A7: Fuel-pump endurance tear-down data

Sample ID 2M032-01

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.
No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM
No Visual Corrosion

2 Check the resistance of the fuel pump

2.17 Ohms

2-1 If open,proceed to Pump Teardown.
2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.
2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.
Flow = 64.89 LPH
Current = 7.14 AMPS
Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 449.16 kPa

3-5 5 Minute pressure leak down test.
Change in pressure: 236.79 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests
0.123 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views
5-2 Carefully remove the fuel pump outer shell.
5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).
5-4 Inspect all the internal pump components keeping in mind the failure tree below:
5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.
5-4b – If closed circuit, but not spinning, look for heat damage, or contamination
5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage
5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.
6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.114	1 to 5	0.789
2 to 3	0.286	2 to 6	0.876
3 to 4	0.349	3 to 7	0.969
4 to 5	0.293	4 to 8	0.871
5 to 6	0.846		
6 to 7	0.712		
7 to 8	0.891		
8 to 1	0.224		

6-2 Com segment run-out 0.0001 thousandths of an inch

raphs).
6-3A Armature Shaft OD - Com End 4.958 mm
6-3B Armature Shaft OD - Impeller End 4.956 mm
6-3C Outlet Bearing ID 4.981 mm
6-3D Impeller Bearing ID Top 4.261 mm
6-3E Impeller Bearing ID Bottom 4.26 mm
6-3F Note conditon and take photographs.
Photos Recorded

6-4 Brush length - % length remaining
Brush 1 10.629 mm
Brush 2 Brush Stuck mm See Photo for Details

6-5 Brush wire condition – take photographs, measure spring force
Brush 1 Photos Spring Force Unavailable
Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based
6-6 upon current wear rate through 3000 hours)
Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).
Impeller Thickness 2.819

6-8 Impeller Drag Torque Less Than .44 in/lbs.

Sample ID 2M032-02

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

2.69 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the

2-3 FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 56.77 LPH

Current = 7.61 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 449.18 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 284.18 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.552 Ohms

5 **Pump Teardown**

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage,

5-3 or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.223	1 to 5	0.989
2 to 3	0.341	2 to 6	0.891
3 to 4	0.657	3 to 7	0.736
4 to 5	0.811	4 to 8	0.657
5 to 6	0.314		
6 to 7	0.131		
7 to 8	0.825		
8 to 1	0.232		

6-2 Com segment run-out 0.0002 thousandths of an inch

raphs).

6-3A Armature Shaft OD - Com End 4.961 mm

6-3B Armature Shaft OD - Impeller End 4.951 mm

6-3C Outlet Bearing ID 4.991 mm

6-3D Impeller Bearing ID Top 4.259 mm

6-3E Impeller Bearing ID Bottom 4.256 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 10.832 mm

Brush 2 10.831 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based

6-6 upon current wear rate through 3000 hours)

Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.822

6-8 Impeller Drag Torque Less Than .44 in/lbs.

Sample ID 2M032-03

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.
No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM
No Visual Corrosion

2 Check the resistance of the fuel pump

3.19 Ohms

2-1 If open,proceed to Pump Teardown.
2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the
2-3 FPM.
2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	61.77	LPH
Current =	6.91	AMPS
Leakage?		No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure 442.79 kPa

3-5 5 Minute pressure leak down test:
Change in pressure: 239.14 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests
0.113 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views
5-2 Carefully remove the fuel pump outer shell.
Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage,
5-3 or contamination).
5-4 Inspect all the internal pump components keeping in mind the failure tree below:
5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.
5-4b – If closed circuit, but not spinning, look for heat damage, or contamination
5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage
5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.
6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.145	1 to 5	0.989
2 to 3	0.671	2 to 6	0.723
3 to 4	0.512	3 to 7	0.881
4 to 5	0.423	4 to 8	0.799
5 to 6	0.317		
6 to 7	0.472		
7 to 8	0.236		
8 to 1	0.147		

6-2 Com segment run-out 0.0001 thousandths of an inch

raphs).

6-3A Armature Shaft OD - Com End	4.978	mm
6-3B Armature Shaft OD - Impeller End	4.981	mm
6-3C Outlet Bearing ID	4.899	mm
6-3D Impeller Bearing ID Top	4.236	mm
6-3E Impeller Bearing ID Bottom	4.229	mm

6-3F Note conditon and take photographs.
Photos: Recorded

6-4 Brush length - % length remaining
Brush 1 10.821 mm
Brush 2 Brush Stuck mm See Photo for Details

6-5 Brush wire condition – take photographs, measure spring force
Brush 1 Photos Spring Force Unavailable
Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based
6-6 upon current wear rate through 3000 hours)
Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).
Impeller Thickness 2.821

6-8 Impeller Drag Torque Less Than .44 in/lbs.

Sample ID 2M032-04

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.
No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM
No Visual Corrosion

2 Check the resistance of the fuel pump

2.98 Ohms

2-1 If open,proceed to Pump Teardown.
2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the
2-3 FPM.
2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	59.77	LPH
Current =	7.01	AMPS
Leakage?		No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 451.98 kPa

3-5 5 Minute pressure leak down test.
Change in pressure: 291.16 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests
0.023 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views
5-2 Carefully remove the fuel pump outer shell.
Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage,
5-3 or contamination).
5-4 Inspect all the internal pump components keeping in mind the failure tree below:
5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.
5-4b – If closed circuit, but not spinning, look for heat damage, or contamination
5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage
5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.
6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.167	1 to 5	0.876
2 to 3	0.231	2 to 6	0.752
3 to 4	0.516	3 to 7	0.992
4 to 5	0.441	4 to 8	0.892
5 to 6	0.389		
6 to 7	0.331		
7 to 8	0.423		
8 to 1	0.561		

6-2 Com segment run-out 0.0001 thousandths of an inch

raphs).

6-3A	Armature Shaft OD - Com End	4.972 mm
6-3B	Armature Shaft OD - Impeller End	4.98 mm
6-3C	Outlet Bearing ID	4.901 mm
6-3D	Impeller Bearing ID Top	4.239 mm
6-3E	Impeller Bearing ID Bottom	4.241 mm

6-3F Note conditon and take photographs.
Photos: Recorded

6-4 Brush length - % length remaining
Brush 1 10.62 mm
Brush 2 Brush Stuck mm See Photo for Details

6-5 Brush wire condition – take photographs, measure spring force
Brush 1 Photos Spring Force Unavailable
Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based
6-6 upon current wear rate through 3000 hours)
Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).
Impeller Thickness 2.823

6-8 Impeller Drag Torque Less Than .44 in/lbs.

Sample ID 2M032-05

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

3.01 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the

2-3 FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 52.19 LPH

Current = 8.57 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 449.87 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 281.19 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.256 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage,

5-3 or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to

Segment	Ohms	Cross Com	Ohms
1 to 2	0.323	1 to 5	0.827
2 to 3	0.411	2 to 6	0.917
3 to 4	0.191	3 to 7	0.911
4 to 5	0.285	4 to 8	0.854
5 to 6	0.391		
6 to 7	0.196		
7 to 8	0.177		
8 to 1	0.289		

6-2 Com segment run-out 0.0001 thousandths of an inch

raphs).

6-3A Armature Shaft OD - Com End 4.981 mm

6-3B Armature Shaft OD - Impeller End 4.98 mm

6-3C Outlet Bearing ID 4.901 mm

6-3D Impeller Bearing ID Top 4.269 mm

6-3E Impeller Bearing ID Bottom 4.269 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 10.631 mm

Brush 2 10.63 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based

6-6 upon current wear rate through 3000 hours)

Com Thickness 0.0002 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.811

6-8 Impeller Drag Torque Less Than .44 in/lbs.

Sample ID 2M032-06

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.
No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM
No Visual Corrosion

2 Check the resistance of the fuel pump

3.1 Ohms

2-1 If open,proceed to Pump Teardown.
2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the
2-3 FPM.
2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage
Flow = 63.17 LPH
Current = 6.88 AMPS
Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 442.19 kPa

3-5 5 Minute pressure leak down test.
Change in pressure: 214.15 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests
0.236 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views
5-2 Carefully remove the fuel pump outer shell.
Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage,
5-3 or contamination).
5-4 Inspect all the internal pump components keeping in mind the failure tree below:
5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.
5-4b – If closed circuit, but not spinning, look for heat damage, or contamination
5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage
5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.
6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.289	1 to 5	0.991
2 to 3	0.333	2 to 6	0.876
3 to 4	0.288	3 to 7	0.995
4 to 5	0.301	4 to 8	0.742
5 to 6	0.675		
6 to 7	0.819		
7 to 8	0.123		
8 to 1	0.167		

6-2 Com segment run-out 0.0002 thousandths of an inch

raphs).
6-3A Armature Shaft OD - Com End 4.955 mm
6-3B Armature Shaft OD - Impeller End 4.953 mm
6-3C Outlet Bearing ID 4.89 mm
6-3D Impeller Bearing ID Top 4.263 mm
6-3E Impeller Bearing ID Bottom 4.26 mm
6-3F Note conditon and take photographs.
Photos: Recorded

6-4 Brush length - % length remaining
Brush 1 10.804 mm
Brush 2 Brush Stuck mm See Photo for Details

6-5 Brush wire condition – take photographs, measure spring force
Brush 1 Photos Spring Force Unavailable
Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based
6-6 upon current wear rate through 3000 hours)
Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).
Impeller Thickness 2.806

6-8 Impeller Drag Torque Less Than .44 in/lbs.

Sample ID 1M445-01

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

1.7 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the

2-3 FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 39.6 LPH

Current = 3.98 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 354.74 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage,

5-3 or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.278	1 to 5	0.582
2 to 3	0.299	2 to 6	0.84
3 to 4	0.276	3 to 7	0.545
4 to 5	0.278	4 to 8	0.542
5 to 6	0.248		
6 to 7	0.321		
7 to 8	0.298		
8 to 1	0.112		

6-2 Com segment run-out 0.0001 thousandths of an inch

raphs).

6-3A Armature Shaft OD - Com End 4.996 mm

6-3B Armature Shaft OD - Impeller End 4.296 mm

6-3C Outlet Bearing ID 5.013 mm

6-3D Impeller Bearing ID Top 4.5 mm

6-3E Impeller Bearing ID Bottom 4.527 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 11.883 mm

Brush 2 11.782 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based

6-6 upon current wear rate through 3000 hours)

Com Thickness 0.0012 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.806

Sample ID 1M445-02

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

1.2 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally

2-3 test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 39.6 LPH

Current = 3.98 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 355.17 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat

5-3 damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print

6-1 Com resistance values – cross com and segment to segment values

Segment to

Segment	Ohms	Cross Com	Ohms
1 to 2	0.261	1 to 5	0.516
2 to 3	0.272	2 to 6	0.506
3 to 4	0.313	3 to 7	0.488
4 to 5	0.358	4 to 8	0.514
5 to 6	0.408		
6 to 7	0.239		
7 to 8	0.414		
8 to 1	0.268		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 4.994 mm

6-3B Armature Shaft OD - Impeller End 4.287 mm

6-3C Outlet Bearing ID 5.002 mm

6-3D Impeller Bearing ID Top 4.506 mm

6-3E Impeller Bearing ID Bottom 4.501 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 11.827 mm

Brush 2 11.884 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours

6-6 based upon current wear rate through 3000 hours)

Com Thickness 0.001 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs)

Impeller Thickness 3.803

Sample ID 1M445-03

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

4.1 Ohms

2-1 If open,proceed to Pump Teardown.
2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally t
2-3 the FPM.
2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	34.18	LPH
Current =	4.08	AMPS
Leakage?		N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 354.11 kPa

3-5 5 Minute pressure leak down test.
Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests
0.007 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views
5-2 Carefully remove the fuel pump outer shell.
Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat
5-3 damage, or contamination).
5-4 Inspect all the internal pump components keeping in mind the failure tree below:
5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.
5-4b – If closed circuit, but not spinning, look for heat damage, or contamination
5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage
5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.
6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.266	1 to 5	0.103
2 to 3	0.271	2 to 6	0.141
3 to 4	0.231	3 to 7	0.156
4 to 5	0.281	4 to 8	0.171
5 to 6	0.302		
6 to 7	0.444		
7 to 8	0.501		
8 to 1	0.622		

6-2 Com segment run-out 0.0012 thousandths of an inch

aphs).

6-3A	Armature Shaft OD - Com End	4.999 mm
6-3B	Armature Shaft OD - Impeller End	4.293 mm
6-3C	Outlet Bearing ID	5.02 mm
6-3D	Impeller Bearing ID Top	4.563 mm
6-3E	Impeller Bearing ID Bottom	4.522 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	11.777	mm
Brush 2	12.002	mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours
6-6 based upon current wear rate through 3000 hours)
Com Thickness 0.0006 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).
Impeller Thickness 3.806

Sample ID 1M445-04

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

3.2 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 48.2 LPH

Current = 4.17 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 360.48 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.002 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.275	1 to 5	0.477
2 to 3	0.302	2 to 6	0.477
3 to 4	0.284	3 to 7	0.481
4 to 5	0.256	4 to 8	0.472
5 to 6	0.256		
6 to 7	0.277		
7 to 8	0.235		
8 to 1	0.255		

6-2 Com segment run-out 0.0012 thousandths of an inch

graphs).

6-3A Armature Shaft OD - Com End 4.996 mm

6-3B Armature Shaft OD - Impeller End 4.292 mm

6-3C Outlet Bearing ID 5.02 mm

6-3D Impeller Bearing ID Top 4.516 mm

6-3E Impeller Bearing ID Bottom 4.522 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 11.701 mm

Brush 2 12.152 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours

6-6 based upon current wear rate through 3000 hours)

Com Thickness 0.0002 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs)

Impeller Thickness 3.806

Sample ID 1M445-06

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

0.9 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 34.18 LPH

Current = 4.08 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 355.51 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.007 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.215	1 to 5	0.765
2 to 3	0.23	2 to 6	0.407
3 to 4	0.27	3 to 7	0.54
4 to 5	0.218	4 to 8	0.497
5 to 6	0.25		
6 to 7	0.23		
7 to 8	0.2		
8 to 1	0.24		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs).

6-3A Armature Shaft OD - Com End 4.992 mm

6-3B Armature Shaft OD - Impeller End 4.281 mm

6-3C Outlet Bearing ID 5.006 mm

6-3D Impeller Bearing ID Top 4.527 mm

6-3E Impeller Bearing ID Bottom 4.523 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 11.71 mm

Brush 2 11.808 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0011 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs)

Impeller Thickness 3.792

Sample ID 1M445-07

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

2.4 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 14.08 LPH

Current = 4.03 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 346.72 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.228	1 to 5	0.536
2 to 3	0.252	2 to 6	0.698
3 to 4	0.255	3 to 7	0.509
4 to 5	0.27	4 to 8	0.531
5 to 6	0.259		
6 to 7	0.249		
7 to 8	0.233		
8 to 1	0.247		

6-2 Com segment run-out 0.0001 thousandths of an inch

raphs).

6-3A Armature Shaft OD - Com End 4.983 mm

6-3B Armature Shaft OD - Impeller End 4.321 mm

6-3C Outlet Bearing ID 5.001 mm

6-3D Impeller Bearing ID Top 4.517 mm

6-3E Impeller Bearing ID Bottom 4.522 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 11.777 mm

Brush 2 11.792 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.001 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.783

Sample ID 1M445-08

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

2.1 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally

2-3 test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 41.04 LPH

Current = 4.01 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 346.05 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.003 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat

5-3 damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.232	1 to 5	0.585
2 to 3	0.249	2 to 6	0.51
3 to 4	0.219	3 to 7	0.49
4 to 5	0.229	4 to 8	0.525
5 to 6	0.388		
6 to 7	0.275		
7 to 8	0.249		
8 to 1	0.269		

6-2 Com segment run-out 0.001 thousandths of an inch

graphs).

6-3A Armature Shaft OD - Com End 4.993 mm

6-3B Armature Shaft OD - Impeller End 4.286 mm

6-3C Outlet Bearing ID 5.017 mm

6-3D Impeller Bearing ID Top 4.531 mm

6-3E Impeller Bearing ID Bottom 4.522 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 11.848 mm

Brush 2 11.955 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours

6-6 based upon current wear rate through 3000 hours)

Com Thickness 0.001 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs)

Impeller Thickness 3.825

Sample ID 1M445-09

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

1.1 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally

2-3 test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	20.16	LPH
Current =	4.015	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 349.15 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat

5-3 damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.277	1 to 5	0.411
2 to 3	0.288	2 to 6	0.432
3 to 4	0.219	3 to 7	0.441
4 to 5	0.245	4 to 8	0.423
5 to 6	0.276		
6 to 7	0.279		
7 to 8	0.305		
8 to 1	0.274		

6-2 Com segment run-out 0.0012 thousandths of an inch

raphs)

6-3A Armature Shaft OD - Com End	4.993	mm
6-3B Armature Shaft OD - Impeller End	4.289	mm
6-3C Outlet Bearing ID	4.981	mm
6-3D Impeller Bearing ID Top	4.368	mm
6-3E Impeller Bearing ID Bottom	4.372	mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	11.899	mm
Brush 2	11.918	mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours

6-6 based upon current wear rate through 3000 hours)

Com Thickness 0.0002 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs)

Impeller Thickness 3.852

Sample ID 1M445-11

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

0.008 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 22.75 LPH

Current = 4.03 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 362.17 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.233	1 to 5	0.502
2 to 3	0.262	2 to 6	0.49
3 to 4	0.217	3 to 7	0.482
4 to 5	0.222	4 to 8	0.547
5 to 6	0.219		
6 to 7	0.234		
7 to 8	0.246		
8 to 1	0.225		

6-2 Com segment run-out 0.0002 thousandths of an inch

graphs).

6-3A Armature Shaft OD - Com End 4.994 mm

6-3B Armature Shaft OD - Impeller End 4.283 mm

6-3C Outlet Bearing ID 5.002 mm

6-3D Impeller Bearing ID Top 4.53 mm

6-3E Impeller Bearing ID Bottom 4.539 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 11.888 mm

Brush 2 11.908 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours

6-6 based upon current wear rate through 3000 hours)

Com Thickness 0.0011 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs)

Impeller Thickness 3.815

Sample ID 1M445-12

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

2.2 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 18.33 LPH

Current = 3.98 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 347.11 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.009 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.218	1 to 5	0.168
2 to 3	0.277	2 to 6	0.177
3 to 4	0.216	3 to 7	0.183
4 to 5	0.223	4 to 8	0.192
5 to 6	0.233		
6 to 7	0.214		
7 to 8	0.308		
8 to 1	0.002		

6-2 Com segment run-out 0.0009 thousandths of an inch

raphs).

6-3A Armature Shaft OD - Com End 4.994 mm

6-3B Armature Shaft OD - Impeller End 4.288 mm

6-3C Outlet Bearing ID 4.989 mm

6-3D Impeller Bearing ID Top 4.361 mm

6-3E Impeller Bearing ID Bottom 4.381 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 11.911 mm

Brush 2 11.923 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.921

Sample ID 1M445-61

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

3.85 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? N/A Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

4 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.278	1 to 5	0.278
2 to 3	0.249	2 to 6	0.38
3 to 4	0.27	3 to 7	0.257
4 to 5	0.327	4 to 8	0.3
5 to 6	0.162		
6 to 7	0.151		
7 to 8	0.262		
8 to 1	0.32		

6-2 Com segment run-out 0.0003 thousandths of an inch

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6-3A Armature Shaft OD - Com End 5.004 mm

6-3B Armature Shaft OD - Impeller End 4.993 mm

6-3C Outlet Bearing ID 5.06 mm

6-3D Impeller Bearing ID Top 4.944 mm

6-3E Impeller Bearing ID Bottom 4.932 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 10.562 mm

Brush 2 10.693 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.744

Sample ID 1M445-62

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

1.5 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? N/A Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

2.5 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.11	1 to 5	0.23
2 to 3	0.02	2 to 6	0.14
3 to 4	0.12	3 to 7	0.22
4 to 5	0.04	4 to 8	0.11
5 to 6	0.12		
6 to 7	0.01		
7 to 8	0.23		
8 to 1	0.04		

6-2 Com segment run-out 0.0007 thousandths of an inch

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6-3A Armature Shaft OD - Com End 4.991 mm

6-3B Armature Shaft OD - Impeller End 4.282 mm

6-3C Outlet Bearing ID 5.077 mm

6-3D Impeller Bearing ID Top 4.944 mm

6-3E Impeller Bearing ID Bottom 4.677 mm

6-3F Note conditon and take photographs. 4.77

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	10.662 mm
Brush 2	10.525 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0005 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.851

Sample ID 1M445-63

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

1.5 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? N/A Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.11	1 to 5	0.18
2 to 3	0.02	2 to 6	0.11
3 to 4	0.23	3 to 7	0.01
4 to 5	0.04	4 to 8	0.04
5 to 6	0.05		
6 to 7	0.01		
7 to 8	0.11		
8 to 1	0.12		

6-2 Com segment run-out N/A thousandths of an inch

raphs)

6-3A Armature Shaft OD - Com End	5.014 mm
6-3B Armature Shaft OD - Impeller End	4.282 mm
6-3C Outlet Bearing ID	5.071 mm
6-3D Impeller Bearing ID Top	4.611 mm
6-3E Impeller Bearing ID Bottom	4.721 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	N/A	mm
Brush 2	N/A	mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness N/A mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.888

Sample ID 1M445-64

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

3.1 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? N/A Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.28	1 to 5	0.02
2 to 3	0.05	2 to 6	0.03
3 to 4	0.06	3 to 7	0.13
4 to 5	0.18	4 to 8	0.022
5 to 6	0.01		
6 to 7	0.19		
7 to 8	0.09		
8 to 1	0.01		

6-2 Com segment run-out 0.0002 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End	4.991 mm
6-3B Armature Shaft OD - Impeller End	4.279 mm
6-3C Outlet Bearing ID	5.067 mm
6-3D Impeller Bearing ID Top	4.575 mm
6-3E Impeller Bearing ID Bottom	4.56 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	10.652 mm
Brush 2	10.666 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.741

Sample ID 1M445-65

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

0.006 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-3

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 83.08 LPH
Current = 8.71 AMPS
Leakage? No Signs Of Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 435.32 kPa

3-5 5 Minute pressure leak down test.
Change in pressure: 122.12 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.153	1 to 5	0.296
2 to 3	0.151	2 to 6	0.268
3 to 4	0.119	3 to 7	0.305
4 to 5	0.227	4 to 8	0.278
5 to 6	0.14		
6 to 7	0.17		
7 to 8	0.165		
8 to 1	0.2		

6-2 Com segment run-out 0.0007 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.003 mm
6-3B Armature Shaft OD - Impeller End 4.995 mm
6-3C Outlet Bearing ID 5.067 mm
6-3D Impeller Bearing ID Top 4.575 mm
6-3E Impeller Bearing ID Bottom 4.56 mm
6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 10.498 mm
Brush 2 10.548 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?
Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0002 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.759

Sample ID 1M445-66

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

2.4 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-3

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? N/A Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.
Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests
0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.03	1 to 5	0.003
2 to 3	0.12	2 to 6	0.005
3 to 4	0.05	3 to 7	0.2
4 to 5	0.06	4 to 8	0.001
5 to 6	0.01		
6 to 7	0.22		
7 to 8	0.011		
8 to 1	0.023		

6-2 Com segment run-out 0.0004 thousandths of an inch

iraphs).

6-3A Armature Shaft OD - Com End 5.011 mm

6-3B Armature Shaft OD - Impeller End 4.297 mm

6-3C Outlet Bearing ID 5.092 mm

6-3D Impeller Bearing ID Top 4.666 mm

6-3E Impeller Bearing ID Bottom 4.627 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	10.992 mm
Brush 2	10.898 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0003 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.869

Sample ID 1M445-67

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

1.7 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? N/A Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.006 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.02	1 to 5	0.2
2 to 3	0.12	2 to 6	0.0111
3 to 4	0.09	3 to 7	0.12
4 to 5	0.24	4 to 8	0.03
5 to 6	0.022		
6 to 7	0.01		
7 to 8	0.03		
8 to 1	0.05		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.011 mm

6-3B Armature Shaft OD - Impeller End 4.299 mm

6-3C Outlet Bearing ID 5.088 mm

6-3D Impeller Bearing ID Top 4.62 mm

6-3E Impeller Bearing ID Bottom 4.618 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	10.993 mm
Brush 2	10.889 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0002 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.77

Sample ID 1M445-68

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

0.013 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 29.11 LPH

Current = 8.76 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 412.12 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 130.23 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.12	1 to 5	0.15
2 to 3	0.01	2 to 6	0.022
3 to 4	0.031	3 to 7	0.011
4 to 5	0.001	4 to 8	0.033
5 to 6	0.04		
6 to 7	0.08		
7 to 8	0.009		
8 to 1	0.011		

6-2 Com segment run-out N/A thousandths of an inch

iraphs).

6-3A Armature Shaft OD - Com End 5.001 mm

6-3B Armature Shaft OD - Impeller End 4.299 mm

6-3C Outlet Bearing ID 5.031 mm

6-3D Impeller Bearing ID Top 4.666 mm

6-3E Impeller Bearing ID Bottom 4.616 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 10.677 mm

Brush 2 10.598 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness N/A mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.881

Sample ID 1M445-69

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Damage

2 Check the resistance of the fuel pump

0.001 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? No Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	2.25	1 to 5	1.45
2 to 3	0.148	2 to 6	0.13
3 to 4	2.65	3 to 7	0.471
4 to 5	2.16	4 to 8	0.27
5 to 6	2.78		
6 to 7	0.12		
7 to 8	0.147		
8 to 1	0.276		

6-2 Com segment run-out 0.0017 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.007 mm

6-3B Armature Shaft OD - Impeller End 5.011 mm

6-3C Outlet Bearing ID 4.939 mm

6-3D Impeller Bearing ID Top 5.014 mm

6-3E Impeller Bearing ID Bottom 4.365 mm

6-3F Note conditon and take photographs.

Melted Armature, Lots of Corrosion

6-4 Brush length - % length remaining

Brush 1	N/A	mm
Brush 2	N/A	mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Non	?
Brush 2	Visible	?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.005 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.778

Sample ID 1M445-70

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

3.6 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow =	N/A	LPH
Current =	N/A	AMPS
Leakage?	N/A	

3-3 Is current draw continuous? N/A Y/N

3-4 Pump Relief Pressure. N/A kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

5.6 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	N/A	1 to 5	N/A
2 to 3	N/A	2 to 6	N/A
3 to 4	N/A	3 to 7	N/A
4 to 5	N/A	4 to 8	N/A
5 to 6	N/A		
6 to 7	N/A		
7 to 8	N/A		
8 to 1	N/A		

6-2 Com segment run-out N/A thousandths of an inch

graphs).

6-3A	Armature Shaft OD - Com End	5.013 mm
6-3B	Armature Shaft OD - Impeller End	4.992 mm
6-3C	Outlet Bearing ID	5.079 mm
6-3D	Impeller Bearing ID Top	4.929 mm
6-3E	Impeller Bearing ID Bottom	4.933 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1	N/A	mm
Brush 2	N/A	mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1	Photos	?
Brush 2	Recorded	?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness N/A mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.765

Sample ID 1M445-71

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Corrosion Damage

2 Check the resistance of the fuel pump

2.1 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 26.15 LPH

Current = 8.89 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 498.17 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 160.17 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.001 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.013	1 to 5	0.002
2 to 3	0.05	2 to 6	0.022
3 to 4	0.09	3 to 7	0.031
4 to 5	0.12	4 to 8	0.001
5 to 6	0.03		
6 to 7	0.024		
7 to 8	0.011		
8 to 1	0.013		

6-2 Com segment run-out 0.0005 thousandths of an inch

graphs).

6-3A Armature Shaft OD - Com End 5.011 mm

6-3B Armature Shaft OD - Impeller End 4.296 mm

6-3C Outlet Bearing ID 5.081 mm

6-3D Impeller Bearing ID Top 4.619 mm

6-3E Impeller Bearing ID Bottom 4.618 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 10.933 mm

Brush 2 10.887 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.769

Sample ID 1M445-72

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Corrosion Damage

2 Check the resistance of the fuel pump

15.5 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 82.33 LPH

Current = 7.99 AMPS

Leakage? N/A

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 450.17 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: N/A kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

1 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.03	1 to 5	0.001
2 to 3	0.02	2 to 6	0.015
3 to 4	0.085	3 to 7	0.013
4 to 5	0.014	4 to 8	0.022
5 to 6	0.205		
6 to 7	0.003		
7 to 8	0.16		
8 to 1	0.012		

6-2 Com segment run-out 0.0015 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 4.995 mm

6-3B Armature Shaft OD - Impeller End 4.996 mm

6-3C Outlet Bearing ID 5.099 mm

6-3D Impeller Bearing ID Top 4.381 mm

6-3E Impeller Bearing ID Bottom 4.372 mm

6-3F Note conditon and take photographs.

Photos Recorded

6-4 Brush length - % length remaining

Brush 1 10.691 mm

Brush 2 10.623 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos ?

Brush 2 Recorded ?

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.002 mm

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 2.746

Sample ID 2M025-19

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

0.731 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 92.11 LPH

Current = 3.84 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 361.12 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 261.55 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.135 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.311	1 to 5	0.666
2 to 3	0.41	2 to 6	0.679
3 to 4	0.179	3 to 7	0.732
4 to 5	0.23	4 to 8	0.44
5 to 6	0.551		
6 to 7	0.59		
7 to 8	0.612		
8 to 1	0.589		

6-2 Com segment run-out 0.0002 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.008 mm

6-3B Armature Shaft OD - Impeller End 5.006 mm

6-3C Outlet Bearing ID 5.033 mm

6-3D Impeller Bearing ID Top 5.044 mm

6-3E Impeller Bearing ID Bottom 5.047 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 12.005 mm

Brush 2 12.023 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0002 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.807

Sample ID 2M025-20

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

5.43 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 81.79 LPH

Current = 3.77 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 362.15 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 286.13 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

1.35 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.415	1 to 5	0.667
2 to 3	0.398	2 to 6	0.502
3 to 4	0.396	3 to 7	0.793
4 to 5	0.422	4 to 8	0.764
5 to 6	0.501		
6 to 7	0.523		
7 to 8	0.511		
8 to 1	0.324		

6-2 Com segment run-out 0.0002 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.004 mm

6-3B Armature Shaft OD - Impeller End 5.006 mm

6-3C Outlet Bearing ID 5.05 mm

6-3D Impeller Bearing ID Top 5.043 mm

6-3E Impeller Bearing ID Bottom 5.041 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 12.003 mm

Brush 2 12.016 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0002 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.834

Sample ID 2M025-21

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

2.07 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 91.17 LPH

Current = 3.97 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 362.17 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 192.17 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.399 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.585	1 to 5	0.765
2 to 3	0.488	2 to 6	0.512
3 to 4	0.304	3 to 7	0.783
4 to 5	0.453	4 to 8	0.576
5 to 6	0.368		
6 to 7	0.541		
7 to 8	0.362		
8 to 1	0.457		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.008 mm

6-3B Armature Shaft OD - Impeller End 5.005 mm

6-3C Outlet Bearing ID 5.036 mm

6-3D Impeller Bearing ID Top 5.049 mm

6-3E Impeller Bearing ID Bottom 5.05 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 12.003 mm

Brush 2 11.996 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.824

Sample ID 2M025-21

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.
No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM
No Visual Corrosion

2 Check the resistance of the fuel pump

4.23 Ohms

2-1 If open,proceed to Pump Teardown.
2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).
If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the
2-3 FPM.
2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.
Flow = 92.15 LPH
Current = 3.67 AMPS
Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 352.17 kPa

3-5 5 Minute pressure leak down test.
Change in pressure: 233.15 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

1.04 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views
5-2 Carefully remove the fuel pump outer shell.
Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or
5-3 contamination).
5-4 Inspect all the internal pump components keeping in mind the failure tree below:
5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.
5-4b – If closed circuit, but not spinning, look for heat damage, or contamination
5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage
5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.218	1 to 5	0.765
2 to 3	0.326	2 to 6	0.512
3 to 4	0.415	3 to 7	0.783
4 to 5	0.521	4 to 8	0.576
5 to 6	0.334		
6 to 7	0.291		
7 to 8	0.362		
8 to 1	0.457		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.008 mm
6-3B Armature Shaft OD - Impeller End 5.005 mm
6-3C Outlet Bearing ID 5.036 mm
6-3D Impeller Bearing ID Top 5.049 mm
6-3E Impeller Bearing ID Bottom 5.05 mm
6-3F Note conditon and take photographs.
Photos: Recorded

6-4 Brush length - % length remaining
Brush 1 12.003 mm
Brush 2 11.996 mm

6-5 Brush wire condition – take photographs, measure spring force
Brush 1 Photos Spring Force Unavailable
Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon
6-6 current wear rate through 3000 hours)
Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).
Impeller Thickness 3.824

Sample ID 2M025-23

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

2.1 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 86.31 LPH

Current = 3.89 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 361.45 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 278.92 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.7 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to

Segment	Ohms	Cross Com	Ohms
1 to 2	0.231	1 to 5	0.891
2 to 3	0.386	2 to 6	0.792
3 to 4	0.197	3 to 7	0.663
4 to 5	0.208	4 to 8	0.745
5 to 6	0.399		
6 to 7	0.401		
7 to 8	0.506		
8 to 1	0.197		

6-2 Com segment run-out 0.0007 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.0001 mm

6-3B Armature Shaft OD - Impeller End 5.004 mm

6-3C Outlet Bearing ID 5.022 mm

6-3D Impeller Bearing ID Top 5.038 mm

6-3E Impeller Bearing ID Bottom 5.04 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 11.996 mm

Brush 2 12.022 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.826

Sample ID 2M025-24

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

3.14 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the

2-3 FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 86.15 LPH

Current = 3.79 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 352.6 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 168.99 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

1.06 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or

5-3 contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.435	1 to 5	0.777
2 to 3	0.514	2 to 6	0.616
3 to 4	0.601	3 to 7	0.719
4 to 5	0.791	4 to 8	0.85
5 to 6	0.542		
6 to 7	0.352		
7 to 8	0.236		
8 to 1	0.298		

6-2 Com segment run-out 0.0003 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.01 mm

6-3B Armature Shaft OD - Impeller End 5.008 mm

6-3C Outlet Bearing ID 5.033 mm

6-3D Impeller Bearing ID Top 5.041 mm

6-3E Impeller Bearing ID Bottom 5.041 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 12.001 mm

Brush 2 11.998 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon

6-6 current wear rate through 3000 hours)

Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.829

Sample ID 2M025-25

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

42.22 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the

2-3 FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 89.2 LPH

Current = 3.52 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 352.19 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 219.15 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

1.25 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or

5-3 contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.56	1 to 5	0.666
2 to 3	0.497	2 to 6	0.679
3 to 4	0.488	3 to 7	0.879
4 to 5	0.512	4 to 8	0.911
5 to 6	0.606		
6 to 7	0.601		
7 to 8	0.597		
8 to 1	0.518		

6-2 Com segment run-out 0.0003 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.005 mm

6-3B Armature Shaft OD - Impeller End 5.016 mm

6-3C Outlet Bearing ID 5.069 mm

6-3D Impeller Bearing ID Top 5.037 mm

6-3E Impeller Bearing ID Bottom 5.039 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 11.997 mm

Brush 2 12.007 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon

6-6 current wear rate through 3000 hours)

Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.815

Sample ID 2M025-26

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

48.02 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 92.81 LPH

Current = 3.43 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 363.71 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 252.68 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.663 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.401	1 to 5	0.607
2 to 3	0.497	2 to 6	0.61
3 to 4	0.488	3 to 7	0.637
4 to 5	0.521	4 to 8	0.598
5 to 6	0.532		
6 to 7	0.51		
7 to 8	0.597		
8 to 1	0.405		

6-2 Com segment run-out 0.0002 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.009 mm

6-3B Armature Shaft OD - Impeller End 5.012 mm

6-3C Outlet Bearing ID 5.069 mm

6-3D Impeller Bearing ID Top 5.03 mm

6-3E Impeller Bearing ID Bottom 5.028 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 11.992 mm

Brush 2 12.001 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon

6-6 current wear rate through 3000 hours)

Com Thickness 0.0003 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.901

Sample ID 2M025-27

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

38.6 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the

2-3 FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 89.22 LPH

Current = 3.67 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 360.19 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 187.19 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.403 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or

5-3 contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.567	1 to 5	0.603
2 to 3	0.428	2 to 6	0.612
3 to 4	0.422	3 to 7	0.675
4 to 5	0.328	4 to 8	0.661
5 to 6	0.311		
6 to 7	0.379		
7 to 8	0.493		
8 to 1	0.389		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.008 mm

6-3B Armature Shaft OD - Impeller End 5.009 mm

6-3C Outlet Bearing ID 5.108 mm

6-3D Impeller Bearing ID Top 5.04 mm

6-3E Impeller Bearing ID Bottom 5.042 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 12.003 mm

Brush 2 12.001 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon

6-6 current wear rate through 3000 hours)

Com Thickness 0.0004 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.813

Sample ID 2M025-28

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

37.28 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 82.16 LPH

Current = 3.48 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 450.16 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 219.66 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

1.9 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.255	1 to 5	1.3
2 to 3	0.544	2 to 6	0.773
3 to 4	0.602	3 to 7	0.649
4 to 5	0.48	4 to 8	1.06
5 to 6	0.466		
6 to 7	0.395		
7 to 8	0.592		
8 to 1	0.571		

6-2 Com segment run-out 0.0002 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.004 mm

6-3B Armature Shaft OD - Impeller End 5.008 mm

6-3C Outlet Bearing ID 5.029 mm

6-3D Impeller Bearing ID Top 5.042 mm

6-3E Impeller Bearing ID Bottom 5.039 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 11.99 mm

Brush 2 12.006 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.823

Sample ID 2M025-29

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

0.185 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 92.15 LPH

Current = 3.6 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 354.65 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 263.35 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.612 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.56	1 to 5	0.578
2 to 3	0.256	2 to 6	0.921
3 to 4	0.323	3 to 7	0.729
4 to 5	0.634	4 to 8	0.833
5 to 6	0.282		
6 to 7	0.216		
7 to 8	0.425		
8 to 1	0.421		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.008 mm

6-3B Armature Shaft OD - Impeller End 5.007 mm

6-3C Outlet Bearing ID 5.04 mm

6-3D Impeller Bearing ID Top 5.071 mm

6-3E Impeller Bearing ID Bottom 5.069 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 12.016 mm

Brush 2 11.999 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0001 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

Impeller Thickness 3.826

Sample ID 2M025-30

1 If FPM Fails to Provide Fuel Flow

1-1 Visually check over the FPM for any physical damage. Are there any signs of impact (loose guide rods, broken flange bosses, broken float arm, etc.

No Visual Damage

1-2 Look for signs of contamination, and corrosion especially inside the reservoir, or on any pre-filters. A complete description of the findings with photographs is necessary on the FPM

No Visual Corrosion

2 Check the resistance of the fuel pump

0.303 Ohms

2-1 If open,proceed to Pump Teardown.

2-2 If closed, Check to see if the pump will spin freely with a low voltage source in air (9 Volt source).

2-3 If the pump does spin freely in air, and there are not any obvious signs of contamination, proceed to Functionally test the FPM.

2-4 If the pump does not spin freely in air, proceed to Pump Teardown.

3 FPM Functional Tests (run tests in E0)

3-1 Test at Normal Function Test Parameters:

3-2 Measure flow, and pressure (grams per second, and kPa), checking for obvious signs of leakage.

Flow = 72.16 LPH

Current = 3.52 AMPS

Leakage? No Visual Leakage

3-3 Is current draw continuous? Yes Y/N

3-4 Pump Relief Pressure. 350.14 kPa

3-5 5 Minute pressure leak down test.

Change in pressure: 266.15 kPa

3-6 If there are no issues with the testing above, proceed to fuel pump tear down

4 Recheck resistance after functional / flow tests

0.718 Ohms

5 Pump Teardown

5-1 Remove the fuel pump from the module. Photograph each pump component a minimum of 3 separate views

5-2 Carefully remove the fuel pump outer shell.

5-3 Carefully disassemble the fuel pump inspecting each piece as it is removed (look for signs of unusual wear, heat damage, or contamination).

5-4 Inspect all the internal pump components keeping in mind the failure tree below:

5-4a – If open circuit, pay close attention to electrical commutation circuit, brushes, shunt wires, coils, etc.

5-4b – If closed circuit, but not spinning, look for heat damage, or contamination

5-4c – If spinning, but no flow look for decoupled armature, or impeller drive slot damage

5-4d – If leak down at the pump level investigate check valve for contamination, or damage

6 Pump Teardown dimensional information. Compare all dimensions to print.

6-1 Com resistance values – cross com and segment to segment values

Segment to Segment	Ohms	Cross Com	Ohms
1 to 2	0.219	1 to 5	1.9
2 to 3	0.265	2 to 6	0.75
3 to 4	0.284	3 to 7	0.606
4 to 5	0.242	4 to 8	0.621
5 to 6	0.242		
6 to 7	0.218		
7 to 8	0.513		
8 to 1	0.201		

6-2 Com segment run-out 0.0001 thousandths of an inch

graphs)

6-3A Armature Shaft OD - Com End 5.009 mm

6-3B Armature Shaft OD - Impeller End 5.009 mm

6-3C Outlet Bearing ID 5.044 mm

6-3D Impeller Bearing ID Top 5.073 mm

6-3E Impeller Bearing ID Bottom 5.071 mm

6-3F Note conditon and take photographs.

Photos: Recorded

6-4 Brush length - % length remaining

Brush 1 12.003 mm

Brush 2 11.593 mm

6-5 Brush wire condition – take photographs, measure spring force

Brush 1 Photos Spring Force Unavailable

Brush 2 Recorded Spring Force Unavailable

6-6 Com wear - thickness loss in % –Estimate end of life (to the minimum recommended performance, e.g. in hours based upon current wear rate through 3000 hours)

Com Thickness 0.0002 thousandths of an inch

6-7 Impeller thickness (note galling or wear conditions on housing / impeller with photographs).

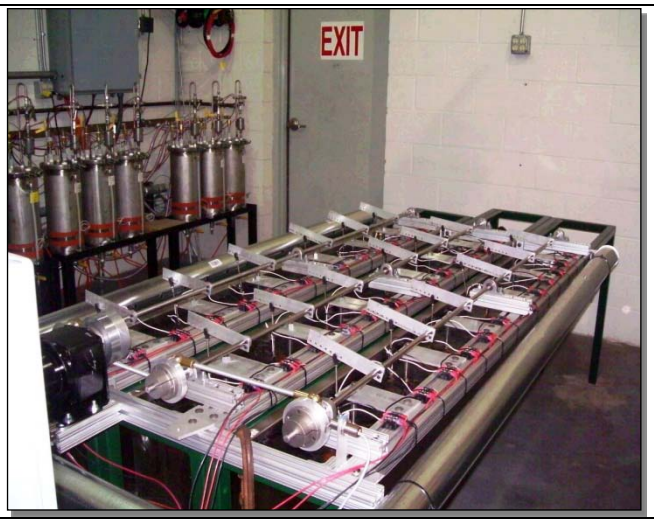
Impeller Thickness 3.826

A8: Fuel sender test procedure

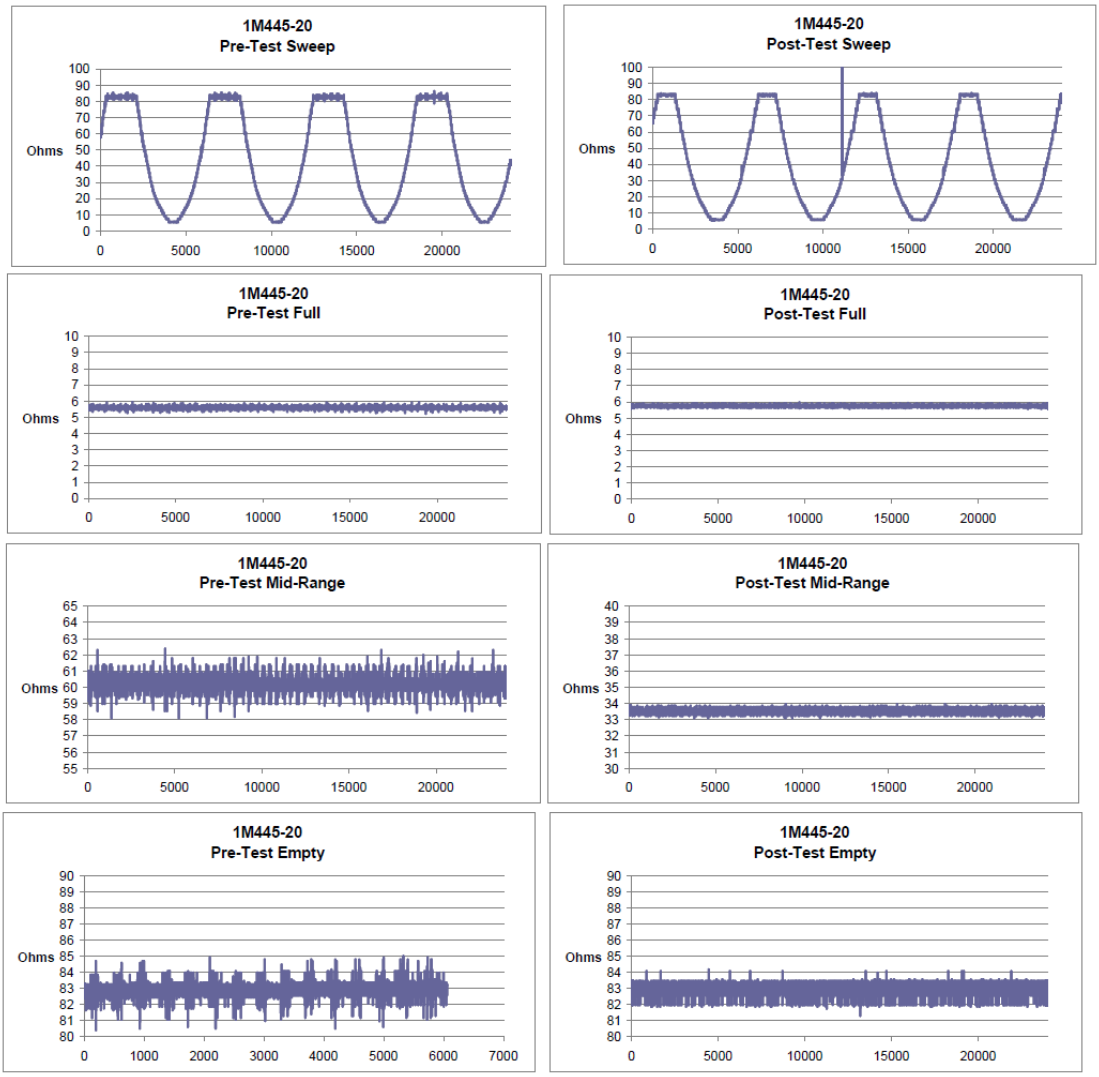
CRC AVFL-15a Fuel Level Sender Testing

I. Fuel Resistance Test
    a. Fuel sensors shall be tested using the cycle/soak test described below except as noted. Senders shall be kept wet and contacts held stationary after durability test (no cycling) until electrical tests are complete.
        i. Cycle 250,000 cycles in test fuel at a cycle rate between 1 and 2 cycles/sec. Sender powered.
        ii. Soak in test fuel for 1 week. Sender not powered.
        iii. Repeat steps (i) and (ii) for a total of 1,000,000 cycles and 4 weeks of static soaks, ending with the 4^{th} static soak.
    b. Notes:
        i. Senders not powered unless otherwise specified.
        ii. Fuels shall be changed (not refreshed). Duration between fuel changes shall be no greater than 168 hours.
        iii. When soaking, assemblies shall be completely covered in test fuel.
        iv. Cycle senders through full range by dipping unit with float assembly in test fuel. Alternatively, mechanically cycle sender with assembly completely covered in test fuel.
        v. Take an 8 oz. fuel sample prior to every fuel change and test
II. Full Sweep Test
    a. The fuel sensor shall withstand 5 million full sweep cycles at +25 to +30° C.
    b. The recommended sweep rate is 1 cycle per second.
    c. The level senders should be powered by the standard level sender circuit.
    d. Notes:
        i. Senders not powered unless otherwise specified.
        ii. Fuels shall be changed (not refreshed). Duration between fuel changes shall be no greater than 168 hours.
        iii. When soaking, assemblies shall be completely covered in test fuel.
        iv. Cycle senders through full range by dipping unit with float assembly in test fuel. Alternatively, mechanically cycle sender with assembly completely covered in test fuel.
        v. Take an 8 oz. fuel sample prior to every fuel change and test
III. Post Mortem
    a. Photograph card, contacts, etc. (high resolution)

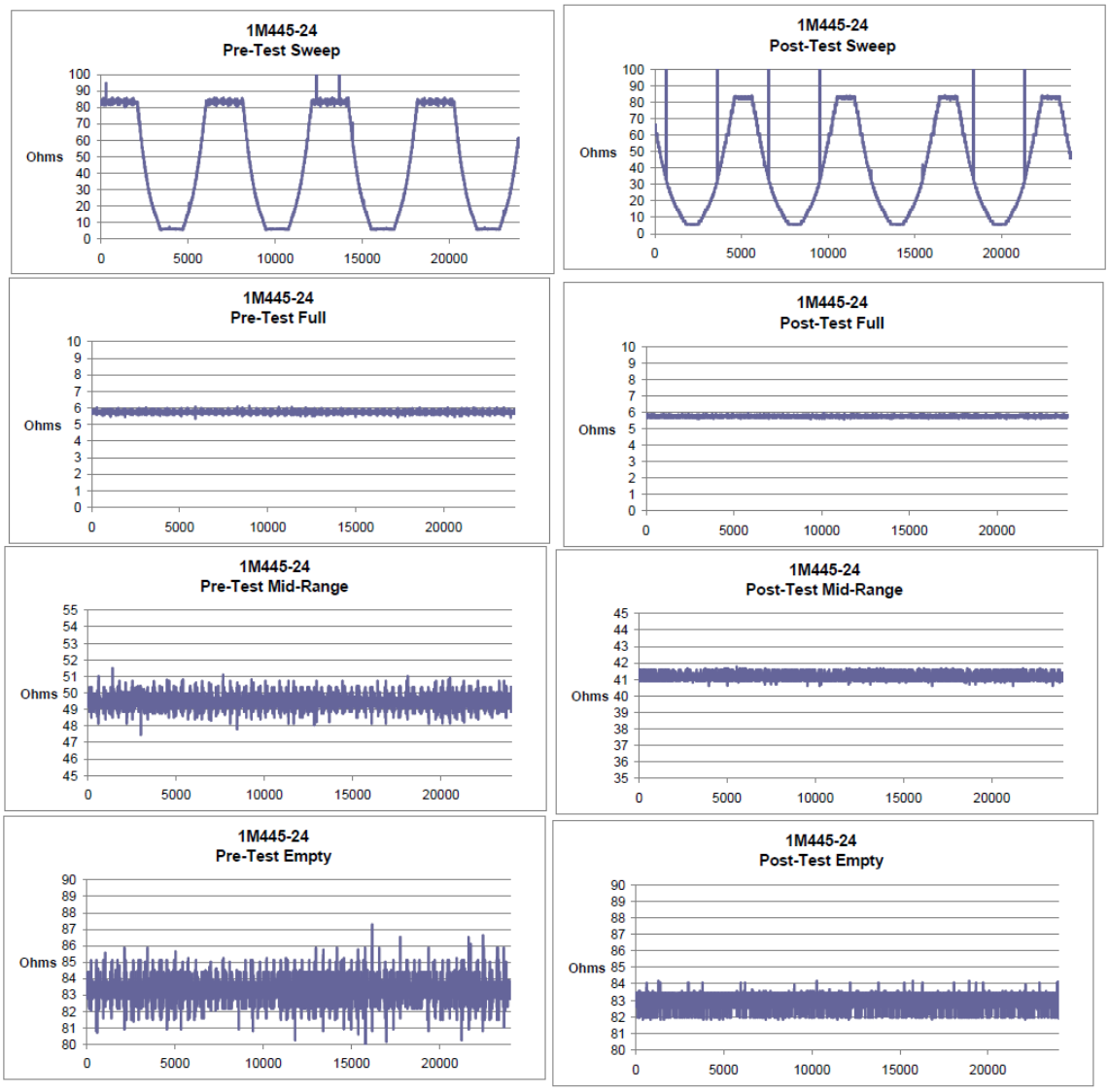
CRC AVFL-15a Fuel Level Sender Testing


EXIT

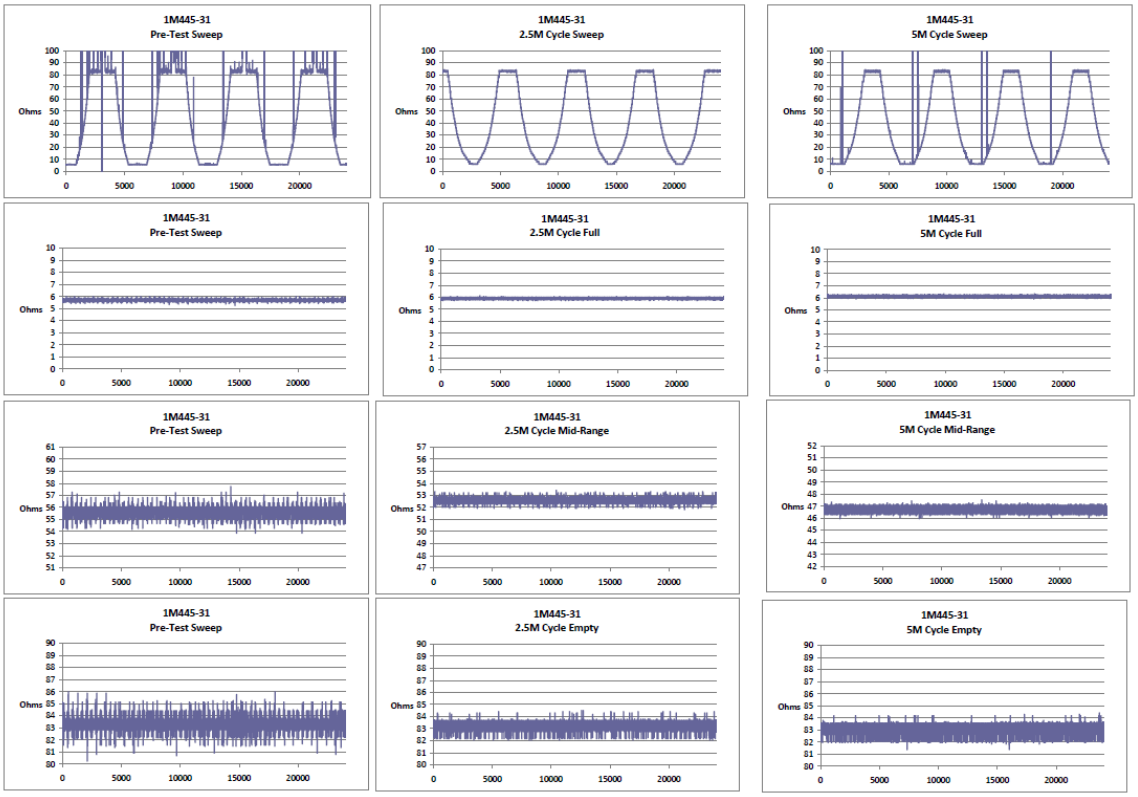
A9: Fuel sender data



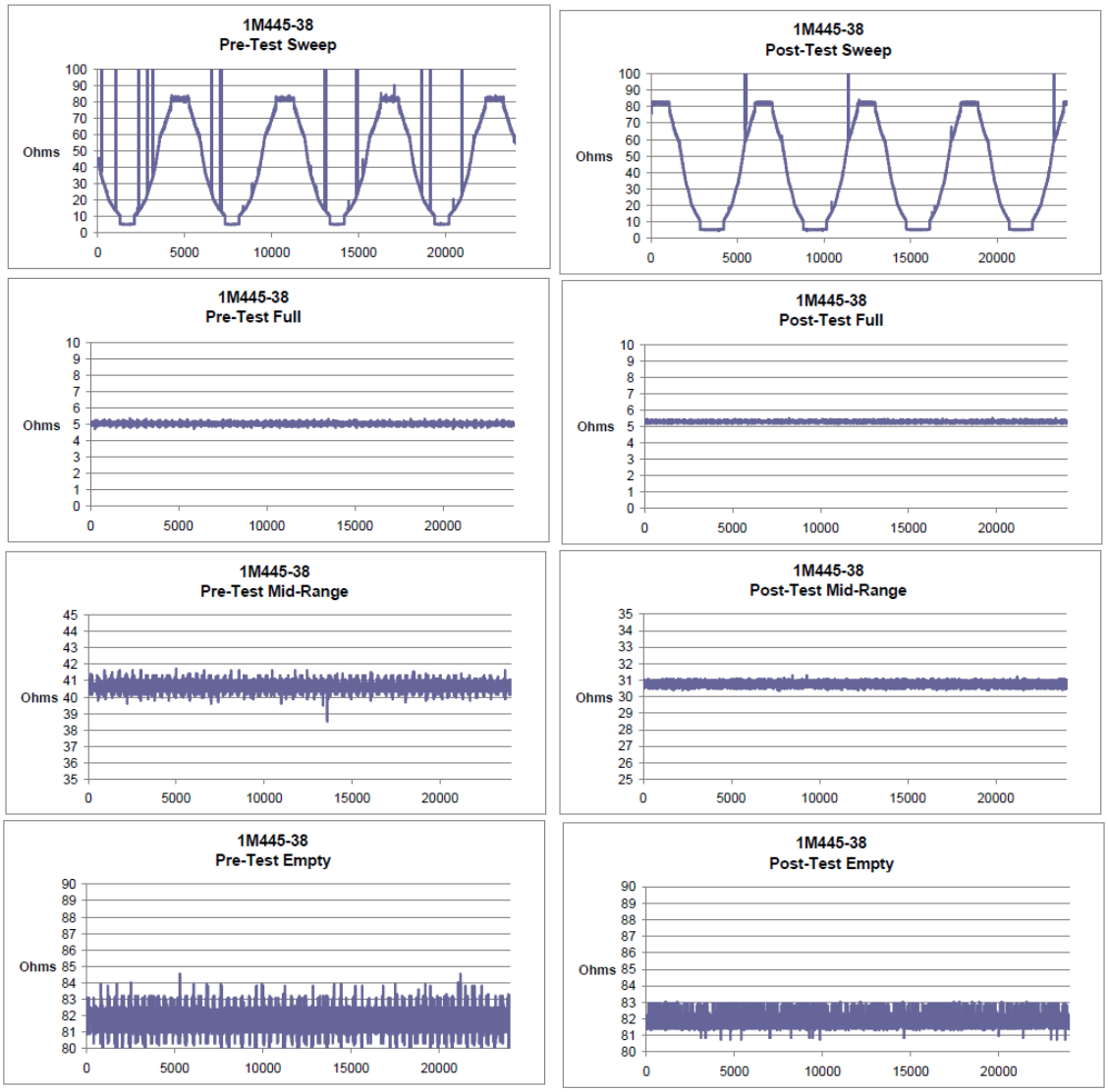
Fuel Level Sender Fuel Resistance **Sender "L"** (E_{15a} Test Fuel)



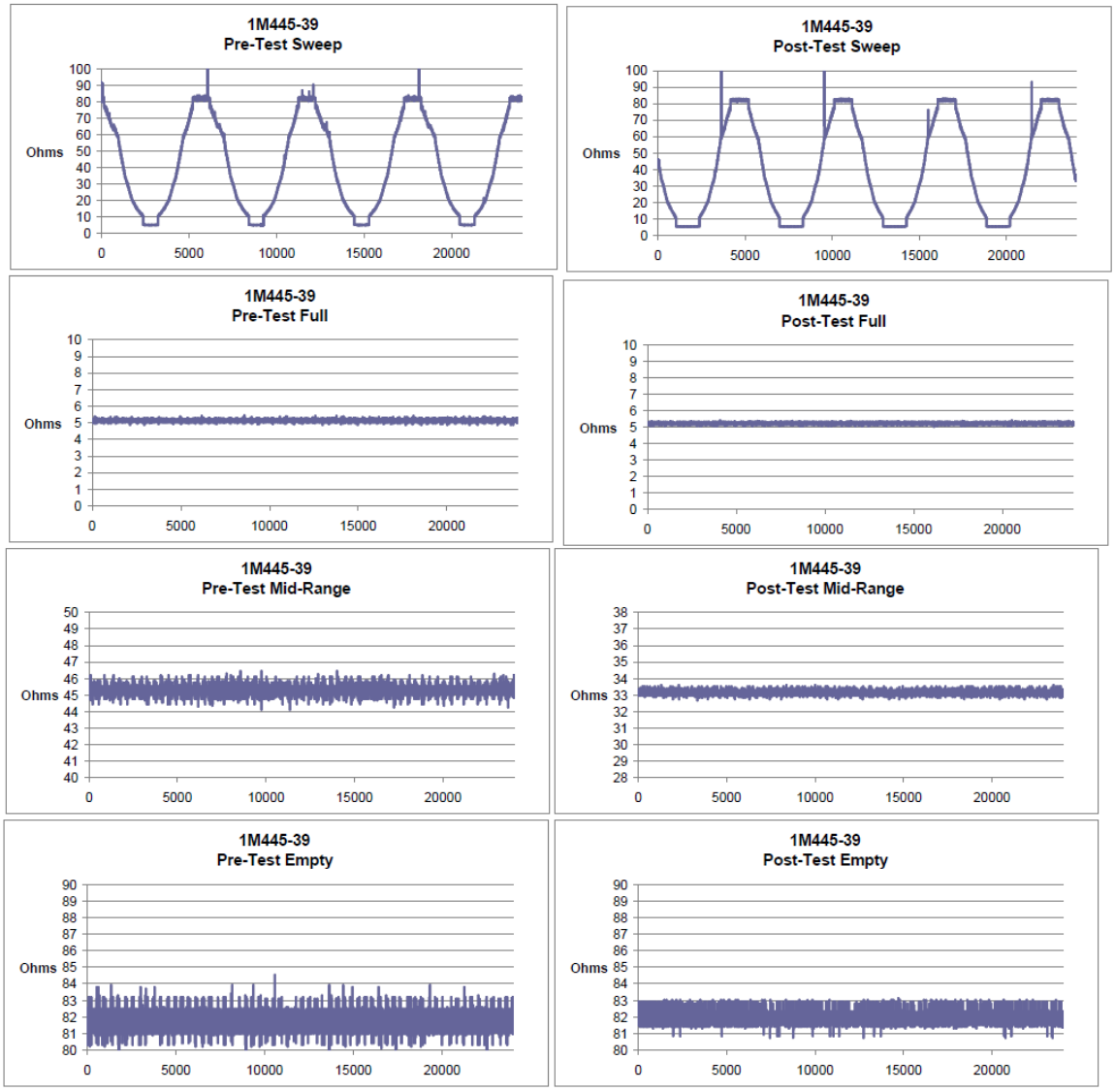
Fuel Level Sender Fuel Resistance **Sender "L"** (E_{15a} Test Fuel)



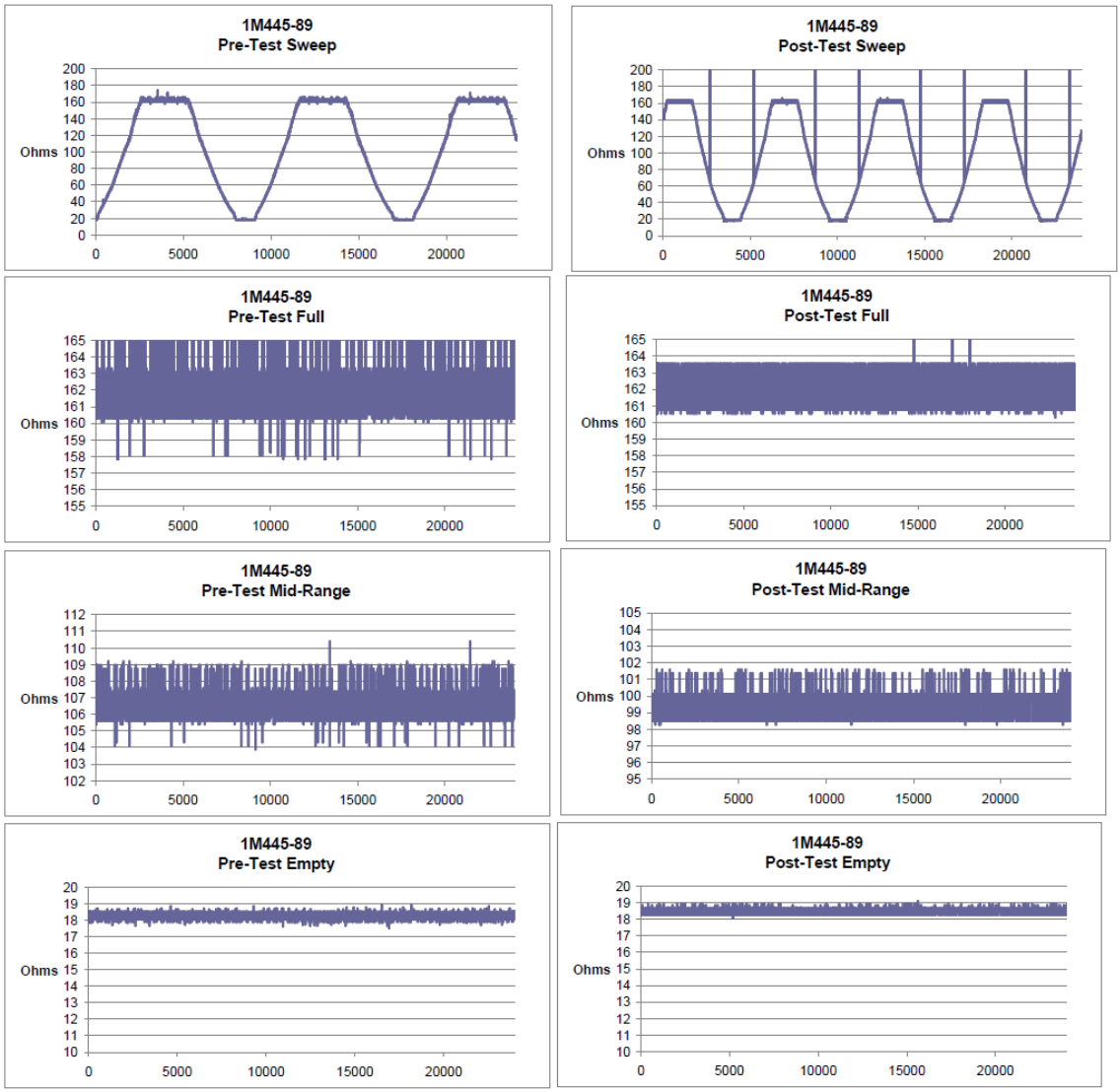
Fuel Level Sender Sweep **Sender "L"** (E_{15a} Test Fuel)



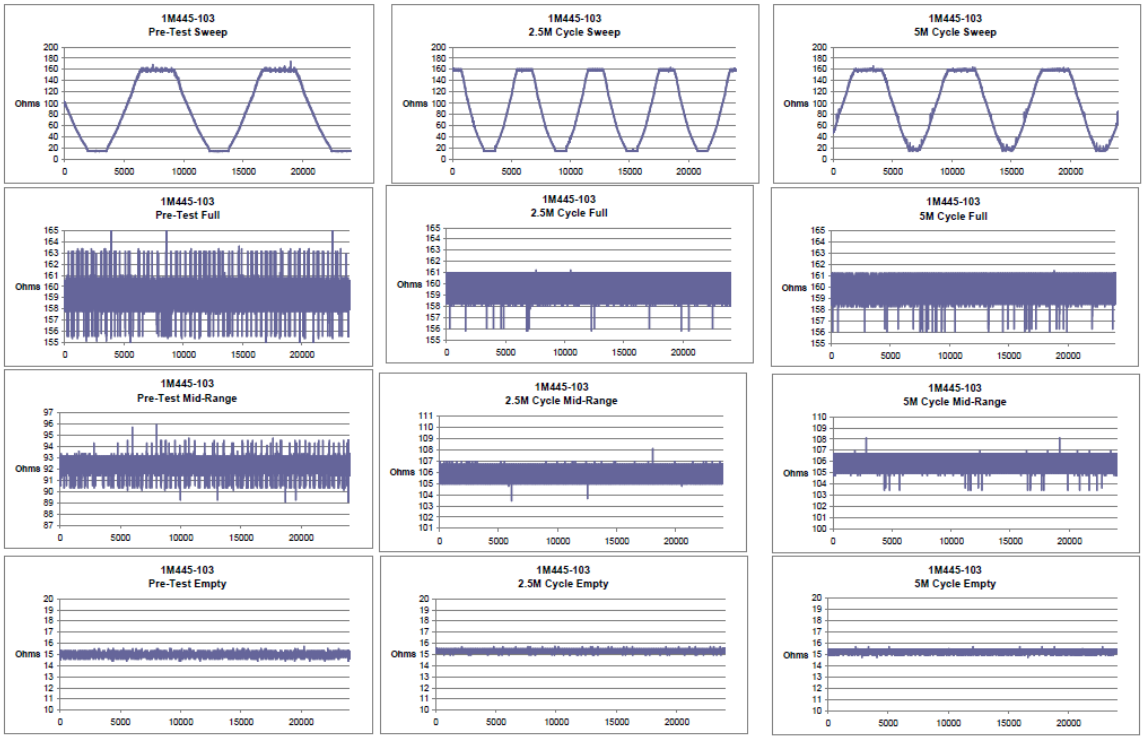
Fuel Level Sender Fuel Resistance **Sender "C"** (E_{15} Test Fuel)



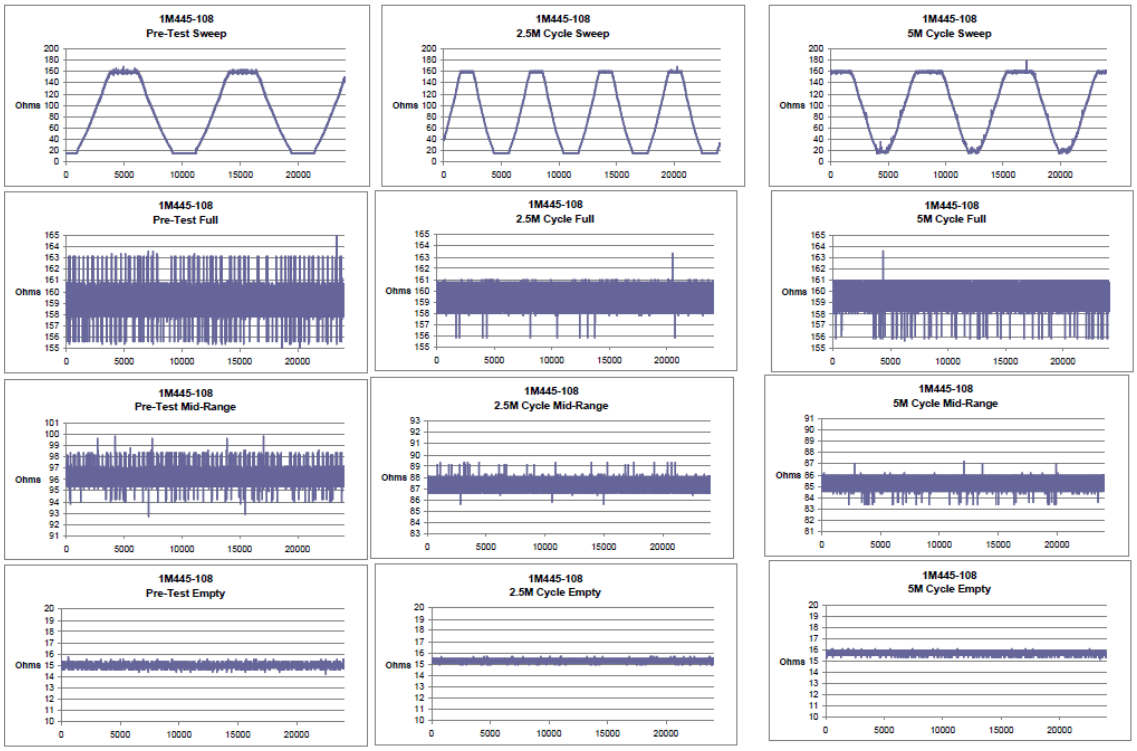
Fuel Level Sender Fuel Resistance **Sender "C"** (E_{15} Test Fuel)



Fuel Level Sender Fuel Resistance Sender "N" (E_{15} Test Fuel)



Fuel Level Sender Sweep Sender "N" (E_{15a} Test Fuel)



Fuel Level Sender Sweep Sender "N" (E_{15a} Test Fuel)

A10: Sender card photographs

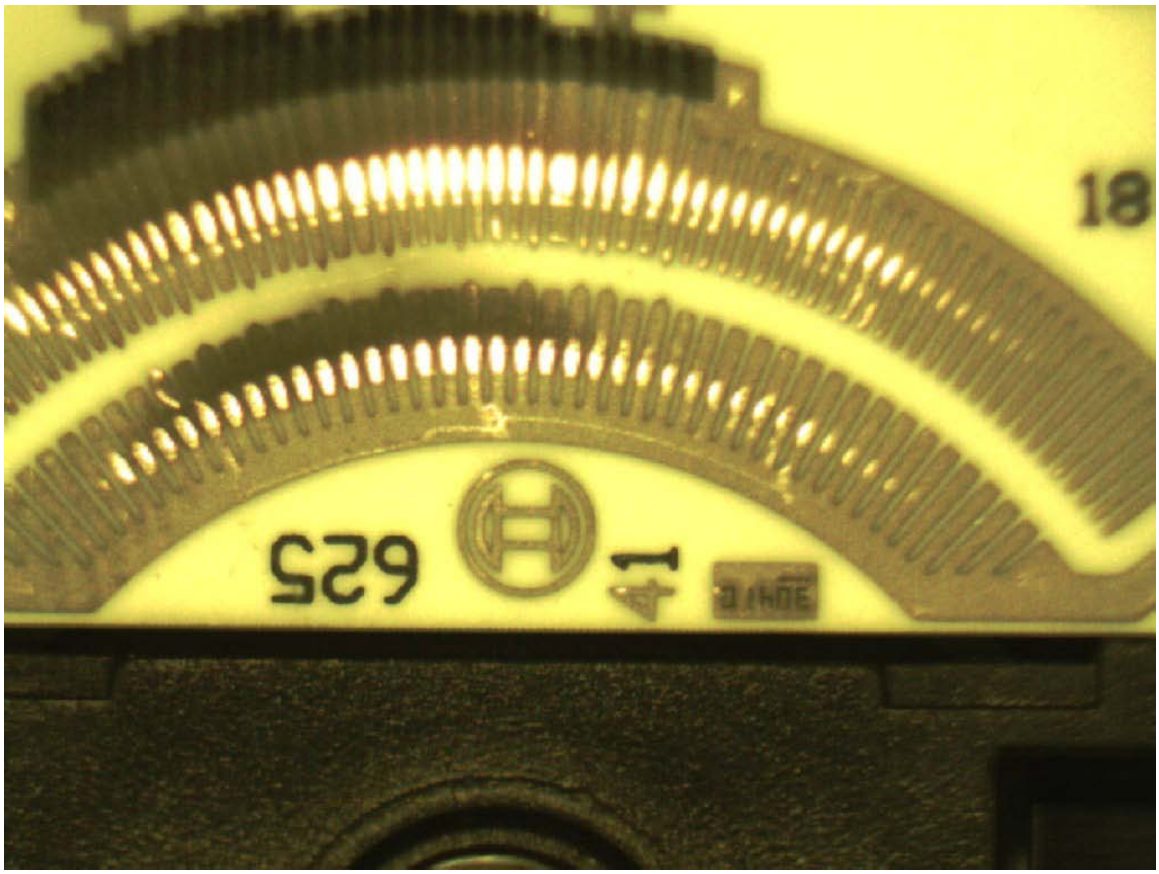


Photo of sender card from sample 20 - Fuel Level Sender Fuel Resistance **Sender "L"** (E_{15a} Test Fuel)

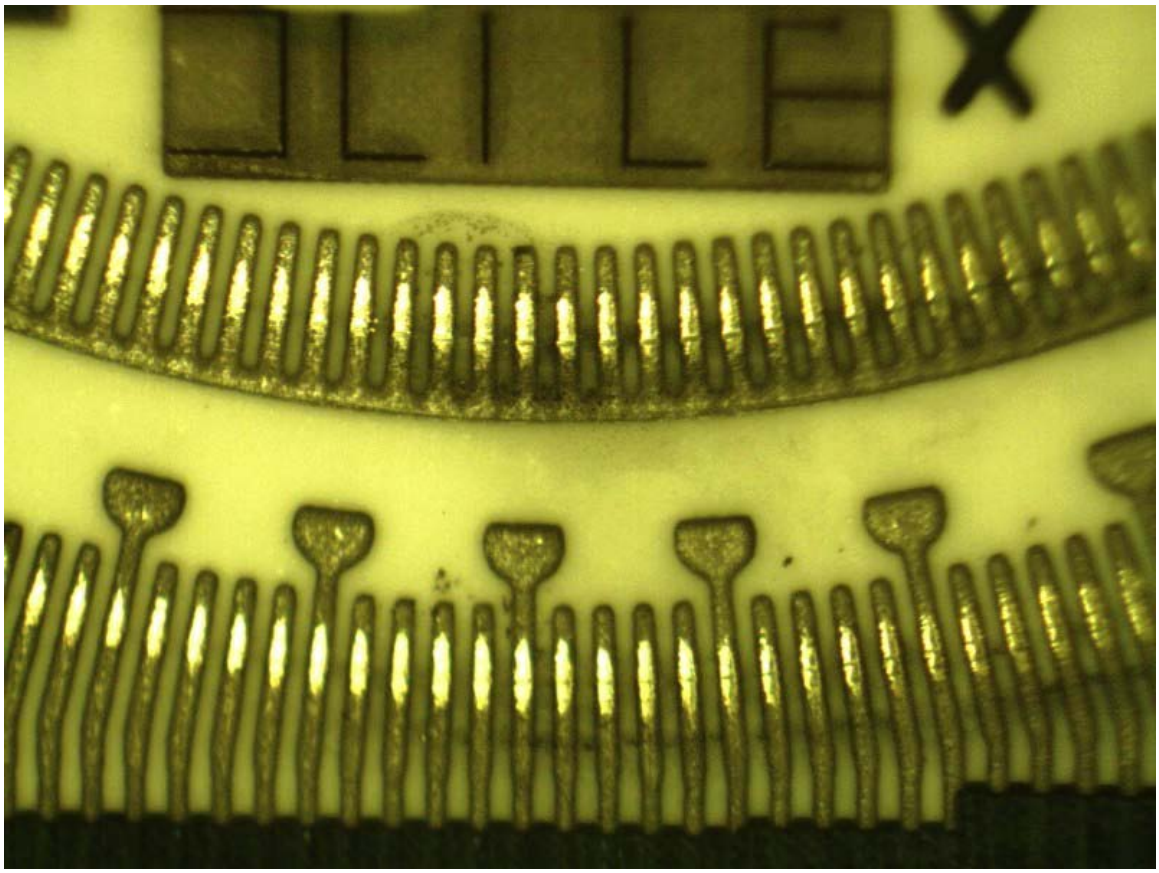


Photo of sender card from sample 38 - Fuel Level Sender Fuel Resistance **Sender "C"** (E_{15} Test Fuel)

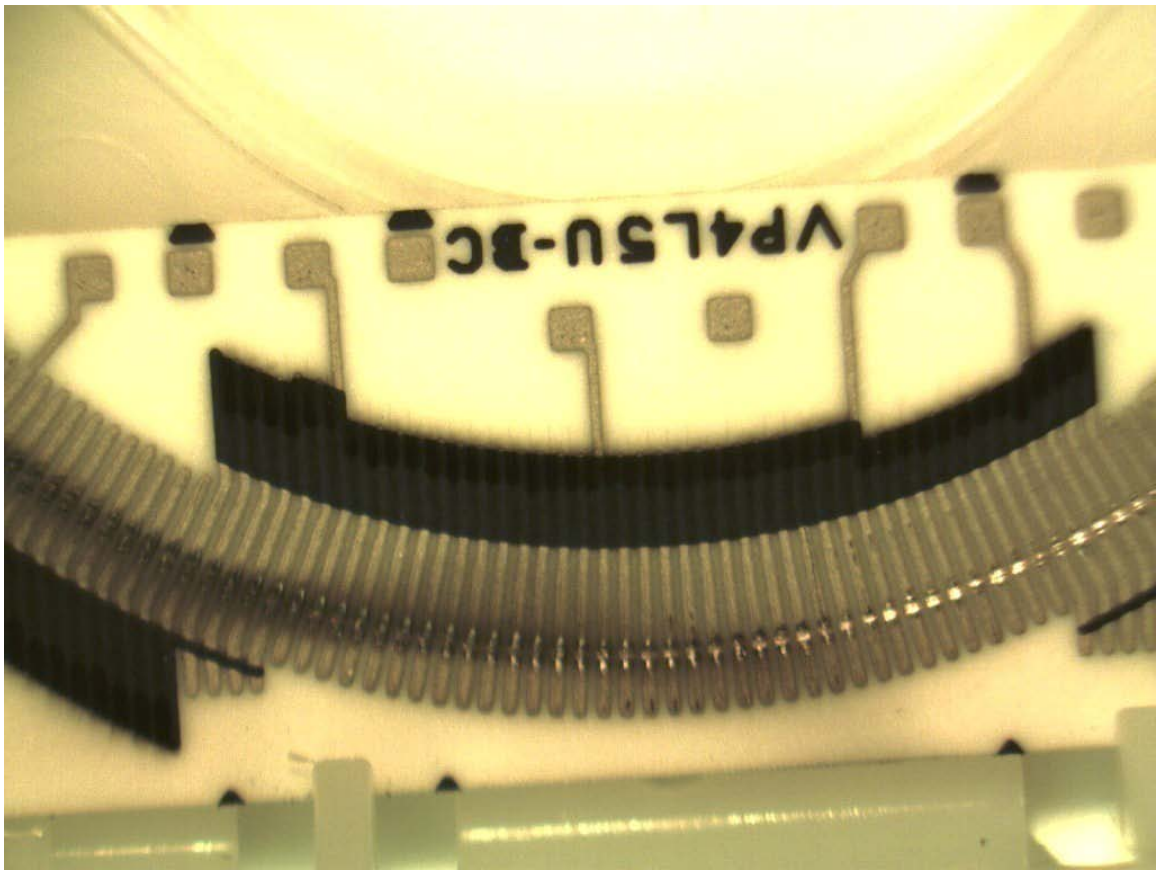


Photo of sender card - Fuel Level Sender Fuel Resistance Sender “N” (E_{15} Test Fuel)

A11: About TSG

Testing Services Group (TSG) is a member in good standing with the ANSI-ASQ National Accreditation Board/ACLASS (Certificate #AT-1389) under “Testing” which accredits to ISO/IEC 17025:2005. TSG has also earned the prestigious "Q1" supplier distinction from Ford Motor Company in 2004 and has maintained that status plus has added several other accreditations with other quality rating organizations. They are as follows:

Company Certifications:
ACLASS (Certificate # AT-1389)
APLAC – Asia Pacific Laboratory Accreditation Cooperation
EA – European Cooperation for Accreditation
ILAC – International Laboratory Accreditation Cooperation
IAAC – Inter-American Accreditation Cooperation
Ford Quality 1
ABYC – American Boat and Yacht Council
IMCI – International Marine Certification Institute
California Fire Marshal

A12: Certificates of Analysis for test fuels

Acceptance data E_{15} test fuel.

Gage Products Company
Certificate of Analysis / QC Results

Page: 1
Date: 06/22/11 at 5:37 PM

Customer PO # :

Packaged Product: 41255-55F
CRC AVFL-15a E15 Gasoline

Property	Test Method	UOM	Specification	Value
SPECIFIC GRAVITY @ 60F	ASTM D4052	REPORT	REPORT	0.7662
RVP @ 100F	ASTM D5191	PSI	REPORT	8.37
ETHANOL	ASTM D6730	VOL. %	14.70 - 15.30	14.83
DISTILLATION, IBP	ASTM D86	DEG F	REPORT	103.6
DISTILLATION, 5%	ASTM D86	DEG F	REPORT	123.4
DISTILLATION, 10%	ASTM D86	DEG F	REPORT	132.1
DISTILLATION, 20%	ASTM D86	DEG F	REPORT	144.0
DISTILLATION, 30%	ASTM D86	DEG F	REPORT	153.1
DISTILLATION, 40%	ASTM D86	DEG F	REPORT	159.6
DISTILLATION, 50%	ASTM D86	DEG F	REPORT	169.0
DISTILLATION, 60%	ASTM D86	DEG F	REPORT	233.1
DISTILLATION, 70%	ASTM D86	DEG F	REPORT	251.6
DISTILLATION, 80%	ASTM D86	DEG F	REPORT	275.2
DISTILLATION, 90%	ASTM D86	DEG F	REPORT	322.0
DISTILLATION, 95%	ASTM D86	DEG F	REPORT	353.5
DISTILLATION, DP	ASTM D86	DEG F	REPORT	403.9
RECOVERY	ASTM D86	VOL.%	REPORT	97.7
RESIDUE	ASTM D86	VOL.%	REPORT	1.0
LOSS	ASTM D86	VOL.%	REPORT	1.3

Lot # 2797800 Made 05/20/11

In sealed unopened containers this product is good until 10/28/11

Approved By: Robert Ratzlaff

Acceptance data E_{15a} test fuel.

Gage Products Company
Certificate of Analysis / QC Results

Page: 1
Date: 06/22/11 at 5:21 PM

Customer PO # :

Packaged Product: 41257-55C
CRC AVFL-15a E15 Gasoline

Property	Test Method	UOM	Specification	Value
WATER CONTENT	ASTM E1064	VOL. %	1, MAX.	0.145
PEROXIDE CONTENT	ASTM D3703	PPM	REPORT	2.68
ACID NUMBER	ASTM D974	MG KOH/G	REPORT	0.0017
RVP @ 100F	ASTM D5191	PSI	REPORT	8.41
TOTAL SULFUR	ASTM D5453	PPM	REPORT	14.41
ETHANOL	ASTM D6730	VOL. %	14.70 - 15.30	14.70
INORGANIC CHLORIDE CONTENT	ION CHROMATOGRAPHY	PPM	REPORT	1.63
NITRATE CONTENT	IC	PPM	REPORT	2.34
TOTAL SULFATE CONTENT	ION CHROMATOGRAPHY	PPM	REPORT	0.51
SPECIFIC GRAVITY @ 60F	ASTM D4052	REPORT	REPORT	0.7658
AROMATICS	ASTM D6730	VOL. %	REPORT	34.6
OLEFINS	ASTM D6730	VOL. %	REPORT	4.3
SATURATES	ASTM D6730	VOL. %	REPORT	46.4
BENZENE	ASTM D6730	VOL. %	REPORT	0.31
TOLUENE	ASTM D6730	VOL. %	REPORT	14.9
DISTILLATION, IBP	ASTM D86	DEG F	REPORT	102.2
DISTILLATION, 5%	ASTM D86	DEG F	REPORT	122.0
DISTILLATION, 10%	ASTM D86	DEG F	REPORT	136.0
DISTILLATION, 20%	ASTM D86	DEG F	REPORT	143.2
DISTILLATION, 30%	ASTM D86	DEG F	REPORT	152.8
DISTILLATION, 40%	ASTM D86	DEG F	REPORT	159.4
DISTILLATION, 50%	ASTM D86	DEG F	REPORT	166.1
DISTILLATION, 60%	ASTM D86	DEG F	REPORT	232.2
DISTILLATION, 70%	ASTM D86	DEG F	REPORT	251.4
DISTILLATION, 80%	ASTM D86	DEG F	REPORT	275.9
DISTILLATION, 90%	ASTM D86	DEG F	REPORT	319.8
DISTILLATION, 95%	ASTM D86	DEG F	REPORT	352.9
DISTILLATION, DP	ASTM D86	DEG F	REPORT	399.6
RECOVERY	ASTM D86	VOL.%	REPORT	97.7
RESIDUE	ASTM D86	VOL.%	REPORT	1.0
LOSS	ASTM D86	VOL.%	REPORT	1.3

Lot # 2888301 Made 05/27/11

In sealed unopened containers this product is good until 11/27/11

Approved By: Robert Pettitt

Acceptance data E_0 used for flow test fuel

Gage Products Company
Certificate of Analysis / QC Results

Page: 1
Date: 06/22/11 at 5:36 PM

Customer PO # :

Packaged Product: 41254-85F
CRC AVFL-15a E0 Gasoline

Property	Test Method	UOM	Specification	Value
RESEARCH OCTANE NUMBER	ASTM D2699	RON	REPORT	91.5
MOTOR OCTANE NUMBER	ASTM D2700	MON	REPORT	82.1
SPECIFIC GRAVITY @ 60F	ASTM D4052	REPORT	REPORT	0.7627
RVP @ 100F	ASTM D5191	PSI	REPORT	7.43
TOTAL SULFUR	ASTM D5453	PPM	80, MAX.	16.4
OXIDATION STABILITY	ASTM D525	MIN.	240, MIN.	>960
AROMATICS	ASTM D6730	VOL. %	REPORT	41.2
OLEFINS	ASTM D6730	VOL. %	REPORT	5.2
SATURATES	ASTM D6730	VOL. %	REPORT	52.7
BENZENE	ASTM D6730	VOL. %	REPORT	0.3
TOLUENE	ASTM D6730	VOL. %	REPORT	18.8
DISTILLATION, IBP	ASTM D86	DEG F	REPORT	98.8
DISTILLATION, 5%	ASTM D86	DEG F	REPORT	126.0
DISTILLATION, 10%	ASTM D86	DEG F	REPORT	139.8
DISTILLATION, 20%	ASTM D86	DEG F	REPORT	163.6
DISTILLATION, 30%	ASTM D86	DEG F	REPORT	187.2
DISTILLATION, 40%	ASTM D86	DEG F	REPORT	209.3
DISTILLATION, 50%	ASTM D86	DEG F	REPORT	228.2
DISTILLATION, 60%	ASTM D86	DEG F	REPORT	244.0
DISTILLATION, 70%	ASTM D86	DEG F	REPORT	261.7
DISTILLATION, 80%	ASTM D86	DEG F	REPORT	286.3
DISTILLATION, 90%	ASTM D86	DEG F	REPORT	329.9
DISTILLATION, 95%	ASTM D86	DEG F	REPORT	360.7
DISTILLATION, DP	ASTM D86	DEG F	REPORT	405.1
RECOVERY	ASTM D86	VOL.%	REPORT	97.5
RESIDUE	ASTM D86	VOL.%	REPORT	1.2
LOSS	ASTM D86	VOL.%	REPORT	1.3
NITROGEN	ASTM D4629	PPM	REPORT	14
MERCAPTANS	ASTM D3227	PPM	REPORT	3
SILVER CORROSION	ASTM D130	CORROSION	1, MAX.	0
COPPER CORROSION	ASTM D130	COPPER CORR.	1, MAX.	1A
EXISTENT GUM (WASHED)	ASTM D381	MG/100ML	5, MAX.	<0.5

Lot # 2797600 Made 05/13/11

In sealed unopened containers this product is good until 10/28/11

Approved By: Robert Petzold

Acceptance data E_0 used as soak test fuel.

GAGE PRODUCTS CO.
821 WANDA AVENUE
FERNDALE, MI 48220
(248) 541-3824

Page: 1
Date: 03/14/12 at 1:59 PM

Gage Products Company
Certificate of Analysis / QC Results

Customer: C00100 / CRC, Inc.

Sales Order # : 28349 Customer PO # : 734 Shipped Qty : 1100

Packaged Product: 41254-55F
CRC AVFL-15a E0 Gasoline

Property	Test Method	UOM	Specification	Value
RESEARCH OCTANE NUMBER	ASTM D2699	RON	REPORT	93.8
MOTOR OCTANE NUMBER	ASTM D2700	MON	REPORT	84.0
SPECIFIC GRAVITY @ 60F	ASTM D4052		REPORT	0.7603
RVP @ 100F	ASTM D5191	PSI	REPORT	10.53
TOTAL SULFUR	ASTM D5453	PPM	80, MAX.	10.13
OXIDATION STABILITY	ASTM D525	MIN.	240, MIN.	1440
AROMATICS	ASTM D6730	VOL. %	REPORT	41.4
OLEFINS	ASTM D6730	VOL. %	REPORT	5.0
SATURATES	ASTM D6730	VOL. %	REPORT	52.8
BENZENE	ASTM D6730	VOL. %	REPORT	0.326
TOLUENE	ASTM D6730	VOL. %	REPORT	12.80
DISTILLATION, IBP	ASTM D86	DEG F	REPORT	85.8
DISTILLATION, 5%	ASTM D86	DEG F	REPORT	111.5
DISTILLATION, 10%	ASTM D86	DEG F	REPORT	127.4
DISTILLATION, 20%	ASTM D86	DEG F	REPORT	158.2
DISTILLATION, 30%	ASTM D86	DEG F	REPORT	190.4
DISTILLATION, 40%	ASTM D86	DEG F	REPORT	219.3
DISTILLATION, 50%	ASTM D86	DEG F	REPORT	242.3
DISTILLATION, 60%	ASTM D86	DEG F	REPORT	262.5
DISTILLATION, 70%	ASTM D86	DEG F	REPORT	283.5
DISTILLATION, 80%	ASTM D86	DEG F	REPORT	308.1
DISTILLATION, 90%	ASTM D86	DEG F	REPORT	329.3
DISTILLATION, 95%	ASTM D86	DEG F	REPORT	343.6
DISTILLATION, DP	ASTM D86	DEG F	REPORT	392.2
RECOVERY	ASTM D86	VOL.%	REPORT	97.1
RESIDUE	ASTM D86	VOL.%	REPORT	1.0
LOSS	ASTM D86	VOL.%	REPORT	1.9
NITROGEN	ASTM D4629	PPM	REPORT	8.4
MERCAPTANS	ASTM D3227	PPM	REPORT	3.0
SILVER CORROSION	ASTM D130	CORROSION	1, MAX.	0
COPPER CORROSION	ASTM D130	COPPER CORR.	1, MAX.	1A
EXISTENT GUM (WASHED)	ASTM D381	MG/100ML	5, MAX.	<0.5

Lot # 3896000 **Made** 03/08/12

In sealed unopened containers this product is good until 08/23/12

Approved By: Robert Patzelt