VOLVO CAR
SERVICE AND PARTS BUSINESS

Technical Journal

TITLE:

Fuel gauge / tank fault tracing guide

REF NO:	ISSUING DEPARTMENT:	CAR MARKET:	
TJ 20532.1.8	Technical Service	United States and Canada	
PARTNER: 3 US 7510 Volvo Car USA		ISSUE DATE: 2017-09-01	STATUS DATE: 2017-09-01
FUNC GROUP: 2331	FUNC DESC: fuel pump; feed pump	Page 1 of 23	

"Right first time in Time"

Attachment

File Name	File Size
Attachment TJ 20532 AWD.pdf	0.5419 MB
Attachment TJ 20532 FWD.pdf	0.2035 MB

Vehicle Type

Type	Eng	Eng Desc	Sales	Body	Gear	Steer	Model Year	Plant	Chassis range	Struc Week Range
124							2007-9999		-	0-0
135							2008-2010		-	0-0
136							2008-9999		-	0-0
156							2010-9999		-	0-0

CSC Customer Symptom Codes

Code	Description
AA	Starting/Engine does not start/Engine turns
X6	Gauges/Fuel level not accurate/Value too high
XA	Gauges/Fuel level not accurate/Value too low

VST Operation Number

VST Operation Number	Description
28468	Engine control module, fault tracing DTC
23341	uel pump replace (includes fuel system de-pressurization, fuel tank draining/filling)
23811	Fuel pressure/residual pressure check
23428	Fuel tank install/remove/replace (excludes draining)

DTC Diagnostic Trouble Codes

Rows beginning with * are modified
Note! If using a printed copy of this Technical Journal, first check for the latest online version.

Text

DESCRIPTION:
***NOTE! THIS DOCUMENT SUPERSEDES THE PREVIOUS TECHNICAL JOURNAL 20532 DATED 2012-02-09.**

DESCRIPTION:
This TJ contains fault tracing information mainly for fuel gauge related issues. However, customers may contact the workshop regarding certain other Engine/Fuel related operating issues. In these cases it is unknown if it is a fuel pressure related issue or an inaccurate gauge reading. Therefore, this TJ will provide a high level fault tracing guide that was created in order to direct the technician down the correct fault tracing and repair path.

The major fuel gauge faults seen on Front Wheel Drive (FWD) vehicles can be divided into 3 categories:
1: Pump level sender unit malfunction.
2: Pump float arm stuck at top position
3: Not possible to fill up to a full tank

The attached document for FWD vehicles is divided in three chapters:
Chapter 1 Fault tracing
Chapter 2 (unused for FWD)
Chapter 3 Translation table- ohm to liters/gallons and miscellaneous information
Chapter 4 Diagnostic sheet that should be filled out prior to contacting The Technical Helpdesk, if necessary.

The major fuel gauge faults seen on All Wheel Drive (AWD) vehicles can be divided into the following categories:

Inaccurate fuel level indication, passive (ejector) side:
1: Float disconnected from fuel sender arm.
2: Level sender arm assy. disconnected from bracket.
3: Level sender arm binding.
4: Kinked hose inside carrier.

5: Kinked hose inside pot. (Noise and pressure pulsations as well)
6: Kinked hose in general.
7: Broken venturi.

Inaccurate fuel level indication, active (pump) side:
8: Level sender arm disconnected from pump.
9: Level sender arm hooked on wire or hose.
10: Kinked hoses

The attached document for AWD vehicles is divided in four chapters:
Chapter 1 Fault tracing
Chapter 2 How to assemble a pump with new design (with return hose stop) in an old tank
Chapter 3 Translation table- ohm to liters/gallons and miscellaneous information
Chapter 4 Diagnostic sheet that needs to be filled if contacting technical helpdesk

In order to aid in fault tracing, a video has been created and is posted on the link below. Please view this view before fault tracing a fuel pressure and/or fuel gauge complaint.

http://www.volvolearning.info/performance_network/fuelgauge/index.html

SERVICE:
For all vehicles: Follow the fault tracing guide in the appropriate attachment.

PRODUCT MODIFICATION (AWD only). Match the item number in description above.

1: Stamping and washer process at supplier, secured 08W23, Chassis number 124 90292, 135 72723, 136 50609
2: Bracket on the carrier* reinforced 09W09, but old parts to be used up, Chassis number, 124 103585, 135 10231, 136 62859, 156 18836
3: Sleeve around electrical cable, hose from remote jet pump feed & return and filter introduced , 09w09, Chassis number 124 103585, 135 10231, 136 62859, 156 18836
4: Manual process changed at supplier and X-ray equipment introduced 08W50, Chassis number 124 102631, 135 97671, 136 61879, 15612060
5: Physical stop in the pot introduced 08W44. Chassis number, 124 99887, 135 92223, 136 60236, 156 6378
6: Process at supplier secured 08W32, Chassis number, 124 95242, 135 80707, 136 55376
7: New clipping feature introduced 08W32, Chassis number, 124 95242, 135 80707, 136 55376
8: Introduced 2 extra tie wraps 08W44, Chassis number, 124 99887, 135 92223, 136 60236, 156 6378
9-10: X-ray equipment introduced 08W50, Chassis number, 124 99887, 135 92223, 136 60236 , 136 12060

Feed, return line and electrical cable harness reduced with110mm. 08W39, Chassis number 124 98473, 135 87366, 136 58612, 156 1421

Tube from pump to life time filter reduced with 60 mm. 08W39, Chassis number, 124 98473, 135 87366, 136 58612, 156 1431

* Carrier= Plastic part inside the fuel tank, to hold the “internals” in place.

VEHICLE REPORT:
N/A

To view TJ attachments continue to next page. This TJ has 3 attachments.

		Volvo Car Customer Service
		TJ Instruction
		TJ No 20532
		Date Feb-12 Issue 04
Title	AWD Fuel gauge/fuel pressure/fuel tank fault tracing guide	

COMPETENCE: Master or Expert rated technician ONLY
IMPORTANT! Please read the entire document before starting any work!

MATERIALS:

Description	Part Number	Quantity
Repair terminal	30728834	2
Repair terminal	30656635	2
Fuel pressure gauge	999 5011	1
Fuel pressure gauge	999 7268	1
Vantage Pro oscilloscope	107-EETM303A-VOLVO	1 or 2

CHAPTER 1 Fault tracing

Print out the diagnostic sheet in Chapter 4. It shall be used as a data collection sheet of all fault tracing information. This will assist in the proper diagnosis and should be used when contacting the Technical Helpdesk and/or the Prior Approval Department. **Note! Skipping fault tracing steps will likely lead to an inaccurate diagnosis.**

Step A. Customer symptom

For this fault tracing, it's absolutely imperative that the service writer gets an accurate description of the customer's complaint. Take time to interview the customer about the symptoms because that will make it much easier later in the fault tracing. **Without an active fault or a good description of the fault it might be very hard to diagnose the system.** Also, be sure to ask if the problem still exists at this time. Some examples of customer's symptoms:

- Engine stalled out, even if fuel gauge shows ¼ left in tank
- Engine does not start even if fuel gauge shows "x" left in tank
- Fuel gauge shows only ½ or ¾ when tank is full.
- Fuel gauge jumps around and is not stable.
- Engine cranks, but vehicle does not start when parked on an incline/decline

Reading out values

Read and write down the values below on the printed diagnostic sheet.
A1 Record the current position of the fuel gauge in the Driver Information module (DIM) display.
A2 Read out the DTCs. Only DTCs from Engine Control Module (ECM), Central Electronic Module (CEM) and Driver Information module (DIM) must be written down on the diagnostic sheet, also taking note of the counters.
A3 Go to VIDA->Diagnostics->Vehicle Communication->select DIM->Parameters and select "fuel level" to check and note down the volume (in Liters).
A4 Go to VIDA->Diagnostics->Vehicle Communication->select DIM->Parameters and select "fuel level sensor, ejector side" to check and note down the volume of the ejector side (in Liters).

Because the wiring for the ejector circuit runs through pump sender circuit, the root cause for a ejector (circuit B) DTC may be the pump sender (circuit A).

Step B. Find out if it's a fuel pressure problem

If the customer's complaint is either "car stalled while driving" or "car is not starting", add exactly **3 gallons** of fuel to the tank and check for starting. If the car starts after adding fuel, proceed to step C.

If the car does not start after adding the 3 gallons of fuel, go to VIDA->Diagnostics->Vehicle Communication->select ECM->Parameters and select "fuel rail pressure (rel)" and "fuel pump duty cycle". Read and write down the values below on the printed diagnostic sheet from Chapter 4.

B1 "Fuel rail pressure (rel)" from VIDA =
B2 "Fuel pump duty cycle" from VIDA =

If the customer complaint is a long crank while starting, check the residual pressure after engine shutdown using fuel pressure gauge P/N 999-5011 and P/N 999-7268 or similar method. It should hold at least 180 Kpa after 20 min.

B1 "Fuel rail pressure (rel)" from VIDA =
B2 "Fuel pump duty cycle" from VIDA =
B3 "Residual pressure after 20 min"=

Compare the values with VIDA specifications and use this to determine the root cause.
If residual pressure on the fuel pressure gauge does not match VIDA, replace the fault trace the fuel pressure sensor.
If the residual pressure is not at least 180 Kpa after 20 min AND there are no fuel leaks (check lines and injectors), then replace the fuel pump.

Step C. Inaccurate fuel gauge problem.

If the customer complains about the fuel level not being accurate or if the vehicle started after adding 3 gallons of fuel, the float sensor circuits need to be checked.

Check fuel level senders resistance readings before removing the tank.

Measure and record the resistance value of the float sensor with the tank in the car utilizing the connector under the rear seat.
Remove the ignition key, connect Volvo's Vantage Pro oscilloscope (P/N 107-EETM303A-VOLVO). Set up the ohmmeter to measure on the 4 kilohm (kohm) scale. Use the appropriate wiring diagram to locate the level sender terminals/connector beneath the rear seat upholstery. Separate the connector halves and use repair terminal P/N 30728834 to probe the terminal leads for each of the level sensor. Measure the resistance across the float terminals of each level sensor. Note that both, the pump side and ejector side, sender share the same ground terminal. Plastic insulators must be crimped on to avoid a short when measuring resistance.

At this stage, the tank has the volume of fuel the car showed up with at the work shop, and/or the 3 gallons that were added in step B.

Read and write down the values below on the printed diagnostic sheet.
C1 Resistance of level sensor in kohms (Be sure to use the 4 kohm scale) =
C2 Resistance of level sensor ejector side in kohms (Be sure to use the 4 kohm scale) =

Note: Damaged or loose terminals will cause an incorrect fuel gauge reading.

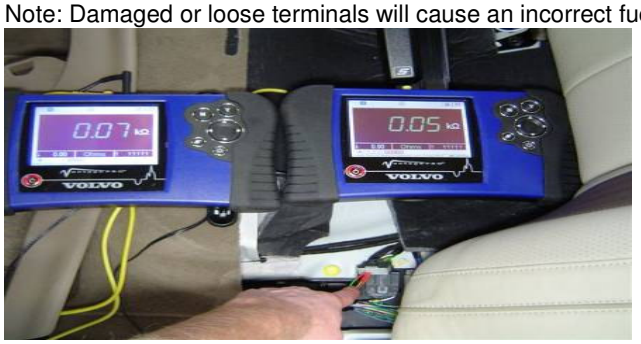

Photo 1. Measuring the connector under rear seat of the car.

Reconnect the terminal connector. Insert ignition key and turn to position II. Recheck the current position of the fuel gauge in the DIM display and with Vida.
C3 DIM display =
C4 "Fuel level" in DIM via VIDA in liters =
C5 "Fuel level sensor, ejector side" in DIM via VIDA in DIM=

Step D. Draining the fuel tank and measurements

Some important information can be collected before removing the tank from the car. This information can be used to compare with the findings from the test that needs to be performed with the tank removed from the car.

Empty the tank of fuel completely using fuel pressure gauge P/N 999-5011 and P/N 999-7268 or similar method. Collect the fuel in an approved container where you are able to measure the volume of the drained fuel. This way measured levels of fuel and actual levels of fuel can be compared. **Obey state and local laws when selecting your fuel container.**

Read and write down the values below on the printed diagnostic sheet from Chapter 4.

D1 Measured fuel volume drained from the tank =
D2 "Fuel level" from CEM parameters via VIDA when tank is empty in volts =
D3 "Fuel level sensor", ejector side" from CEM parameters via VIDA when tank is empty in volts =

Step E. Rotation/Tilt test of empty tank/pump when removed from car.

Remove the empty tank from the car. Make two jumper wires by using connector P/N 30656635 or similar. These leads will fit on the fuel pump connector pins. Plastic insulators must be crimped onto the connector avoid a short when measuring resistance.
Connect Volvo's Vantage Pro oscilloscope (P/N 107-EETM303A-VOLVO) to the jumper wires. Set up the ohmmeter to measure on a 4 kohm scale. Other ohmmeters can also be used, but be sure to use the kohm scale only.
Connect the jumper leads to the terminals on the fuel pump according to Photo 2.

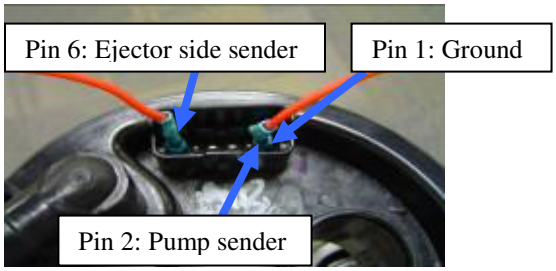

Photo 2

The float arm normally moves very easily between its max/min values when the tank is tilted +/- 30 degrees around the vertical position. You should be able to simulate empty and full readings by doing these small movements. Tilt the tank very slowly, several times between these positions, while continuously reading the resistance value and looking for any strange behavior. The tilt test needs to be performed in two different ways: 1st when the pump is away from the tilt/rotation axis and 2nd when the pump is near the tilt/rotation axis (see Photos 3 and 4).
Read and write down the values below on the printed diagnostic sheet from Chapter 4.

Tilt/movement when pump is away from the tilt axis (Photo 3)
E1 Empty tank simulation (pump away from axis) Resistance Pump side pins1+2 (spec 0.99 +/- 0.01 kohms)=
E2 Full tank simulation (pump away from axis) Resistance Pump side pins1+2 (spec 0.05 +/- 0.01 kohms)=
E3 Empty tank simulation (pump away from axis) Resistance Ejector side pins1+6 (spec 0.99 +/- 0.01 kohms)=
E4 Full tank simulation (pump away from axis) Resistance Ejector side pins1+6 (spec 0.05 +/- 0.01 kohms)=
E5 Note any strange reading behavior during the tilt procedures: (Be sure to use the 4 kohm scale)

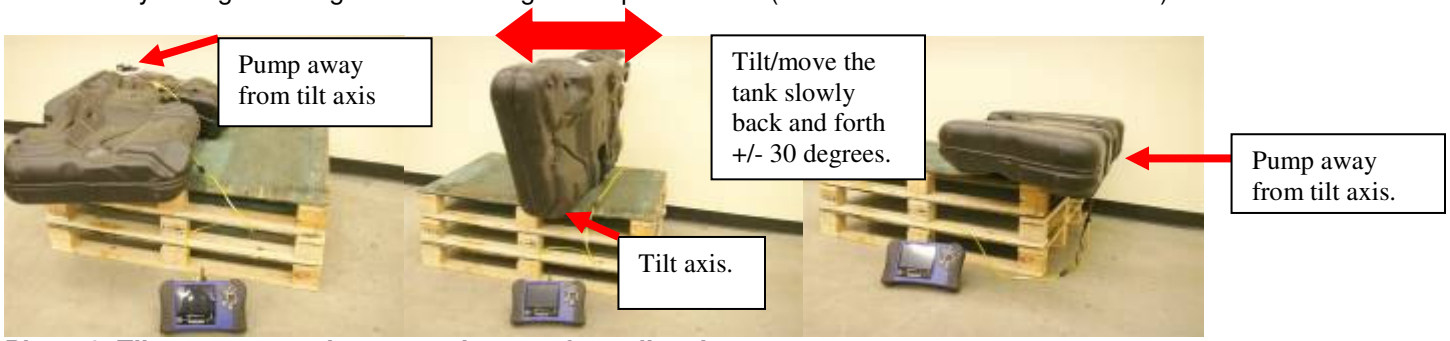

Photo 3. Tilt/movement when pump is away from tilt axis.

Tilt/movement when pump is near tilt axis (Photo 4)
E6 Empty tank simulation (pump near axis) Resistance Pump side pins1+2 (spec 0.99 +/- 0.01 kohms)=
E7 Full tank simulation (pump near axis) Resistance Pump side pins1+2 (spec 0.05 +/- 0.01 kohms)=
E8 Empty tank simulation (pump near axis) Resistance Ejector side pins1+6 (spec 0.99 +/- 0.01 kohms)=
E9 Full tank simulation (pump near axis) Resistance Ejector side pins1+6 (spec 0.05 +/- 0.01 kohms)=
E10 Notes of any strange reading behavior during the tilt procedures: (Be sure to use the 4 kohm scale)

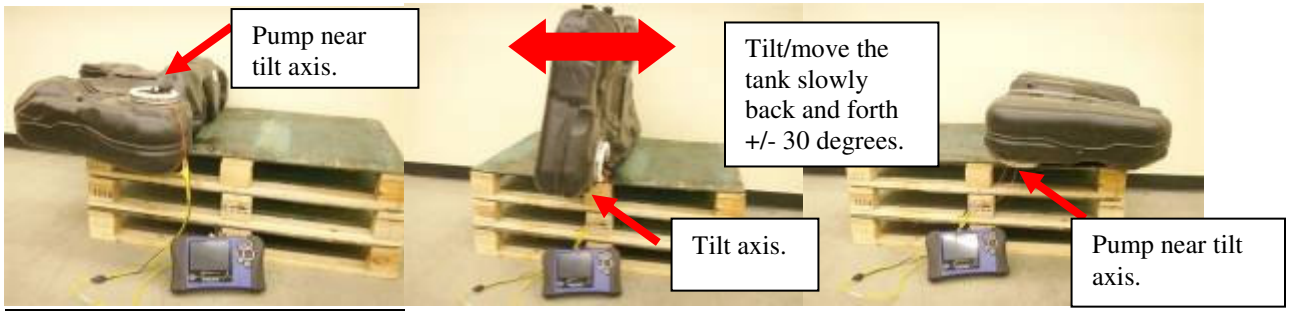

Photo 4. Tilt/movement when pump is near tilt axis

Analysis of the behavior of resistance values.
The sender unit resistance values shall move from 0.99 +/- 0.01 kohms at empty, and down to 0.05 +/- 0.01 kohms at full when everything is OK.

Pump side:
If the resistance value clearly stops at a certain value, it's most likely a stuck float arm and **actions must be taken according to step G.**
However, it can also be that the sender unit is not working, so therefore the pump needs to be tested separately according to "stand alone pump sender unit test" in step F.

Ejector side:
It the resistance value clearly stops at a certain value it's most likely a stuck float arm. The tank needs to be replaced, but the pump can be reused if it passes the "pump sender unit test" in step F.

Step F. Stand alone pump sender unit test

Remove the pump from the tank. Be sure the level sender arm is properly attached to the pump.
Clip the connector together before measuring the resistance value (see Photo 5). To clip the connector together, you need to cut a short opening in the plastic sheathing with a scissor. Be very careful when doing this so that wires are not damaged.

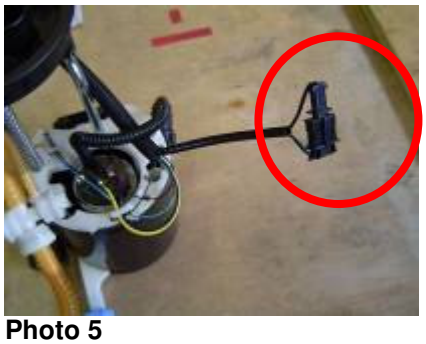

Photo 5

Connect pins 1 and 2 to the ohmmeter as you did in Step E. Slowly sweep the sender from bottom to top and back to bottom and see if it reads all the way from 0.99 +/- 0.01 kohms to 0.05 +/- 0.01 kohms. Be aware of a possible short between your jumper wires at pin 1 and 2.

Read and write down the values below on the printed diagnostic sheet from Chapter 4.
F1 Resistance reading when float arm at bottom (spec 0.99 +/- 0.01 kohms) =
F2 Resistance reading when float arm at top (spec 0.05 +/- 0.01 kohms) =
F3 Note any erratic reading during the sweep (be sure to use the 4 kohm scale) =
Any failure in the pump side sender will require fuel pump replacement.

Note: If the fuel pump needs to be replaced, the new pump will have a new design (includes a stop bar for the return hose). In order to install a new style pump in an old tank, you must cut the return hose according to chapter 2.

If the fuel pump and/or fuel tank require replacement, fill out the attached form then transfer this information to the Prior Approval application on VRC2 to obtain an approval code before installing the fuel pump and/or tank. If your diagnostics are inconclusive your request will be returned with comments redirecting the diagnostics or repair.

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Step G. Rerouting hoses/Reinstalling pump/Installing new pump

The three steps below must be followed when assembling a pump, regardless if you find the root cause for the customer's symptom to be a stuck float arm or not. This will ensure that your pump installation will not cause any stuck float arm condition. The three steps below all contribute to separating the float arm pin from the life time filter hose.

1) Reroute and ensure the hoses will not conflict with the float arm pin.
Assemble a new zip tie around the lifetime filter hose and the thicker black Liquid Valve Support (LVS) hose, 76.2 mm (3") from the 90 degree connector (see Photo 6). This will keep the hose away from the position where the float arm pin passes. The float arm pin will pass the hose assembly at a location 50.8 mm (2") from the 90 degree connector.

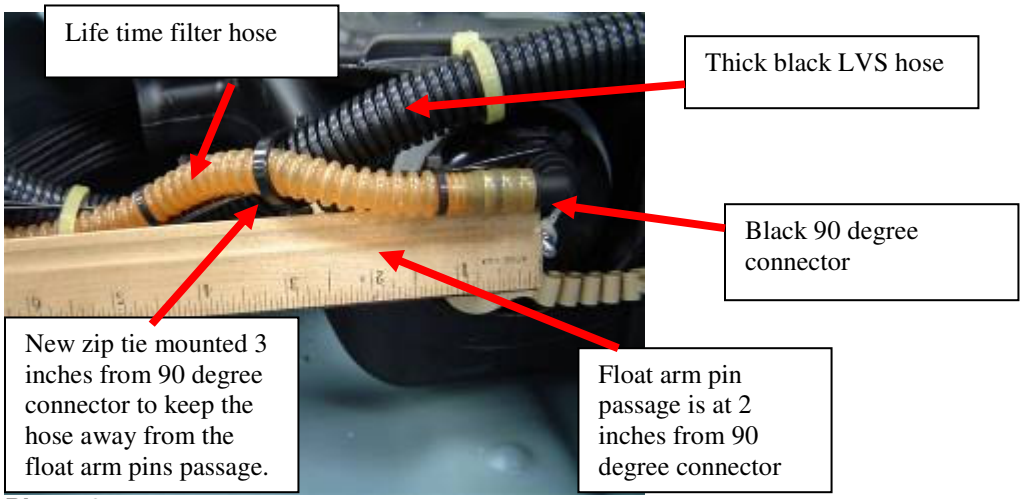

Photo 6

2) Cut the float arm pin where the indented area begins. Be careful to not cut too much as the float arm can fall off.

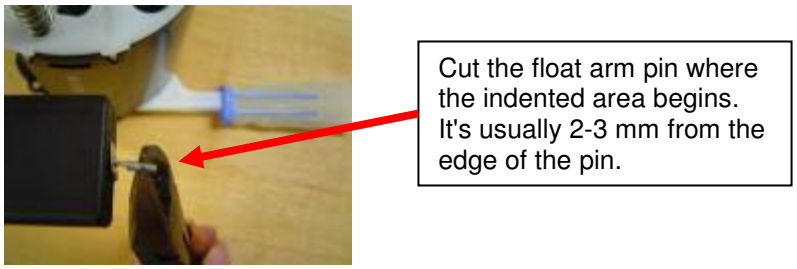

Photo 7

3) When reinstalling/installing a pump you should put it in a position as far clockwise as possible within the limitations (looking from above). See Photo 8. There are some small tolerances of the assembly that can be utilized to keep the float arm pin away from the life time filter hose.

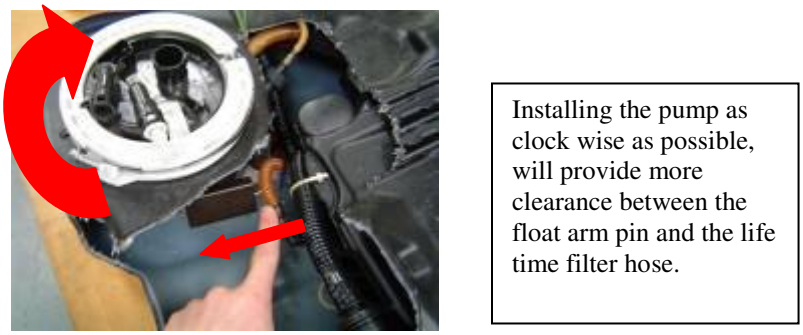

Photo8

Step H. Final check before installing the tank in the car.

After the tank and pump are assembled together, connect the ohmmeter and perform the flip test of the tank as a final confirmation to check that the float arm is moving correctly.

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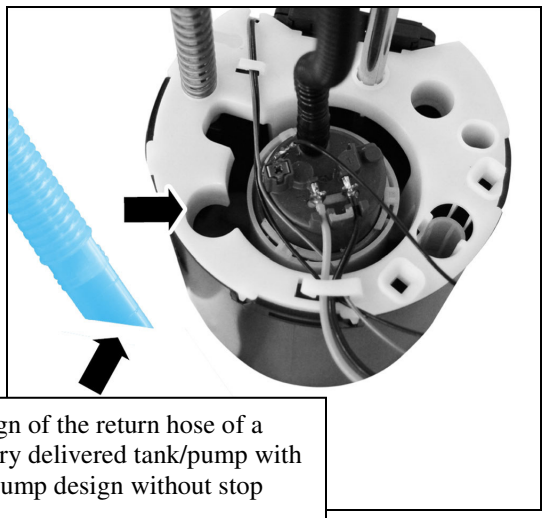
CHAPTER 2
How to assemble a pump with new design (with a return hose stop) in an old tank.

When ordering a pump, the new pump will have a new design (includes a stop bar for the return hose). If such a pump is installed in an old tank, the return hose needs to be shortened by 100 mm (approx 4"). If your current pump does not have a return hose stop bar you will know that the return hose in the tank is too long for the new pump and you need to follow the instructions below (Photo 11).

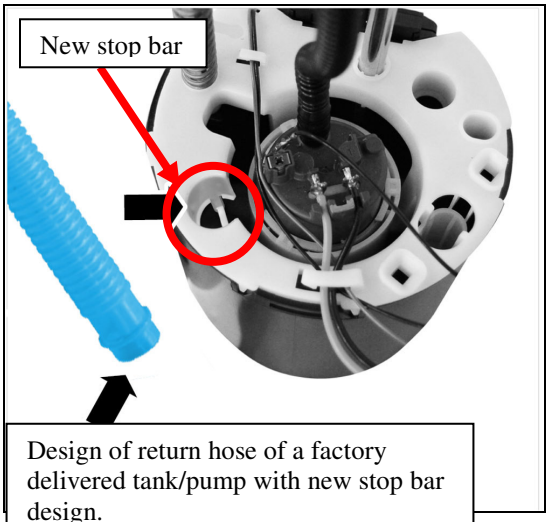
Old pump design (no stop bar)
Return hose is inserted 50 mm (approx 2").

New pump design (with stop bar)
Return hose on old tank needs to be shortened by 100 mm (approx 4") to fit in new pump and then be inserted to the stop bar.



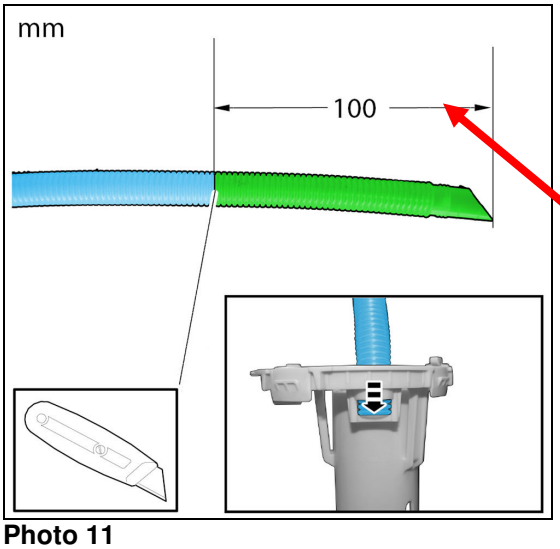
Design of the return hose of a factory delivered tank/pump with old pump design without stop bar.

Photo 9



Design of return hose of a factory delivered tank/pump with new stop bar design.

Photo 10



Return hose from an old tank needs to be shortened by 100 mm if a new pump with stop bar is installed.

Photo 11

CHAPTER 3

Translation table Kohms to liters/gallons and voltage as readout in CEM.

Active Side (Pump side)				Passive Side (Ejector Side)			
Sensor Resistance (kohms)	Volume (liters)	Volume (gallons)	Voltage read by VIDA CEM	Sensor Resistance (kohms)	Volume (liters)	Volume (gallons)	Voltage read by VIDA CEM
0.99	0	0	4.1	0.99	0	0	4.1
0.96	1	0.3	4.1	0.98	1	0.3	4.1
0.86	2	0.5	4.0	0.98	2	0.5	4.0
0.79	3	0.8	3.9	0.89	3	0.8	3.9
0.74	4	1.1	3.9	0.81	4	1.1	3.9
0.69	5	1.3	3.8	0.74	5	1.3	3.8
0.64	6	1.6	3.7	0.69	6	1.6	3.7
0.61	7	1.8	3.7	0.64	7	1.8	3.7
0.57	8	2.1	3.6	0.6	8	2.1	3.6
0.54	9	2.4	3.5	0.55	9	2.4	3.5
0.5	10	2.6	3.5	0.52	10	2.6	3.5
0.48	11	2.9	3.4	0.48	11	2.9	3.4
0.45	12	3.2	3.4	0.46	12	3.2	3.4
0.42	13	3.4	3.3	0.43	13	3.4	3.3
0.4	14	3.7	3.2	0.41	14	3.7	3.2
0.38	15	4	3.2	0.38	15	4	3.2
0.35	16	4.2	3.1	0.36	16	4.2	3.1
0.33	17	4.5	3.0	0.34	17	4.5	3.0
0.31	18	4.8	2.9	0.31	18	4.8	2.9
0.29	19	5	2.8	0.3	19	5	2.8
0.26	20	5.3	2.7	0.28	20	5.3	2.7
0.25	21	5.5	2.7	0.26	21	5.5	2.7
0.23	22	5.8	2.6	0.24	22	5.8	2.6
0.21	23	6.1	2.4	0.23	23	6.1	2.4
0.19	24	6.3	2.3	0.22	24	6.3	2.3
0.18	25	6.6	2.2	0.2	25	6.6	2.2
0.16	26	6.9	2.1	0.19	26	6.9	2.1
0.15	27	7.1	2.0	0.18	27	7.1	2.0
0.13	28	7.4	1.9	0.16	28	7.4	1.9
0.11	29	7.7	1.7	0.15	29	7.7	1.7
0.1	30	7.9	1.6	0.14	30	7.9	1.6
0.08	31	8.2	1.3	0.13	31	8.2	1.3
0.07	32	8.5	1.2	0.11	32	8.5	1.2
0.06	33	8.7	1.1	0.1	33	8.7	1.1
0.05	34	9	0.9	0.09	34	9	0.9
0.05	35	9.2	0.9	0.08	35	9.2	0.9

Use the above sheet for comparison for any readings you believe are inaccurate. Keep in mind any inaccurate readings should agree with the customer's complaint.

Note: the float arm can physically be moved to a position which is higher than the normal full fuel fill level of 18.5 gallons. This will result in an ohms measurement which is lower than shown on the chart above. With the tank positioned upside down the value could possibly read as low as 0.05 kohms, which is not a fault.

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CHAPTER 4 Diagnostic data sheet

Gather all information on this check sheet to determine the failure route cause. Transfer this information to the Prior Approval application on VRC2 to obtain an approval code before installing the fuel pump and/or tank. If your diagnostics are inconclusive your request will be returned with comments redirecting the diagnostics or repair.

Customer symptom

A. Read out values

A1 DIM display = (circle one) Empty 1/8 ¼ 3/8 ½ 5/8 ¾ 7/8 FULL
A2 Fault codes with counters =ECM CEM DIM
A3 "Fuel level" in DIM via Vida in liters =
A4 "Fuel level sensor, ejector side" in Dim via Vida in liters =

B. Fault tracing result for fuel pressure problem

B1 "Fuel rail pressure (rel)" via VIDA =
B2 "Fuel pump duty cycle" via VIDA =
B3 Residual pressure after 20 min =

C. Fuel level sender resistance reading measured from the connector beneath the rear seat

C1 Resistance of level sensor in Kilo ohms =
C2 Resistance of level sensor, ejector side in Kilo ohms =
C3 Dim display = (circle one) Empty 1/8 ¼ 3/8 ½ 5/8 ¾ 7/8 FULL
C4 "Fuel level" in DIM via Vida =
C5 "Fuel level sensor, ejector side" in DIM via Vida in Dim =

D. Draining the fuel tank and measurements

D1 Measured fuel volume drained from the tank =
D2 "Fuel level" from CEM parameters via VIDA when tank is empty in volts. =
D3 "Fuel level sensor, ejector side" from CEM parameters via VIDA when tank is empty in volts. =

E. Rotation test of empty tank/pump when removed from car

Tilt/movement when pump facing away from axis =

E1 Empty tank simulation (pump facing away from axis) (spec 0.99 +/- 0.01 kohms)=
E2 Full tank simulation (pump facing away from axis) (spec 0.05 +/- 0.01 kohms)=
E3 Empty tank simulation (pump facing away from axis) (spec 0.99 +/- 0.01 kohms)=
E4 Full tank simulation (pump facing away from axis) (spec 0.05 +/- 0.01 kohms)=
E5 Note any strange reading behavior during the tilt procedures: (Be sure to use the 4 kohm scale)

Tilt/movement when pump facing near tilt axis=

E6 Empty tank simulation (pump facing near axis) Resistance Pump side pins1+2 (spec 0.99 +/- 0.01 kohms)=
E7 Full tank simulation (pump facing near axis) Resistance Pump side pins1+2 (spec 0.05 +/- 0.01 kohms)=
E8 Empty tank simulation (pump facing near axis) Resistance Ejector side pins1+6 (spec 0.99 +/- 0.01 kohms)=
E9 Full tank simulation (pump facing near axis) Resistance Ejector side pins1+6 (spec 0.05 +/- 0.01 kohms)=
E10 Notes of any strange reading behavior during the tilt procedures: (Be sure to use the 4 kohm scale) =

F. Stand alone pump sender unit testing

F1 Resistance readings when float arm at bottom (spec 0.99 +/- 0.01 kohms) =
F2 Resistance readings when float arm at top (spec 0.05 +/- 0.01 kohms) =
F3 Note all erratic readings during the sweep test. (Be sure to use the 4 kohm scale) =

VOLVO

Volvo Car Customer Service		
	TJ Instruction	
	TJ No 20532	
		Date Feb-12 Issue 04
Title	FWD Fuel gauge/fuel pressure/fuel tank fault tracing guide	

COMPETENCE: Master or Expert rated technician ONLY
IMPORTANT! Please read the entire document before starting any work!

MATERIALS:

Description	Part Number	Quantity
Repair terminal	30728834	2
Repair terminal	30656635	2
Fuel pressure gauge	999 5011	1
Fuel pressure gauge	999 7268	1
Vantage Pro oscilloscope	107-EETM303A-VOLVO	1

CHAPTER 1 Fault tracing

Print out the diagnostic sheet in Chapter 4. It shall be used as a data collection sheet of all fault tracing information. This will assist in the proper diagnosis and should be used when contacting the Technical Helpdesk and/or the Prior Approval Department. **Note: Skipping fault tracing steps will likely lead to an inaccurate diagnosis.**

Step A. Customer symptom

For this fault tracing, it's absolutely imperative that the service writer gets an accurate description of the customer's complaints. Take time to interview the customer about the symptoms because that will make it much easier later in the fault tracing. **Without an active fault or a good description of the fault it might be very hard to diagnose the system.**
Also, be sure to ask if the problem still exists at this time. Some examples of customer's complaints:

- Fuel gauge all of a sudden drops to zero
- Engine stalled out, even if fuel gauge shows "x" left in tank
- Engine does not start even if fuel gauge shows "x" left in tank
- Fuel gauge shows full all the time.
- Fuel gauge jumps around and is not stable.
- Engine cranks, but vehicle does not start when parked on an incline/decline

Reading out values

Read and write down the values below on the printed diagnostic sheet.
A1 Record the reading of the current position of the fuel gauge in the dim display.
A2 Read out the DTCs. Only DTCs from Engine Control Module (ECM), Central Electronic Module (CEM) and Driver Information module (DIM) must be written down on the diagnostic sheet also taking note of the counters.
A3 Go to VIDA->Diagnostics->Vehicle Communication->select DIM->Parameters and select "fuel level" to check and note down the fuel volume (in Liters).

Step B. Find out if it's a fuel pressure problem

If the customer's complaint is either "car stalled while driving" or "car is not starting", add exactly **3 gallons** of fuel to the tank and check for starting. If the car starts after adding fuel, proceed to step C.

If the car does not start after adding the 3 gallons, go to VIDA->Diagnostics->Vehicle Communication->select ECM->Parameters and select "fuel rail pressure" and "fuel pump duty cycle".
Read and write down the values below on the printed diagnostic sheet.
B1 "Fuel rail pressure (rel)" from VIDA =
B2 "Fuel pump duty cycle" from VIDA =

If the customer complaint is a long crank while starting, check the residual pressure after engine shutdown **using fuel pressure gauge P/N 999-5011 and P/N 999-7268 or similar method**. It should hold at least 180 Kpa after 20 min.
B1 "Fuel rail pressure (rel)" from VIDA =
B2 "Fuel pump duty cycle" from VIDA =
B3 "Residual pressure after 20 min"=
Compare the values with VIDA specifications and use this to determine the root cause.
If residual pressure on the fuel pressure gauge does not match VIDA, replace the fault trace the fuel pressure sensor.
If the residual pressure is not at least 180 Kpa after 20 min AND there are no fuel leaks (check lines and injectors), then replace the fuel pump.

Step C. Inaccurate fuel gauge problem.

If the customer complains about the fuel level not being accurate or if the vehicle started after adding 3 gallons of fuel, the float circuit needs to be checked.

Check fuel level sender resistance readings before removing the tank.

Measure and record the resistance value of the float sensor with the tank in the car utilizing the connector under the rear seat.
Remove the ignition key, Connect Volvo's Vantage Pro oscilloscope (P/N 107-EETM303A-VOLVO). Set up the ohmmeter to measure on the 4 kilohm (kohm) scale. Use the appropriate wiring diagram to locate the level sender terminals/connector beneath the rear seat upholstery. Separate the connector halves and use repair terminal P/N 30728834 to probe the terminal leads for the level sensor. Measure the resistance across the two float terminals. The plastic insulators must be crimped on to avoid a short when measuring resistance.

At this stage, the tank has the volume of fuel the car showed up with at the work shop, and/or the 3 gallons that were added in step B.

Read and write down the values below on the printed diagnostic sheet.
C1 "Resistance of float in kohms"=
Refit the connector halves after recording your measurement.

Note: Damaged or loose terminals will cause an incorrect fuel gauge reading.

Photo 1. Measuring connector under rear seat of the car.

Reconnect the terminal connector. Recheck the current position of the fuel gauge in the dim display.
C2 DIM display =
C3 Fuel level in DIM via VIDA in liters =

Step D. Draining the fuel tank and measurements

Some important information can be collected before removing the tank from the car. This information can be used to compare with the findings from the test that needs to be performed with the tank removed from the car.

Empty the tank of fuel completely using fuel pressure gauge P/N 999-5011 and P/N 999-7268 or similar method. Collect the fuel in an approved container where you are able to measure the volume of the drained fuel. This way measured levels of fuel and actual levels of fuel can be compared. **Obey state and local laws when selecting your fuel container.**

Read and write down the values below on the printed diagnostic sheet from Chapter 4

D1 Measured fuel volume drained from the tank=
D2 "Fuel level" from CEM parameters via Vida when tank is empty in volts =

Step E. Rotation/Tilt test of empty tank/pump when removed from car.

Remove the empty tank from the car. Make two jumper wires by using connector P/N 30656635 or similar. These leads will fit on the fuel pump connector pins. Plastic insulators must be crimped onto the connector avoid a short when measuring resistance.
Connect Volvo's Vantage Pro oscilloscope (P/N 107-EETM303A-VOLVO) to the jumper wires. Set up the ohmmeter to measure on a 4 kohm scale. Connect the jumper leads to the terminals on the fuel pump according to Photo 2.

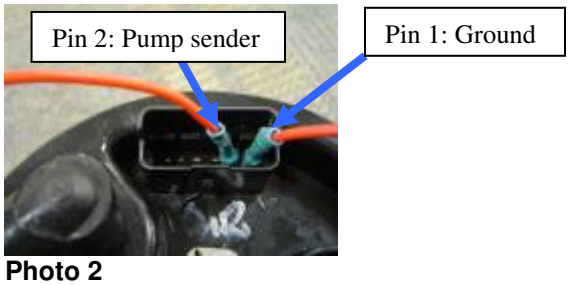

Photo 2

The float arm normally moves very easily between its max/min values when the tank is tilted +/- 30 degrees around the vertical position. You should be able to simulate empty and full readings by doing these small movements. Tilt the tank very slowly, several times between these positions, while continuously reading the resistance value and looking for any strange behavior. You should also test the +/- 180 degree positions. The tilt test needs to be performed in two different ways: 1st when the pump is away from the tilt/rotation axis and 2nd when the pump is near the tilt/rotation axis (see Photos 3 and 4).
Read and write down the values below on the printed diagnostic sheet from Chapter 4.

Tilt/movement when pump is away from the tilt axis (Photo 3)
Read and write down the values below on the printed diagnostic sheet.
E1 "Resistance Pump" at empty tank simulation (pump away from axis) (spec 0.99 +/- 0.01 kohms)=
E2 "Resistance Pump" at full tank simulation (pump away from axis) (spec 0.05 +/- 0.01 kohms)=
E3 Note any strange reading behavior during the tilt procedures: (but be sure to use the 4 kohm scale)

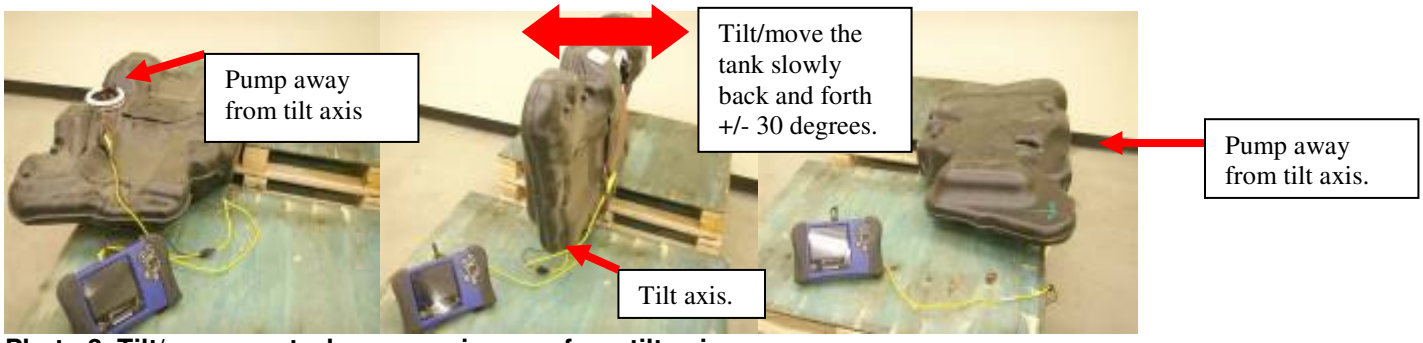

Photo 3. Tilt/movement when pump is away from tilt axis.

Tilt/movement when pump is near tilt axis (Photo 4)
Read and write down the values below on the printed diagnostic sheet.
E4 "Resistance Pump" at empty tank simulation (pump near axis) (spec 0.99 +/- 0.01 kohms)=
E5 "Resistance Pump" at full tank simulation (pump near axis) (spec 0.05 +/- 0.01 kohms)=
E6 Notes of any strange reading behavior during the tilt procedures: (but be sure to use the 4 kohm scale)

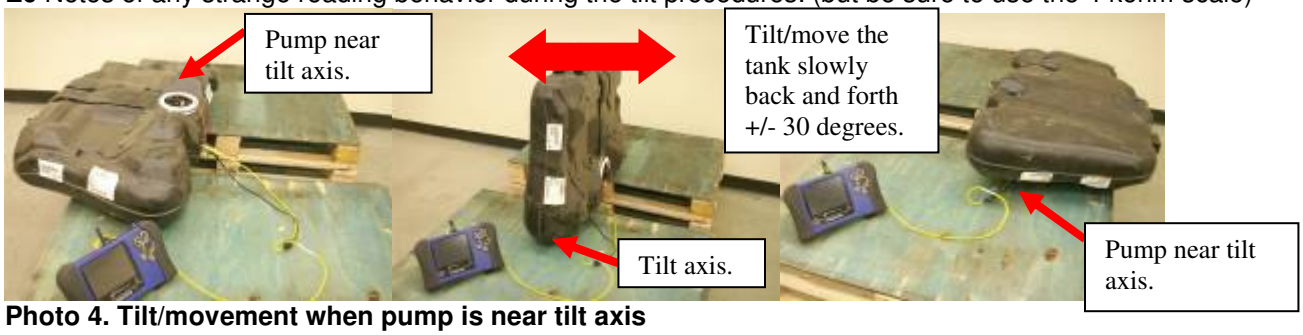

Photo 4. Tilt/movement when pump is near tilt axis

Remove the pump from the tank.
Check if the tank carrier is fixed. The carrier includes all of the plastic hoses and brackets inside the tank.
The carrier is supposed to be melted in to the tank shell at the area of raised bumps shown in Photo 5. If its not, you will be able to stick your thumb in between the bumps and the tank shell. The entire carrier will also be a bit loose, will move closer to the pump, and drop down a little bit.
Such a condition can end up in two different customer symptoms:
1) Fuel gauge reads full (or almost full) even if the tank is not full because the float arm gets stuck at the top of the tank on the Liquid Valve Support (LVS) hose/pipe (see Photo 5).
2) The tank will not take a full tank and the fuel gauge never shows more than 7/8. This happens because the ventilation check valve has dropped down a bit and shuts itself off before the tank is full. This will cause the fuel nozzle to shut off before a full tank is reached.
If the carrier is not fixed properly to the tank, the tank needs to be replaced.

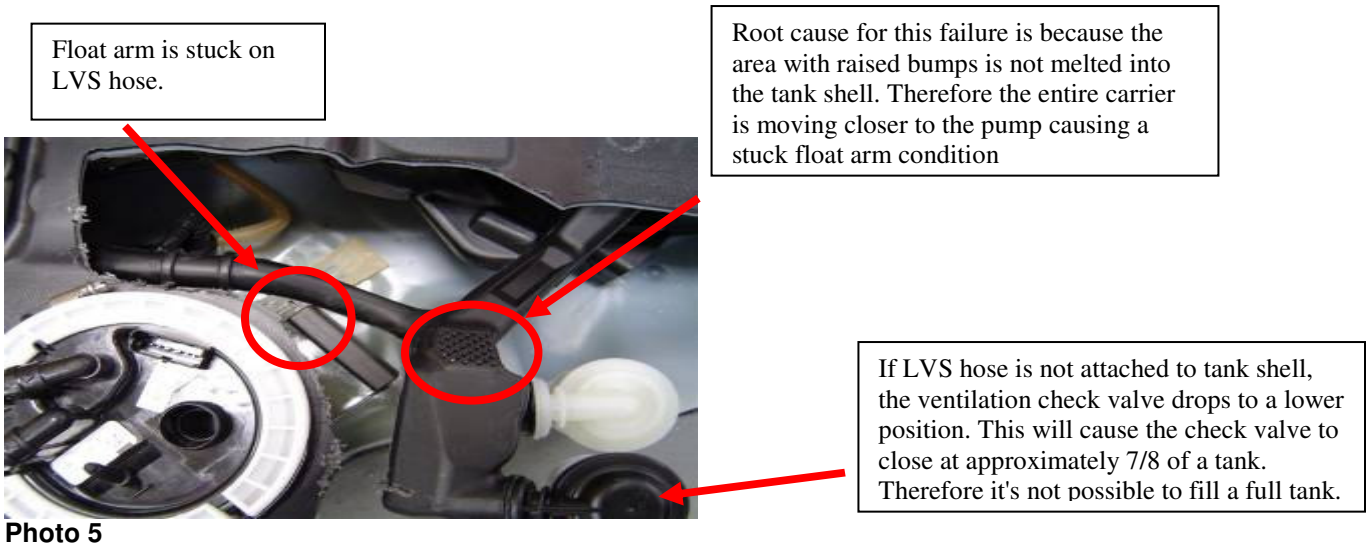

Photo 5

Step F. Stand alone pump sender unit test

Remove the pump from the tank.
Before measuring the resistance value of the float, the connector pins shown in Photo 5 need to be shorted together using an alligator clip or a similar tool.

Photo 6

Connect pins 1 and 2 to the ohmmeter as you did in Step E. Slowly sweep the sender from bottom to top and back to bottom and see if it reads all the way from 0.99 +/- 0.01 kohms to 0.05 +/- 0.01 kohms. Be aware of a possible short between your jumper wires at pin 1 and 2.

Read and write down the values below on the printed diagnostic sheet from Chapter 4.
F1 "Resistance reading when float arm at bottom" (spec 0.99 +/- 0.01 kohms)=
F2 "Resistance reading when float arm at top" (spec 0.05 +/- 0.01 kohms)=
F3 "Any erratic reading during the sweep"= (be sure to use the 4 kohm scale)
Any failure in the sender will require fuel pump replacement.

If the fuel pump and/or fuel tank require replacement, fill out the attached form then transfer this information to the Prior Approval application on VRC2 to obtain an approval code before installing the fuel pump and/or tank. If your diagnostics are inconclusive your request will be returned with comments redirecting the diagnostics or repair.

Step G. Special routing not used on FWD

Step H. Final check before install tank in car.

After the tank and pump are assembled together, connect the ohmmeter and perform the flip test of the tank as a final confirmation to check that the float arm is moving correctly.

CHAPTER 2
Pump modification not used on FWD

CHAPTER 3

Translation table kohm to liters/gallon and miscellaneous information

Pump readings							
Sensor Resistance (kohms)	**Volume (liters)**	**Volume (gallons)**	**Voltage read by VIDA CEM**	**Sensor Resistance (kohms)**	**Volume (liters)**	**Volume (gallons)**	**Voltage read by VIDA CEM**
0.99	0	0	4.09	0.34	36	9.5	3.03
0.99	1	0.3	4.09	0.33	37	9.8	3.00
0.98	2	0.5	4.08	0.32	38	10	2.96
0.98	3	0.8	4.08	0.31	39	10.3	2.92
0.94	4	1.1	4.05	0.3	40	10.6	2.88
0.9	5	1.3	4.01	0.29	41	10.8	2.84
0.86	6	1.6	3.98	0.28	42	11.1	2.79
0.82	7	1.8	3.94	0.28	43	11.4	2.79
0.79	8	2.1	3.91	0.27	44	11.6	2.75
0.76	9	2.4	3.87	0.26	45	11.9	2.70
0.74	10	2.6	3.85	0.25	46	12.2	2.65
0.71	11	2.9	3.81	0.25	47	12.4	2.65
0.69	12	3.2	3.79	0.24	48	12.7	2.60
0.67	13	3.4	3.76	0.23	49	12.9	2.55
0.64	14	3.7	3.72	0.23	50	13.2	2.55
0.62	15	4	3.69	0.22	51	13.5	2.49
0.6	16	4.2	3.65	0.21	52	13.7	2.44
0.59	17	4.5	3.64	0.2	53	14	2.38
0.57	18	4.8	3.60	0.2	54	14.3	2.38
0.55	19	5	3.57	0.19	55	14.5	2.31
0.54	20	5.3	3.55	0.18	56	14.8	2.24
0.52	21	5.5	3.51	0.18	57	15.1	2.24
0.5	22	5.8	3.47	0.17	58	15.3	2.17
0.49	23	6.1	3.45	0.16	59	15.6	2.10
0.47	24	6.3	3.40	0.16	60	15.9	2.10
0.46	25	6.6	3.38	0.15	61	16.1	2.02
0.45	26	6.9	3.35	0.14	62	16.4	1.94
0.44	27	7.1	3.33	0.14	63	16.6	1.94
0.42	28	7.4	3.28	0.13	64	16.9	1.85
0.41	29	7.7	3.25	0.12	65	17.2	1.76
0.4	30	7.9	3.22	0.12	66	17.4	1.76
0.39	31	8.2	3.19	0.11	67	17.7	1.66
0.38	32	8.5	3.16	0.1	68	18	1.56
0.37	33	8.7	3.13	0.1	69	18.2	1.56
0.36	34	9	3.10	0.09	70	18.5	1.45
0.35	35	9.2	3.07				

Use the above sheet for comparison for any readings you believe are inaccurate. Keep in mind any inaccurate readings should agree with the customer's complaint.

Note: the float arm can physically be moved to a position which is higher than the normal full fuel fill level of 18.5 gallons. This will result in an ohms measurement which is lower than shown on the chart above. With the tank positioned upside down the value could possibly read as low as 0.05 kohms, which is not a fault.

VOLVO

CHAPTER 4 Diagnostic data sheet

Gather all information on this check sheet to determine the failure route cause. Transfer this information to the Prior Approval application on VRC2 to obtain an approval code before installing the fuel pump and/or tank. If your diagnostics are inconclusive your request will be returned with comments redirecting the diagnostics or repair.

Customer symptom

A. Read out values

A1 Dim display = (circle one) Empty 1/8 ¼ 3/8 ½ 5/8 ¾ 7/8 FULL
A2 Fault codes with counters = ECM CEM DIM
A3 Fuel level in DIM via Vida in liters =

B. Fault tracing result for fuel pressure problem (if applicable)

B1 "Fuel rail pressure (rel)" from VIDA =
B2 "Fuel pump duty cycle" from VIDA =
B3 "Residual pressure after 20 min"=

C. Fuel level sender resistance reading measured from the connector beneath the rear seat

C1 "Resistance of float in Kilo ohms"=
C2 Dim display = (circle one) Empty 1/8 ¼ 3/8 ½ 5/8 ¾ 7/8 FULL
C3 Fuel level in DIM via Vida in liters =

D. Draining the fuel tank and measurements

D1 "Measured fuel volume drained from the tank"=
D2 Fuel level" from CEM parameters via Vida when tank is empty in volts =

E. Rotation test of empty tank/pump when removed from car

Tilt/movement when pump is away from the tilt axis
E1 "Resistance Pump side" at empty tank simulation (pump away from axis) (spec 0.99 +/- 0.01 kohms) =
E2 "Resistance Pump side" at full tank simulation (pump away from axis) (spec 0.05 +/- 0.01 kohms) =
E3 Note any strange reading behavior during the tilt procedures: (Be sure to use the 4 kohm scale)

Tilt/movement when pump is near tilt axis
E4 "Resistance Pump" at empty tank simulation (pump near axis) (spec 0.99 +/- 0.01 kohms) =
E5 "Resistance Pump" at full tank simulation (pump near axis) (spec 0.05 +/- 0.01 kohms) =
E6 Note any strange reading behavior during the tilt procedures: (Be sure to use the 4 kohm scale) =

F. Stand alone pump sender unit testing

F1 Resistance reading when float arm at bottom (spec 0.99 +/- 0.01 kohms) =
F2 Resistance reading when float arm at top (spec 0.05 +/- 0.01 kohms) =
F3 Note any erratic readings during the sweep. (Be sure to use the 4 kohm scale) =

VOLVO

Prior Approval
Fuel Gauge / Send Tank Form

Current Date:	Prior Approval Contact Information Phone: 1-800-500-5570

All Prior Approval Forms must be submitted through TIE!
Please fill out form completely. Required fields are marked with an asterisk (*).
Forms without required fields completed will be rejected.

New Case	Existing Case

Retailer Code*:

Retailer Name*:

Technician Name*:

Contact Phone #*:

E-mail Address*:

Model*: _____ **Model Year*:** _____ **Repair Order #*:**_____ **Repair Date*:** _____

VIN Number*: **Mileage*:**_____ **No. of Repair Attempts*:** ____

Vehicle Information:

1. Can the customer's complaint be duplicated?*	Yes	No
2. If yes to question 1, explain exactly what happened.		
3. Is the vehicle AWD?*	Yes	No
4. How many times has the vehicle been in for this concern?*		
5. Step A1: How much fuel was on the DIM display when the vehicle was brought in?*		
6. Step A2: List any DTC in the CEM, DIM or ECM that can be related to this issue. Write "N/A" if there are no codes.*		
7. Step A3: What is the "fuel level" in the DIM via VIDA (in liters, FWD 0-70, AWD 0-35)?*		
8. Step A4 AWD: What is the fuel level sensor ejector side in DIM via VIDA (in liters, round up to the nearest liter)?		

Prior Approval Fuel Gauge / Send Tank Form

9. Step B1 (if a fuel pressure issue): What is the "fuel rail pressure (rel)" via VIDA with the engine running (in kPa)?		
10. Step B2 (if a fuel pressure issue): What is the fuel pump duty cycle via VIDA (in percentage)?		
11. Step B3 (if a fuel pressure issue): What is residual pressure after 20 minutes?		
12. Step C1-3 (if a gauge issue): Does the resistance check of the rear seat connector correspond with the liter value readout by VIDA in questions 7 and 8? (Use the translation table in the TJ.)	Yes	No
13. Step D1 (if a gauge issue): What is the fuel volume drained from the tank (in liters)?		
14. Step D2 (if a gauge issue): What is the "fuel level" via the CEM with the tank empty (in volts)?		
15. Step D3 (if a gauge issue) AWD: What is the "fuel level" via the CEM with the tank empty? Ejector side (in volts)		
16. Step E (if a gauge issue): During the rotation test, were there any erratic readings?	Yes	No
17. Step E (if a gauge issue): Type the resistance readings at the full tank position and at the empty tank position for the pump and, if equipped, also the ejector. Note any inaccurate readings during the rotation tests and on which step (E1-E9) it occurs.		
18. Step F (if a gauge issue): With the pump/sender removed, are the resistance readings of the pump/ sender correct during its sweep test?	Yes	No
19. Has the tank been inspected for any interference with the pump/sender?	Yes	No
20. What part do you believe needs to be replaced?*		
21. Describe all outstanding conditions why the requested part needs to be replaced. Also, list all parts that have been replaced for this issue in past repair attempts.*		
22. Add attachments to TIE report showing the fault.		

Technical Journals:

TJ 20532 - AWD Fuel gauge/fuel pressure/fuel tank fault tracing guide
TJ 20532 - FWD Fuel gauge/fuel pressure/fuel tank fault tracing guide
TJ 27217 Long cranking time, fuel pump triple valve