/4-18 NPT
Electrical Connection:	Miniature DIN connection screw terminal
Operating Temperature:	-40 to 121º C
Burst Pressure:	100psi
Proof Pressure:	60psi
Shock:	50 g, 11 ms half-sine shock
Vibration:	± 20 g
Fatigue:	100 million cycles FS
Weight:	4.5 oz max

Things to Remember

*******Mirenco strongly recommends calling if anything is not clearly understood prior to installing and/or calibrating the Fuel-Tracker unit*******

Call Mirenco at 800-423-9903 if you have any questions.

Hardware Installation

- The Fuel-Tracker system blue wire needs to be connected to preferably either sensor 3 or sensor 4 on the GlobalTRACS or JDLink system
- The sensor should be mounted to the engine remotely using the black hose that is supplied or similar.
- The hose connects the sensor, mounted away from the engine, to the intake manifold.
- The hose should start at the intake manifold and gradually slope upward until it reaches the sensor. This ensures that any condensation flows back into the intake manifold and does not cause damage to the sensor.
- The Fuel-Tracker power should be connected into a keyed source. Turning the key to the run position should power the display unit on.

3-Step Process

Each step represents a physical trip to the vehicle in order to install and calibrate the unit.

Step 1: Installation of the Fuel-Tracker. No values should be entered into the Fuel-Tracker until Trip 2. After the Installation of the Fuel-Tracker, the vehicle should be given 2-3 days of normal production operation in order for the Fuel-Tracker to record the MAX value associated with the vehicle under maximum load.

Step 2: Program the values into the Fuel-Tracker. These values should be the low value (Idle value), max value, lower display value, upper display value. To find the low value, the vehicle needs to be at operating temperature at which time you would read the value the Fuel-Tracker shows right off of the display when the vehicle is at idle. An example of the low value (Idle value) is 0.13. Once the values are entered into the Fuel-Tracker unit correctly, the fuel usage needs to be tracked manually down to the minute every time the vehicle is re-fueled for about a week. Mirenco will track the fuel data that is received and compare it to the manually tracked fuel data in order to see if further calibration is needed.

Step 3: If further calibration is needed, this will require the technician to change one of the four values that were entered into the Fuel-Tracker unit in order for the vehicle to report accurate data.

Installation Overview

This Fuel-Tracker system is intended to be installed on a wide variety of vehicles and equipment. Installation for each will likely have considerable differences in mounting locations, wiring routes, and electrical connections. The electrical connections and pressure requirements for the display unit and sensor will determine the mounting locations for each piece of the Fuel-Tracker system. Wiring routes and locations should therefore be determined after an appropriate location for the display meter and sensor have been located.

Hardware Installation

Installing the Display Meter

The display meter is enclosed in a Nema 4 enclosure intended for indoor use. Installation of the display meter is best suited for an interior location, preferably inside the operator's cab. The display meter provides a readout indicating the fuel consumption rate. This readout may be placed in view of the operator but is not necessary. Electrical connections to the display meter will require a key-switched power source, vehicle chassis ground, a connection to the GlobalTRACS or JDLink system and a cable to the sensor. Calibration of the unit will require viewing of the display readout and require use of the two push buttons on the front of the display and should therefore be mounted in a location that is accessible.

In an ideal situation the display unit would be mounted in the cab in a visible location such as on the dash. This location will also provide a likely source for a nearby keyed power source, chassis ground and suitable space to easily route the remaining wires and cables to the GlobalTRACS or JDLink system and sensor. The display meter is easily fastened to most surfaces using self-tapping screws or bolts.

Installing the Sensor

The Fuel-Tracker system uses the intake air pressure of the engine to determine the fuel consumption rate. The sensor may be installed in a location that is located downstream of the turbo outlet, up-to and including the intake manifold of the engine. Any location that is suitable for mounting and provides an uninterrupted supply of intake air pressure is acceptable for mounting the sensor.

The sensor connector should be removed from the sensor before the sensor is installed. Pay special attention to the orientation of the sensor connector. The connector and sensor have a paint mark indicating the proper orientation of the connector on the sensor. Remove the sensor connector and ensure that the rubber seal between the connector and sensor is not misplaced.

Sensor installation requires a suitable location for mounting and room for a cable to be connected and routed to the display meter. Unused ports on the intake manifold are best suited for installation of the sensor. The sensor should be remote mounted in order to reduce engine vibrations on the sensor unless remote mounting the sensor is not possible. Use the hose and hose connectors included to remote mount the sensor. The hose connection to the engine, routing of the hose and mounting direction of the sensor should be completed in a way that would allow any condensation that may occur within the hose and/or sensor to drain out of and away from the sensor. The hose connection to the engine should not be mounted downward in a way that would allow fluids to collect. The hose should be routed without leaving low spots in which fluids could collect. The threaded end of the sensor should be facing downward.

Electrical Connections

The complete installation of the Fuel-Tracker system requires four electrical connections to complete the system installation after the hardware has been mounted. The power, ground and signal wires for the display unit should be routed and connected first followed by routing and connecting the cable between the display meter and the sensor.

The power, ground and signal wires of the display unit are connected as follows.

Chassis Gnd - (Black) This ground should be grounded to the equipment's chassis. The ground should have continuity with the GlobalTRACS or JDLinks chassis ground connection (pin 47 grey, Chassis GND). ***Note: The chassis ground may or may not be grounded to the battery ground.***

+ Power - (Red) The positive power wire should be connected to a keyed 12 or 24 VDC power source. This power source should be 12 to 24 VDC in reference to chassis ground. The keyed source should provide 12 or 24 VDC when the key is in the run position and less than 3 volts when in the off position.

Signal - (Blue) The signal wire is connected to sensor inputs 3 or 4 on the GlobalTRACS or JDLink system. Sensor inputs 3 and 4 are respectively purple and green wires found on pins 30 and 31. Modifications can be made if needed to connect to sensor inputs 1 or 2. Refer to the GlobalTRACS or JDLink documentation or call Mirenco for further details.

The power, ground and signal wires connect into the back of the display meter and electrical connections are completed as described previously. The power, ground and signal wires should be connected first to their source but not connected to the back of the display meter at this time.

The sensor cable should be routed and connected next. Route the cable out of harms way using cable ties to securely fasten the cable along the way. Connect the sensor cable to the back of the display meter. Connect the sensor cable to the sensor. ***Note: Remember to place the rubber seal on the sensor before the connector is connected. Special attention should be given to the correct orientation of the sensor cable connector when connecting to the sensor. Align the paint mark on the sensor connector with the paint mark on the sensor itself. Installing the connector improperly will damage the sensor.***

Ensure that the ignition key is in the off position then connect the power, ground and signal connector into the back of the display meter. The Fuel-Tracker hardware should be completely installed at this point.

Programming and Calibrating the Meter

Overview

After the display meter, sensor and all wiring have been installed and connected and the Fuel-Tracker is operating, the display meter can be programmed and calibrated for each individual piece of equipment that it is installed. To properly and effectively complete the process it is best to understand the entire picture before attempting the individual steps.

The sensor provides a 4 to 20 mA signal to the display meter. This signal represents a 0 to 30 psi reading from the intake manifold of the engine. Laboratory experience has shown that the fuel flow rate of a turbo charged engine closely follows the intake pressure of the engine. The display meter linerizes the 4 to 20 mA input and totalizes fuel usage over time.

The display meter has a lower and upper signal input value. These values are factory set to 4 and 20 mA, representing the full scale of the sensor from 4 to 20 mA. The meter also has a lower and upper display value. These values are also set to 4 and 20 mA, respectively. The display values will ultimately be programmed to represent the fuel flow rates as to be determined for the lower and upper input values.

To complete the programming and calibration of the Fuel-Tracks system a series of four steps must be completed. The first step requires finding the lower signal input value. The lower signal input value represents the intake manifold pressure of the engine while at idle. The second step requires finding the upper signal input value. The upper signal input value represents the intake manifold pressure of the engine while at maximum fuel usage. The third step requires programming the lower and upper input and display values into the display meter.

Steps one and two will find the lower and upper input signals while step three programs these values into the display meter along with the corresponding lower and upper display values as determined by engine horsepower.

Step four requires that the equipment's fuel usage is tracked manually for a period of time and then compared to the reported value from the Fuel-Tracker system. The difference is calculated between the two and adjustments to the upper display value can be made to correct any differences. This step may be repeated until the difference is within acceptable limits.

Step One - Determining the Lower (idle) Signal Input Value

No programming changes should be made at this time. This step only requires proper vehicle preparation and documentation of display values.

Start the equipment's engine and allow it to reach normal operating temperature. Ensure that all auxiliary power take offs are turned off. This includes but is not limited to air-conditioning, hydraulics, PTOs or any other auxiliary device drawing additional power.

The display meter will be displaying one of three display screens. Pressing the SEL button on the lower left of the display will alternate between the three displays. The three displays are the "Totalizer" display the "Output" display and the "Max" display. The "Totalizer" display has a symbol resembling a lower case "t" that is shown on the far right of the display screen when this

display has been chosen. The “Max” display is indicated by “max” on the display screen. The “Output” display has no indicator visible on the display screen. Press the SEL button until the “Output” display screen is displayed. The display will show a number that should be near 4.0 while the engine is idling and would otherwise show a fluctuating number if the engine is above idle. Bring the engine to idle and note the value that is displayed. Document this value as the lower signal input value.

Step Two – Determining the Upper (max) Signal Input Value

Completing step two requires the use of the max function in the display meter. Press the SEL button to view the “Max” display. The “Max” display displays the maximum value that the display meter has received from the sensor. This value will reach it’s maximum when the engine is under full load. Accurate calibration of the Fuel-Tracker depends on finding this maximum value. For this reason the equipment should be allowed to operate for an extended period of time (a full day of operation is normally enough) to allow the engine to be placed under full load allowing the display meter to record the maximum value from the sensor. After the equipment has been operating for a long enough period of time to ensure that a maximum intake manifold pressure has been reached the value can be retrieved from the display meter and recorded for use in step three. Typical “Max” values range between 13.5 to 20. If the “Max” value is less than 13.5 it is likely that the engine has not been under full load.

If the max value does not indicate that the engine has been under full load it is best to allow more time for the engine to reach full load under normal operating conditions. If this is not possible the engines factory specifications may be used to determine the upper signal input value. Contact your local equipment service center and find the factory maximum turbo boost pressure for that engine. Call Mirenco (800.423.9903) with the turbo boost specifications and the signal input value can be determined.

Step Three – Programming the Lower and Upper Signal Input Values and Display Values

In steps one and two the lower and upper signal input values were found and recorded. These values will now be programmed into the display meter along with the corresponding lower and upper display values representing the correct fuel flow rates for the engine on this piece of equipment.

First find the lower and upper display values for this piece of equipment in the following tables. **In *Table 1* an example is given demonstrating the lower and upper display values for a 250 horsepower engine.** Refer to the appropriate table for your engine size and determine the correct lower and upper display values. Using the tables below will automatically determine the units of measure that the Fuel-Tracker will be programmed with. Engines ranging from 0 to 400 horsepower will be set in pints, >400 to 800 in quarts, >800 to 1600 in ½ gallons and >1600 to 2000 in gallons.

	Lower Display Values				Upper Display Values					
	0		100		200		300		400	
0			6.45	45.71	8.53	91.43	10.61	137.14	12.69	182.86
10	4.58	4.57	6.66	50.29	8.74	96.00	10.82	141.71		
20	4.79	9.14	6.87	54.86	8.95	100.57	11.03	146.29		
30	4.99	13.71	7.07	59.43	9.15	105.14	11.23	150.86		
40	5.20	18.29	7.28	64.00	9.36	109.71	11.44	155.43		
50	5.41	22.86	7.49	68.57	9.57	114.29	11.65	160.00		
60	5.62	27.43	7.70	73.14	9.78	118.86	11.86	164.57		
70	5.83	32.00	7.91	77.71	9.99	123.43	12.07	169.14		
80	6.03	36.57	8.11	82.29	10.19	128.00	12.27	173.71		
90	6.24	41.14	8.32	86.86	10.40	132.57	12.48	178.29		

Table 1: ***Pints per Hour***

	400		500		600		700		800	
0			7.38	114.29	8.42	137.14	9.46	160.00	10.50	182.86
10	6.45	93.71	7.49	116.57	8.53	139.43	9.57	162.29		
20	6.55	96.00	7.59	118.86	8.63	141.71	9.67	164.57		
30	6.66	98.29	7.70	121.14	8.74	144.00	9.78	166.86		
40	6.76	100.57	7.80	123.43	8.84	146.29	9.88	169.14		
50	6.86	102.86	7.90	125.71	8.94	148.57	9.98	171.43		
60	6.97	105.14	8.01	128.00	9.05	150.86	10.09	173.71		
70	7.07	107.43	8.11	130.29	9.15	153.14	10.19	176.00		
80	7.18	109.71	8.22	132.57	9.26	155.43	10.30	178.29		
90	7.28	112.00	8.32	134.86	9.36	157.71	10.40	180.57		

Table 2: ***Quarts per Hour***

	800		900		1000		1100		1200		1300		1400		1500		1600	
0			5.77	102.86	6.29	114.29	6.81	125.71	7.33	137.14	7.85	148.57	8.37	160.00	8.89	171.43	9.41	182.86
10	5.30	92.57	5.82	104.00	6.34	115.43	6.86	126.86	7.38	138.29	7.90	149.71	8.42	161.14	8.94	172.57		
20	5.36	93.71	5.88	105.14	6.40	116.57	6.92	128.00	7.44	139.43	7.96	150.86	8.48	162.29	9.00	173.71		
30	5.41	94.86	5.93	106.29	6.45	117.71	6.97	129.14	7.49	140.57	8.01	152.00	8.53	163.43	9.05	174.86		
40	5.46	96.00	5.98	107.43	6.50	118.86	7.02	130.29	7.54	141.71	8.06	153.14	8.58	164.57	9.10	176.00		
50	5.51	97.14	6.03	108.57	6.55	120.00	7.07	131.43	7.59	142.86	8.11	154.29	8.63	165.71	9.15	177.14		
60	5.56	98.29	6.08	109.71	6.60	121.14	7.12	132.57	7.64	144.00	8.16	155.43	8.68	166.86	9.20	178.29		
70	5.62	99.43	6.14	110.86	6.66	122.29	7.18	133.71	7.70	145.14	8.22	156.57	8.74	168.00	9.26	179.43		
80	5.67	100.57	6.19	112.00	6.71	123.43	7.23	134.86	7.75	146.29	8.27	157.71	8.79	169.14	9.31	180.57		
90	5.72	101.71	6.24	113.14	6.76	124.57	7.28	136.00	7.80	147.43	8.32	158.86	8.84	170.29	9.36	181.71		

Table 3: ***Half Gallons per Hour***

	1600		1700		1800		1900		2000	
0			4.97	97.14	5.23	102.86	5.49	108.57	5.75	114.29
10	4.73	92.00	4.99	97.71	5.25	103.43	5.51	109.14	5.77	114.86
20	4.76	92.57	5.02	98.29	5.28	104.00	5.54	109.71	5.80	115.43
30	4.78	93.14	5.04	98.86	5.30	104.57	5.56	110.29	5.82	116.00
40	4.81	93.71	5.07	99.43	5.33	105.14	5.59	110.86	5.85	116.57
50	4.84	94.29	5.10	100.00	5.36	105.71	5.62	111.43	5.88	117.14
60	4.86	94.86	5.12	100.57	5.38	106.29	5.64	112.00	5.90	117.71
70	4.89	95.43	5.15	101.14	5.41	106.86	5.67	112.57	5.93	118.29
80	4.91	96.00	5.17	101.71	5.43	107.43	5.69	113.14	5.95	118.86
90	4.94	96.57	5.20	102.29	5.46	108.00	5.72	113.71	5.98	119.43

Table 4: ***Gallons per Hour***

The lower and upper signal input and display values are now ready to be entered into the Fuel-Tracker display meter. Turn the key to the run position but do not start the engine (the engine does not need to running at this time). In the following steps the signal input and display values will be programmed into the display meter. Entering programming mode will be necessary to complete these steps. While in programming mode there will be many settings that can be accessed and changed. It is important that only those settings described below are changed. If at any time the wrong selection is made or your location within programming mode is unclear programming mode should be exited immediately and restart from the beginning. To exit programming mode refer to 20.) in the following steps.

Entering programming mode.

1.) Press and hold the "SEL" (left) button until the display flashes between "Pro" and "NO". You are now in programming mode.

Navigating to the input settings.

2.) Press the "RST" (right) button once. The display will change to "1-INP" and will begin to alternate between "1-INP" and "Pro".

3.) Press the "SEL" button once. The display will change to "rANGE" and will begin to alternate between "rANGE" and "0.2a".

4.) Continue to press the "SEL" button multiple times stopping at "INP 1". The display will change each time as follows.

Alternating
"dECPt" – "0.00"
"OFSEt" – "000.00"
"FILtr" – "1"
"bANd" – "010"
"StYLE" – "KEY"
"INP 1" – "04.000" ***Stop here!***

5.) When the display has reached "INP 1" and alternates between "INP 1" and "04.000" continue with the next step.

Inputting the lower signal input value.

6.) The display screen should be alternating between "INP 1" and "04.000". If not, exit programming mode and start from step 1.

7.) Press the "RST" button to edit the value. The zero on the far right of the display should be blinking indicating that you can now edit this value.

8.) Pressing the "SEL" button once will allow you to edit the next value. Pressing the "RST" button once will increase that value by one.

9.) Use the “SEL” button to navigate to the appropriate locations and the “RST” button to enter the correct value.

10.) When the correct lower signal input value has been entered press and hold the “SEL” button until the display changes to “dSP 1” and alternates between “dSP 1” and “004.00”. You are now ready to continue with the next step.

Inputting the lower display value.

11.) The display screen should be alternating between “dSP 1” and “004.00”. If not, exit programming mode and start from step 1.

12.) Repeat steps 7 – 9 above.

13.) When the correct lower display value has been entered press and hold the “SEL” button until the display changes to “INP 2” and alternates between “INP 2” and “20.000”. You are now ready to continue with the next step.

Inputting the upper signal input value.

14.) The display screen should be alternating between “INP 2” and “20.000”. If not, exit programming mode and start from step 1.

15.) Repeat steps 7 – 9 above.

16.) When the correct upper signal input value has been entered press and hold the “SEL” button until the display changes to “dSP 2” and alternates between “dSP 2” and “020.00”. You are now ready to continue with the next step.

Inputting the upper display value.

17.) The display screen should be alternating between “dSP 2” and “020.00”. If not, exit programming mode and start from step 1.

18.) Repeat steps 7 – 9 above.

19.) When the correct upper display value has been entered press and hold the “SEL” button until the display changes to “USr IN” and alternates between “USr IN” and “NO”. You are now ready to exit programming mode.

Exiting programming mode.

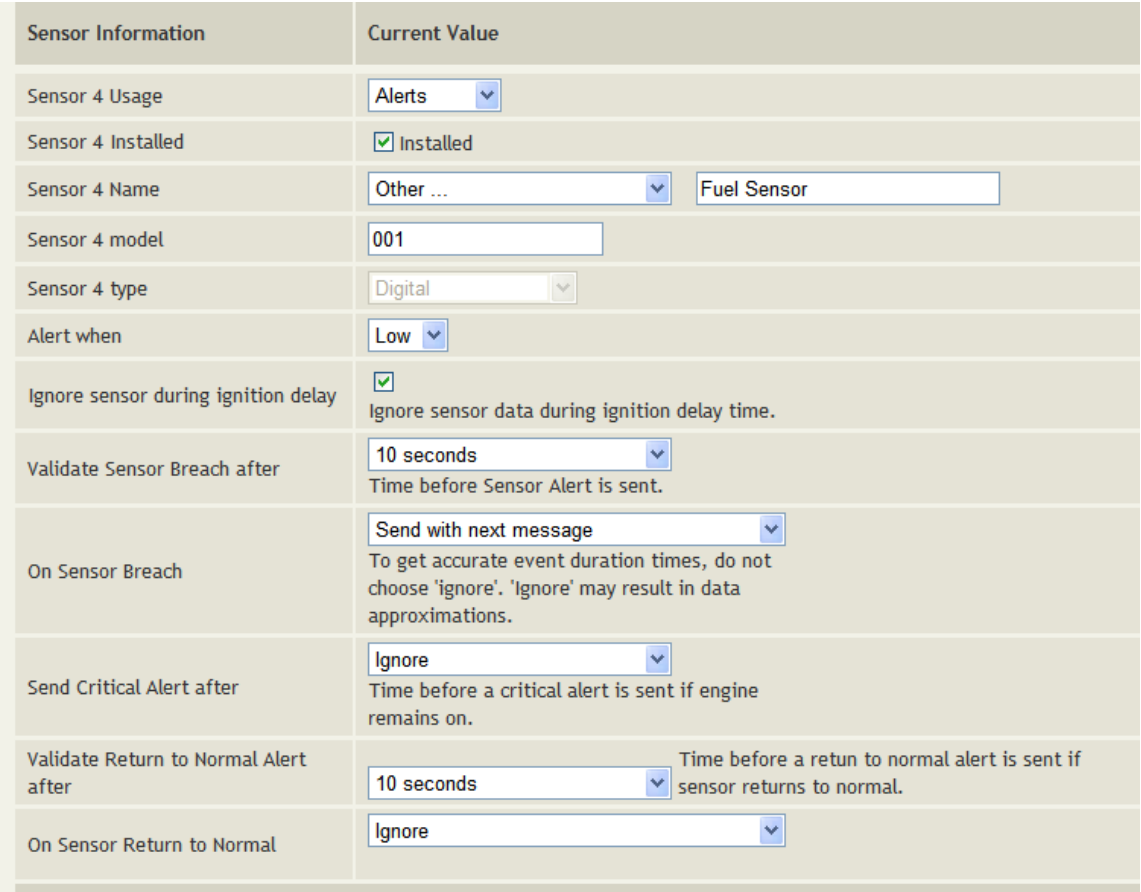
20.) To exit programming mode press the “SEL” button repeatedly until the display changes to “End”.

When pressing the “SEL” button if the display does not change but only cycles through the numbers on the display you must first push and hold the “SEL” button until the display changes and then begin pressing the “SEL” button repeatedly.

Sensor Setup on the GlobalTRACS and JDLink

At this point the display meter has been programmed but may need to be calibrated to ensure accuracy for each engine that is monitored. The sensors will now need to be activated through the GlobalTRACS or JDLink unit before fuel usage data can be received from the Fuel-Tracker system.

Log onto the GlobalTRACS or JDLink website and enter the sensor setup screen for the unit on the piece of equipment with the Fuel-Tracker system installed. The Fuel-Tracker system should be connected to sensor 3 or 4 on the GlobalTRACS or JDLink unit. Modify the sensor setup for the sensor that was used in this case. Make changes to the sensor setup screen to reflect the settings in the figure below. Save and exit after all changes have been completed. Fuel usage data should now be sending from the Fuel-Tracker system through the GlobalTRACS or JDLink system. The Fuel-Tracker system is now ready for calibration in step four.



Calibrating the Display Meter

Step Four – Calibrating the Fuel-Tracker System

Calibration of the Fuel-Tracker system requires manual tracking of the fuel used for the engine over a period of time compared to the fuel usage reported by the Fuel-Tracker system. This can be completed in a single day or can be allowed to span a week or more. The process includes recording the amount of fuel used by the machine as documented from the fuel pump and comparing that to the fuel "recorded" by the Fuel-Tracker system over the same time period.

Tracking fuel usage manually requires consistently filling the fuel tank to the same level (normally full) and recording the gallons filled as well as the date and time that it was completed. This process should be repeated for several consecutive refueling events. Refueling can occur once a day for a period of several weeks or may be completed over a couple of days. Refueling can also be completed several times during a single day. The longer the time period that fuel consumption is tracked the better the calibration results.

After the fuel usage information has been gathered the following calculations may be followed to find an appropriate calibration value. Assuming the fuel calculated by the Fuel-Tracker system is not equal to the gallons added to the fuel tank, a calibration to the programming values can be made. If the difference between the calculated gallons and actual gallons used is acceptable, no further calibration is needed. If the difference is not within an acceptable range calibrations may be completed as described below.

Find the percentage difference between the gallons filled in the tank verses the gallons recorded by the Fuel-Tracker.

$$\frac{\left(Gallons(Tank) - Gallons(Fuel - Trac\,\mathrm{ker}\right)}{Gallons(Tank)} = \%Diff$$

Next calculate the fuel rate range and apply the % Diff to find the new upper display value. The following equation uses the value of the display values currently programmed into the display meter.

> *Note: dSP1 and dSP2 are the lower and upper display values (LDV, UDV) found in step 3.*

dSP2 + (dSP2 – dSP1) ∗ 0.5 ∗ (% Diff) = new_dSP2

The previous equation will calculate a new value for dSP2. Program this value into the display meter replacing the current value for dSP2. Calibration is now complete. Repeat this step to verify accuracy and to further calibrate if necessary.

The calibration of the Fuel-Tracker system is now complete.