



SA Explosion Prevention CC

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TEST REPORT: SAEEx 05-031

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LITTLE BLACK BOX (EMS II): ENGINE MONITOR SYSTEM

1. SUBJECT

The evaluation and testing of a Little Black Box (EMS II), Engine Monitor System, for compliance with the 200°C temperature requirements as specified in **Clause 4.10 of SANS 868: "Compression ignition engine systems and machines powered by such engine systems, for use in mines and plants with explosive gas atmospheres or dust atmospheres or both"; Part-2: Draft-Edition 3:2004, "Non-hazardous locations in underground mines"**, for use on non-flameproof, diesel powered, vehicles in non-hazardous locations underground in coal mines.

2. DESCRIPTION

- 2.1 **General:** The Little Black Box (EMS II), Engine Monitor System, is manufactured by Innovative Auto, LINDEN, Johannesburg. The system consists of a Control Box, powered by 12 or 24 volts, various probes depending on the end-user requirements and a solenoid operated fuel cut-off valve. The system is provided with a visual and audible warning device to warn the operator that the system has reached a predetermined temperature or safety limit and consequently approaches engine shut-down within 35 seconds.

The system is intended as a fail-safe design (Open/Close Circuit protected).

- 2.2 **Variations:** The system is available in several variations to provide for different applications. The EMS II can be fitted or connected with any of the following probes in any combination and shuts down the engine via a 30Amp relay operating the fuel pump solenoid.

Probes:

#	Protection	Probe - Position	Remarks	Make / Part No
1	Surface Temp.	Exhaust Pipe	200°C	CTC - P50/200
2	Engine Coolant	Temperature - Thermostat housing	Adjustable	Standard to vehicle
3	Engine Coolant	Level -Radiator top tank	Fixed	Anelec: 415207 (probe) & 415209 (interface box)
4	Engine Lubrication	Oil Pressure sensor	(70kPa)	VDO - 230112001002

(1) NOTE: Temperatures can change to accommodate end-user requirements or to OEM specification.

/2.3 Operation:

5.1.3 TEST 3: (Coolant level)

The coolant was drained from the cooling system while the engine was running.

Results: The fuel supply to the engine was cut when the coolant break contact with the level switch.

5.1.4 TEST 4: (Oil pressure)

The engine oil pressure switch was disconnected to simulate oil pressure failure.

Results: The fuel supply was cut when the oil pressure switch was disconnected.

5.1.5 TEST 5: (Fail-safe design of fuel shut-off system) (Open/Close Circuit protected)

The probes were individually disconnected or connected, depending on the type of probe, to verify fail-safe design of the fuel shut-off system

Results: The fuel supply to the engine was cut when each of the probes was disconnected or connected.

6. TEST RESULTS SUMMARY

The Black Box, Engine Monitor System (EMS II), complete with the relay switch for the fuel cut-off valve and the selected exhaust temperature probe met the fuel cut-off at maximum 200°C at the exhaust pipe as prescribed for non-flameproof vehicles in SANS 868: Part-2 (2004 Final draft), clause 4.10 "Safety shut-off system".

Engine system surface temperature did not exceed 200°C as required in SANS 868-2 (Draft).

Each optional safety device fitted met the requirements of the manufacturer.

In all tests that the fuel supply to the engine was cut the visual and audible warning devices were activated approximately 35 seconds before the engine stopped.

7. CONCLUSION

The Black Box, Engine Monitor System (EMS II), as described in paragraph 2 of this report and in the condition as tested and examined, is suitable for use on non-flameproof vehicles for Group I, maximum surface temperature 200°C according to **Clause 4.10 of SANS 868: "Compression ignition engine systems and machines powered by such engine systems, for use in mines and plants with explosive gas atmospheres or dust atmospheres or both"; Part-2: Draft-Edition 3:2004, "Non-hazardous locations in underground mines"**.

8. ADDITIONAL INFORMATION

PLEASE NOTE:

- (A) **FINAL APPROVAL OF AN NON-FLAMEPROOF VEHICLE TO BE USED IN AN NON-HAZARDOUS LOCATION IN A FIERY MINE IS FOR THE CHIEF DIRECTORATE OF MINE EQUIPMENT.**

/(B) NON-FLAMEPROOF . . .

2.3 **Operation:** The primary function (compulsory - Coal Mines) of the system is to prevent the surface temperature of the engine system to exceed the prescribed maximum temperature of 200°C for non-flameproof vehicles by cutting the fuel supply to the engine, causing the engine to stop and cool-down. The secondary function (optional) is to protect the engine from over heating and lubrication failure by also cutting the fuel supply to the engine, causing the engine to stop.

3. SELECTION OF TEST UNIT

The Engine Monitor System for evaluation and testing was supplied and fitted to the test vehicle by the test sponsor.

4. TEST SET-UP

The test set-up consisted of the following:

- 4.1 **Vehicle:** (Non-flameproof) Toyota 2.4 D LDV powered by a de-rated, naturally aspirated four cylinder, Toyota, diesel engine, swept volume 2.4 l in the standard configuration fitted with a Safety Shut-off System.
- 4.2 **Dynamometer:** Rolling wheel dynamometer.
- 4.3 **Safety shut-off system:** Little Black Box, Engine Monitor System (EMS II), connected to the fuel cut-off valve via a relay switch and probes fitted/connected to the following points:
1. Exhaust pipe: ±50mm from Exhaust manifold/pipe flange on the exhaust pipe.
 2. Thermostat housing - Coolant temp. sensor. (Optional)
 3. Radiator top tank - Coolant level. (Optional)
 4. Engine block - Oil pressure sensor. (Optional)

5 TEST METHODS AND RESULTS

The Little Black Box, Engine Monitor System (EMS II) was tested and examined for compliance with the relevant requirements of SANS 868; Part-2: (2004 Final draft), clause 4.10. The following tests were carried out (not necessarily in the order given):

5.1 Engine Monitoring System - Engine shut-down

- 5.1.1 **TEST 1:** (Exhaust surface temperature, compulsory to coal mines)
The exhaust pipe probe was fitted to a temperature test piece and the temperature was increased to 200°C to check for compliance.

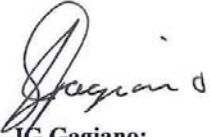
Results: The fuel supply to the engine was cut when the exhaust pipe probe reached 193°C.

- 5.1.2 **TEST 2:** (Engine coolant temperature - optional)
The engine was run with the fan belts removed from the fan and water pump to increase the coolant temperature to above normal to check for operation. (Temperature to activate the fuel cut-off system can be set by adjusting the alarm setting potentiometer inside the Main Box to meet OEM requirements)

Results: The fuel supply to the engine was cut when the coolant reached 85°C.

/5.1.3 TEST 3: ...

- (B) NON-FLAMEPROOF VEHICLES ARE ONLY TO BE USED IN NON-HAZARDOUS LOCATIONS IN COAL MINES.
- (C) A VEHICLE IS NOT CERTIFIED NON-FLAMEPROOF BY JUST INSTALLING AN ENGINE SHUT-DOWN SYSTEM.



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EXPLOSION PREVENTION