

# Eminox - FBC Active Fuel Borne Catalyst System



## Installation and Set-up Manual

**Exhaust Engineering Excellence**





# Eminox - FBC Active Fuel Borne Catalyst System

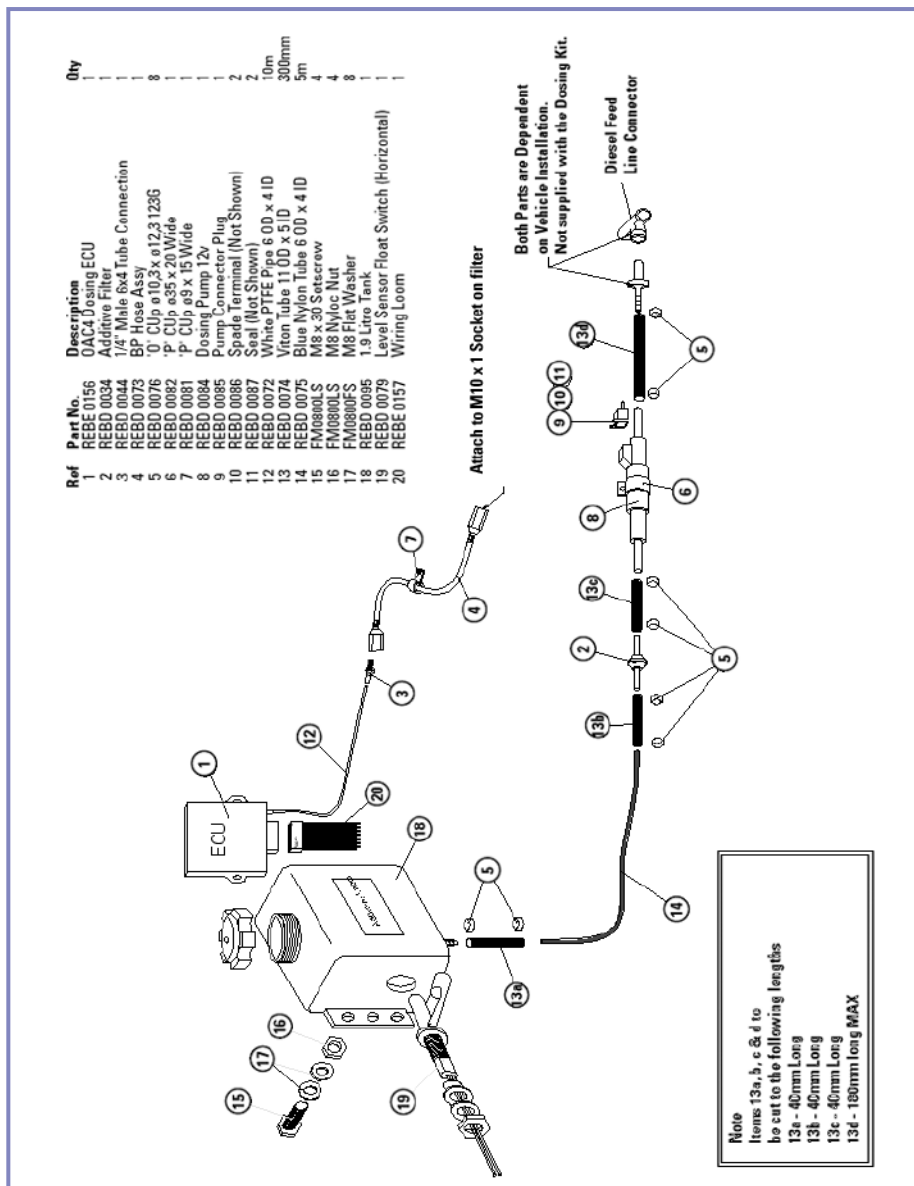
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### 3 Identification of dosing system parts

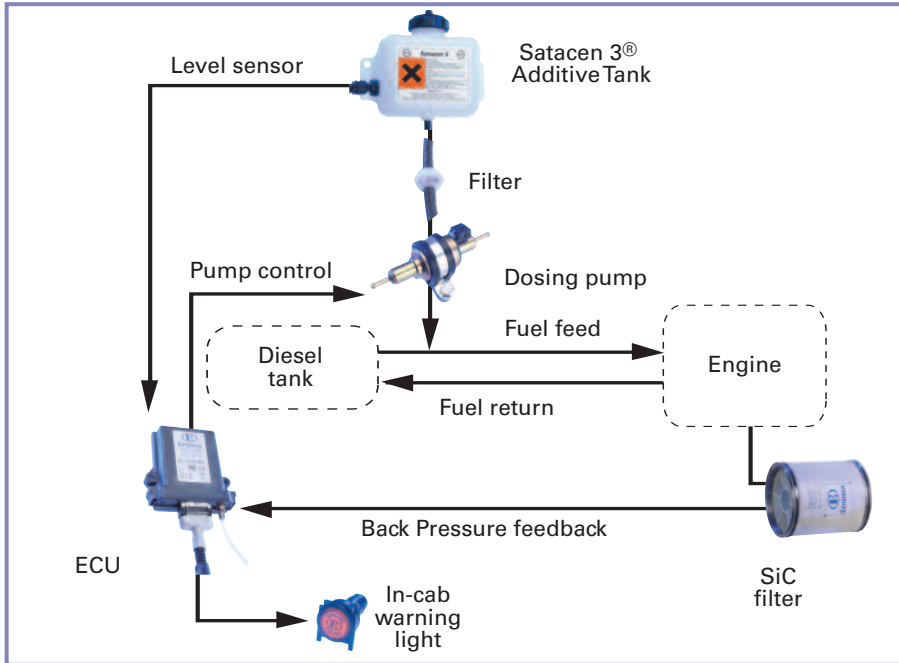
Figure 1 – FBC dosing system parts detail



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## 4 FBC system schematic

Figure 2 - Dosing system installation schematic



## 5 Installation guidelines

Installing the system components in the order detailed below allows optimum routing and length of electrical cables and hoses to be achieved.

1. DPF exhaust system with SiC filter
2. Additive tank
3. Solenoid dosing pump
4. Additive hose and diesel fuel feed line "T" Piece
5. ECU & back pressure feedback hose
6. Wiring harness routing
7. Dash lamp

All wiring and hoses must be securely fastened to the vehicle paying particular attention to avoid heat sources, potential fouls, and chafing points. Care should be taken to avoid kinks in the back pressure hose and additive feed tubes.

The diesel fuel feed line "T" piece fitting must be ordered separately. Please advise the sales team at time of order, the diesel fuel FEED line diameter and material type. Compression or push-fit connections are available.

## 6 Dosing system installation notes

### 6.1 Additive tank

Using the mounting holes provided, install the additive tank to a vertical plane. This will provide a flooded suction to the solenoid dosing pump. To assist in selecting the optimum tank location whilst maintaining flexibility, a 5 metre length of blue additive supply hose (Figure 1, item 14) is provided in the standard dosing kit. The chosen location should also provide good access for future filling and servicing.

Additive tanks of various sizes and material are available:

- Plastic tanks (Figure 3) of nominal capacity 2, 3 and 5 litres are standard. They are in a natural finish (similar to wash water bottles) in which the additive level is clearly visible. A breathable filler screw cap and low level switch are fitted as standard.
- A stainless steel 5 or 10 litre nominal capacity tank is also available (Figure 4). They are manufactured in an all-welded construction and are complete with mounting points, tube hose tail connection, breathable filler cap, low level sight glass and low level alarm switch.



Figure 3 – plastic additive tank



Figure 4 – metal additive tank

All tanks will be supplied with a label advising the use of Satacen 3<sup>®</sup> only, when refilling the system.

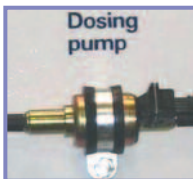


Figure 5 – Dosing Pump

### 6.2 Solenoid pump

The solenoid pump (Figure 1, item 8 & Figure 5) should be installed using the 'P' clip (Figure 1, item 6) provided with an M6 nut and bolt. **It MUST be installed HORIZONTALLY as close to the injection point as possible. The pump flow direction is indicated with an arrow stamped on the side of its body.** When identifying a suitable location for the pump ensure it is located above the injection point.

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There is no polarity to the connections of the solenoid pump. A female connection kit is provided (Figure 1, items 9, 10 & 11 & Figure 6). The wires from the harness should be prepared and fitted with the white rubber seals prior to securing the spade crimp connectors and then secured within the plug housing by pushing in from the rear.

## 6.3 Additive hose assembly

Two types of additive supply hose are provided (Figure 1 – items 13 & 14). A 300mm length of high grade rubber hose (special material specification) is incorporated within the standard kit (Figure 1, item 13). Cut this to the approximate lengths advised in Figure 1. The blue Ø6mm OD hose (Figure 1, item 14) is provided to make up the balance of the suction hose length. It is inserted into rubber hose at each joint then secured with the 'O' clips (Figure 1, item 5). It is essential to use only the grades of additive hose supplied with the Eminox FBC inline dosing system to ensure compatibility with Satacen 3® additive.

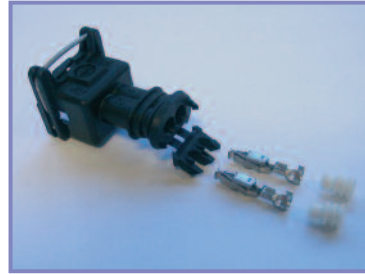


Figure 6 – Pump plug, connectors and seals

**When replacing or supplementing the kit provided – DO NOT replace with standard grade diesel fuel hose, contact Eminox for extra supplies.**

Refer to Figure 1 for the general hose assembly guidelines. All joints must be secured using the 'O' clips provided.

### 6.3.1 Additive tank to the filter

Attach a 40mm length of rubber hose to the additive tank outlet and secure with an 'O' clip. Insert and secure the blue hose to the rubber hose from the additive tank. Carefully route the blue hose down to the pump location. Whilst routing and securing the additive hose, care must be taken not to allow kinks in its length. If preferred the hose can also be further protected by threading it through the flexible conduit.

### 6.3.2 Additive filter to the pump

Install the in-line additive filter (Fig 1, item 2) to the suction side of the pump securing each joint with the 'O' clips. A 40mm length of rubber hose is secured on the inlet and outlet of the filter. The filter flow direction is indicated with an arrow stamped on the side of its body.

### 6.3.3 Solenoid pump to the injection point

Use a maximum hose length of 180mm. The length may vary with custom applications but it is very important to ensure that the distance between the pump and injection point is kept as short as possible. The hose is secured using the 'O' clips. Vehicle fuel feed lines vary in size and material. Details of the diesel fuel feed line, such as outside diameter if a nylon hose is used, or inside diameter if the fuel line is rubber requires specification. Eminox can supply a selection of fittings to suit the application such as push fit or compression fittings and hose tails.

The injection point assembly **MUST** be connected to the vehicle diesel FEED line between the vehicle fuel tank and the engine.

Typical pump installations are shown in Figures 7a & 7b.



Figures 7a (left) & 7b - Injection point assembly arrangements

It is recommended that full installation of the electrical system is completed prior to filling the system with additive. This will confirm the operation of the level switch, as described later in Section 7 - Commissioning.

#### 6.4 ECU – Additive dosing controller (with back pressure monitoring)

The dosing controller (REBE0156, see Figure 8) is designed to control a solenoid driven injection pump using system parameters of time and back pressure. The unit is housed in a rugged IP65 plastic enclosure with integral harness connector. A dash-mounted indicator is provided for the driver/operator and a bi-colour (green/red) LED is located on the ECU endplate. Using a propriety download cable there is the facility to connect the ECU to an RS232 port of a laptop computer for setup and diagnostics purposes. A non-volatile memory maintains the pump strokes count and a 1024 hour rolling record of hourly based statistical analysis of back pressure and alarms.



Figure 8 - REBE0156 Controller

The ECU enclosure **MUST NOT** be opened. All of the setup and interrogation functions can be performed without the need to break the box seal.

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## 6.4.1 ECU Installation

The ECU location is very important and should be considered carefully. It should be mounted vertically so that the plug connection is at the bottom. Access to the top centre of the case with a magnet is required to initiate the prime function during commissioning. Secure the case using the mounting holes which are 102mm apart with M6 nuts and bolts - see Section 10 for dimensions. Locate in a position that is protected from potential mechanical damage but also allows access to the plug connection and the top of the box. Consideration for its location should focus on a location that provides protection from the elements and road debris. The ideal location is within the vehicle dashboard.

## 6.4.2 Back pressure connection

Flexible hoses (Figure 1, items 4 & 12) are provided to make a two stage transition from the filter silencer (DPF) to the ECU. This connection provides the facility to constantly monitor the exhaust system back pressure. The ECU will trigger a warning to the operator should a high back pressure condition occur.

The stainless steel flexible hose (Figure 1, item 4) is connected to the exhaust silencer where temperatures may be high. It comprises a stainless steel over-braided PTFE smooth bore hose with a 1/4" BSP male to M10 x 1mm male adaptor at one end and a 1/4" BSP female connection at the other. The adaptor is attached to the M10 x 1mm female boss located on the DPF inlet canister.

A fitting (Figure 1, item 3) is provided to adapt from the stainless steel hose (Figure 1, item 4) to the translucent PTFE hose (Figure 1, item 12).

The PTFE hose is connected to both the ECU and the fitting (Figure 1, item 3) by placing the knurled locking ring on the hose, pushing the hose over the hose tail and then securing with the knurled screw locking ring.

It is recommended that routing of the hoses is identified and then loosely installed.

Attention should be paid to locating positions at which the hose can be secured to either the vehicle chassis or other suitable parts – such as vehicle looms. When satisfied with the routing, attach the hoses and secure with cable ties **ensuring that neither the stainless steel braided hose nor the PTFE hose is either kinked or compressed by the cable ties.**

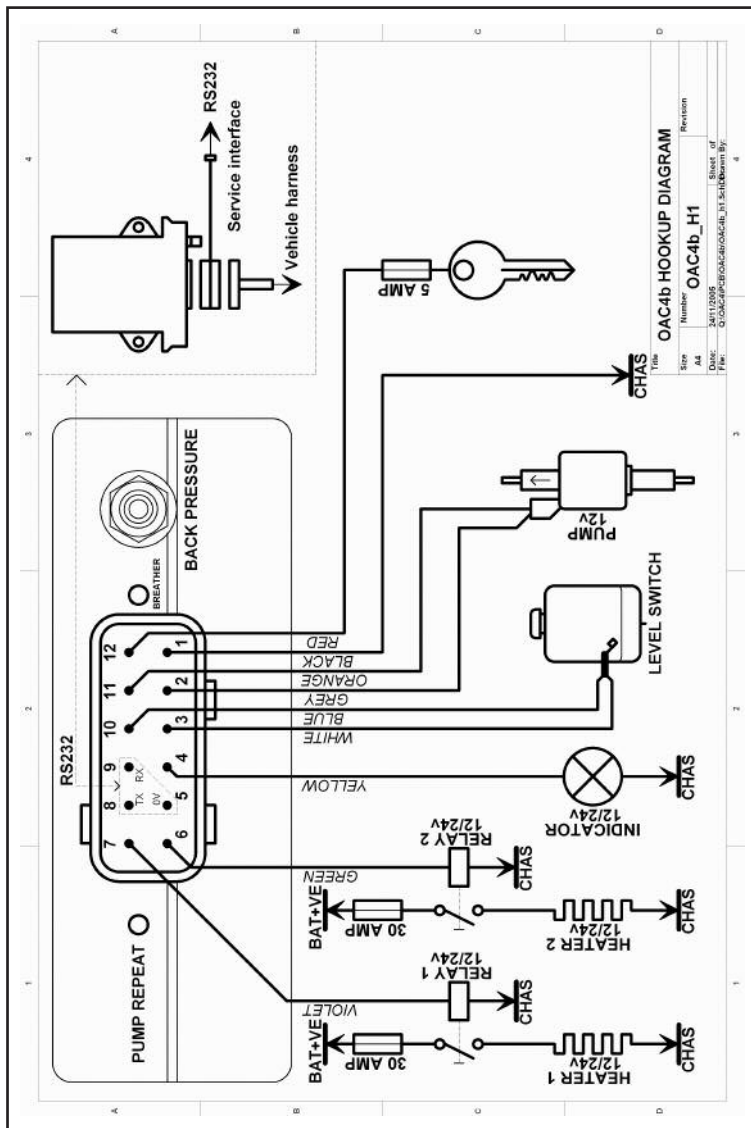
## 6.4.3 Wiring harness

The wiring harness supplied (Figure 1, item 20) should be routed on the vehicle using the electrical conduit and connections supplied. Care must be taken to ensure that the cables are neatly secured with cable ties and that they are protected from water and dirt ingress. Referring to the electrical connection diagram (Figure 9 on next page) and utilising the colour coded wiring harness provided, make all the connections as indicated. The black earth connection from the ECU should be no more than 2m in length. This ensures that the system will not be subjected to a large voltage drop which will affect its performance. When all components are connected and the ignition power supply is verified with a multi-meter, plug the wiring harness into the ECU.

**It should be noted that there is no polarity to the wiring of either the level switch or the solenoid injection pump.**

## 6.4.4 Electrical connection diagram

Figure 9 - Electrical hook-up diagram



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## 6.4.5 Injection pump cycle time

The dosing pump base cycle time setting is dependent upon several key factors, namely engine size, power, Euro level, vehicle application and annual mileage. Custom designed installations developed by Eminox will be supplied with the correct cycle time and back pressure settings. Refer to Eminox for a recommendation of timer settings for bespoke applications. The pump cycle time is linked to the system back pressure and changes as the soot load on the filter increases.

**Note** - When the system is first run or a new filter is installed, the pump runs at twice the base cycle time rate for a conditioning period (default 60 hours) to prepare the internal surfaces of the engine, fuel and exhaust systems.

## 6.4.6 Prime function

The ECU controller has a function which allows the pump to operate at one second intervals. This is the prime function and is used to move additive from the tank through the lines to the injection point. The prime function can be initiated either through the computer interface or by passing a magnet over the reed switch in the top centre section of the box. The pump will continue to prime for 5 minutes or until the magnet is passed over the reed switch again. Figure 10 shows the location of the reed switch.



Figure 10 – Reed switch location

## 6.5 Active regeneration function

The active regeneration system is designed to be used in conjunction with the Fuel Borne Catalyst (FBC) dosing system on vehicles which have low exhaust temperatures or difficult duty cycles. The active regeneration function will help to control back pressure and avoid blocking the filter. The active regeneration system can be added to the standard dosing kit with the addition of extra hardware to the filter and electrical harness.

The active regeneration system uses back pressure monitoring during vehicle operation to prompt a regeneration event at the optimal point in the vehicles duty cycle without hindering performance. Thus increasing the range of vehicles on which the FBC system can be used on.

### 6.5.1 Installing the system

These instructions assume that the user has carried out the fitment of the Eminox FBC dosing system as per this manual.

Before commencing the installation the following things need to be considered.

- Location of 12v battery source – This is required to power the glow plugs. The relays and fuses need to be positioned close to the power source to avoid excessive lengths of cable. A long cable will result in a large voltage drop which will prevent the glow plugs from reaching their optimal operating temperature.
- Location of the exhaust and an identification of a suitable route through the vehicle for the power cables. Often this is similar to the route of the back pressure hose. Care must be taken to avoid hot spots and pinch points, again whilst minimising the length of cable required.
- Location of a suitable earth connection. This should be a minimum distance from the filter ensuring that the voltage drop is not significant. A mounting bolt of the filter cradle to the chassis is a suitable place on most applications.

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## 6.5.2 Connecting up the relays

The relays need to be positioned close to the power source. Figure 1 on the next page shows the wiring diagram for the relays. Before commencing installation check that the relays are the correct voltage rating for the electrical system. The active kit comes with 12v or 24v depending on specification at time of order. This will cover all applications in the light to heavy duty markets. **Do not** attempt to connect a 12v relay to a 24v system or vice versa.

12V feed is required for 12V glow plugs. If no 12V feed is available on the vehicle, then a 24 to 12V dropper must be installed. 24V glow plugs are currently being validated and upon completion of successful validation, will be released. When available a 24V feed can be used.

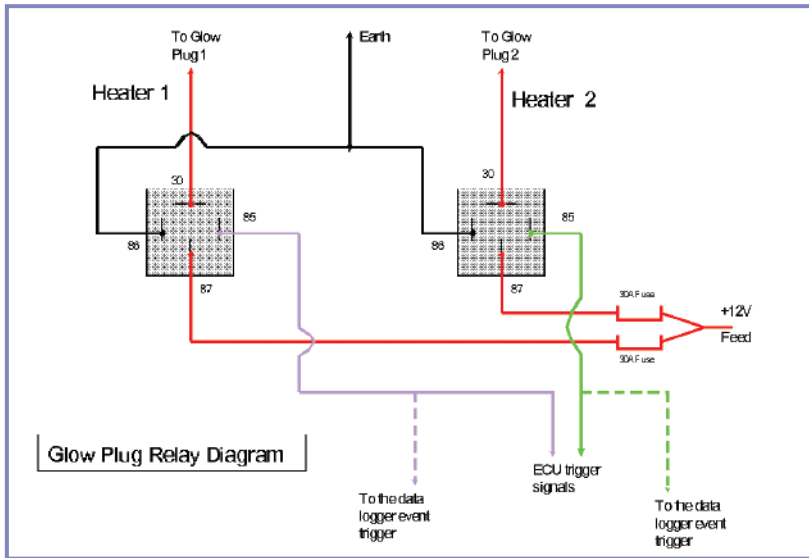


Figure 11 showing the relay wiring diagram

The dashed lines on Figure 11 represent connections that are not required for a normal installation of the active regeneration hardware.

The violet and green cables are already part of the wiring harness supplied with the standard FBC dosing kit. The black earth wire needs to be 22AWG; the excess wire from the wiring harness is suitable for this purpose. The power supply cable (red) will differ in size depending on which kit the user is installing. The 12v kit has 14AWG wire as the distance to the exhaust from the power source is generally less than 5m. The 24v systems have 8AWG to cope with distances found on buses and trucks (up to 12 metres in length). These cables have been specified to ensure the voltage drop along the cable to the glow plugs is not excessive.

It is imperative that the glow plugs run off parallel circuits. This will ensure that in the unlikely event of the 1st circuit failing, the 2nd circuit will continue to operate. The relays should be labelled 1 and 2 to denote which glow plug is connected to which relay.

### 6.5.3 Power cable routing

This has already been touched on in section 6.4.3 of this manual. The cables need to be routed through the vehicle using the conduit supplied. Care must be taken to avoid fouling existing vehicle systems and touching hot spots on the vehicle. The cable must be securely mounted using the cable ties provided.

### 6.5.4 Glow plugs installation

The glow plugs fit into the flange on the inlet side of the filter. Figure 2 on the next page shows a drawing of an active filter with the glow plugs mounting into the new inlet flange. The glow plug thread size is M10x1.25. The system has been validated with the Bosch glow plug supplied with the kit; no other type of glow plug should be used in the system.

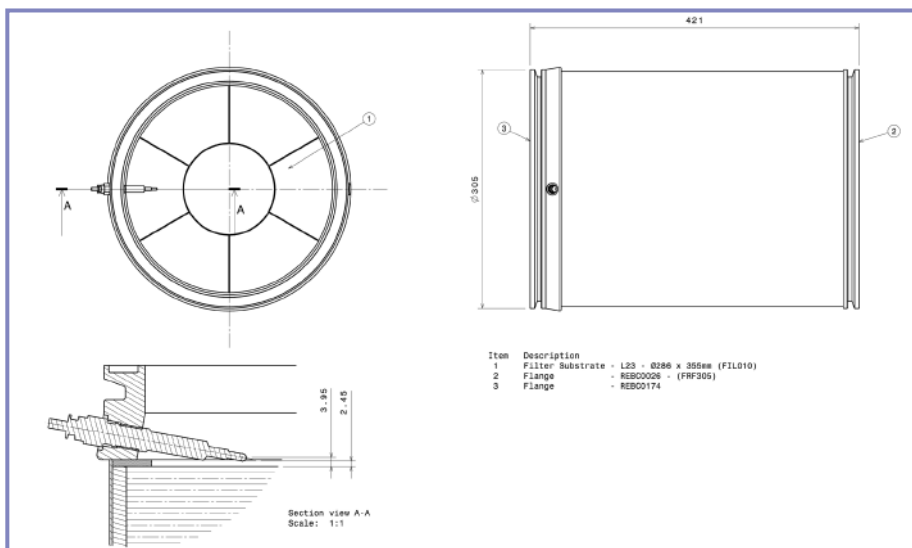


Figure 12 showing an active filter schematic with glow plug in the inlet flange.

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It is recommended that glow plug one is always installed on the nearside of the filter and glow plug two on the offside. This should ensure that the wiring path between the relays and glow plugs is clear. Once the filter and glow plugs are installed on the vehicle the cables should be attached to the glow plugs. The outlet or inlet canister will have a mount for an earth connection attached to it. An M4 ring crimp terminal is provided in the kit for this purpose. A length of cable (14AWG or larger) should be used to attach the filter and canisters to a suitable point on the chassis to provide an earth connection.



Figure 13 & Figure 14 showing the glow plug wired up (left) and the earth connection to outlet can

The system's hardware is now ready and the dosing system can be commissioned in the same way as the non-active FBC dosing system.

## 6.6 Active settings

The Electronic Control Unit (ECU) uses a unique algorithm to control the active functionality of the system. The calibration on the FBC ECU needs to be configured to suit the vehicle and normal duty cycle. The ECU should not be tampered with by the operator or other non-Eminox personnel, doing so will invalidate the warranty on the system, alterations to this can only be carried out by an Eminox Service Engineer.

## 7 Dosing system commissioning

It is recommended that the electrical system is commissioned and a functional check made of normal operation, which includes the lamp test, before the additive tank is filled. Ensure the wiring connections are complete according to the wiring diagram (Figure 9) and the loom is secured. Insert the grey plug into the ECU.

- Check all the flexible hose connections between the tank and the injection point and ensure all crimp connections are complete and secure.
- Check all the back pressure hose connections are secure and there are no kinks at any point between the exhaust filter and the ECU.
- Check power to the ECU and the level switch circuit. With the ignition ON and an empty additive tank, the ECU LED should be lit RED and the dash light should illuminate for one second then proceed to blink four times, on an 8 second cycle.
- Carefully fill the additive tank with Satacen 3<sup>®</sup>. As the tank is filled the level alarm warning will cancel. The ECU LED will turn from RED to GREEN and the dash alarm will cancel. This demonstrates that the low level alarm float switch is operational and functioning correctly.
- Having filled the additive tank, check all flexible hoses, tank outlet and fittings for any evidence of leaks.
- Prime the dosing system as described in Section 11.2. The pump should be heard operating and on touching the casing it will be possible to feel its operation. The system is near fully primed when the clear filter (which should be just in front of the pump) can be seen to have filled up with additive (dark brown). If required, the system prime sequence can be started again with the magnet. Leave the system in prime for a further two to three minutes after the filter has fluid in it. The pump can be taken off prime by passing the magnet over the reed switch again.
- Add a quantity of Satacen 3<sup>®</sup> additive to the vehicle diesel tank in the ratio 0.5ml per litre of fuel in the tank. This helps with the conditioning of the engine and the DPF exhaust system.
- Prior to completion and with the ignition switch ON, check the cycle time of the pump. The time between pump operations should match the selected cycle time setting. NOTE - In the first sixty hours of operation the dose rate will be twice that of the base setting, i.e. the time between pump pulses will be half the cycle time setting.
- System commissioning is now complete and testing of the installation can be completed by running the vehicle engine. Please ensure that tools are clear and all normal operator checks are conducted prior to starting the vehicle.

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## 8 Operation and Maintenance

### 8.1 Typical service intervals

During normal operation, FBC system maintenance depends upon the rate at which soot and ash deposits accumulate in the filter. The ash deposits are the incombustible residues of burnt engine oil and soot. As ash levels rise in the filter the capacity for soot is reduced and the back pressure of the exhaust system will rise more frequently. The FBC system service and fault lamp will indicate when the filter requires servicing. In addition, periodic filter cleaning is recommended to maintain the service interval and system performance. Table 1 below summarises the service type required and interval period for common vehicle categories.

Vehicle	Duty cycle	Approx. Annual Mileage /km	Service every 4 to 6 months	Service every 12 months
London taxi	Mainly low speed city centre operation	30,000 - 50,000	A, B, C, D	A, B, C, D, E
Light van, minibus, 1.3T-3.5T GVW	Varied use from city centre to long distance	30,000 - 60,000	A, B, C, D	A, B, C, D, E
Light Truck 3.5T - 7.5T GVW	Varied use from city centre to long distance	50,000 - 80,000	A, B, C, D	A, B, C, D, E
Truck 7.5T GVW	Varied use from city centre to long distance	50,000 - 80,000	A, B, C, D	A, B, C, D, E
Truck 28T-44T GVW	Long distance haulage	80,000 - 100,000	A, B, C, D	A, B, C, D, E
Refuse collection vehicles	Local operation. Mainly very low speed and sustained idling	15,000 - 30,000	A, B, C, D	A, B, C, D, E
Single and double deck buses	City centre operation. Mainly low speed with periods of higher speed Operation	30,000 - 60,000	A, B, C, D	A, B, C, D, E
Coaches	Mixed city centre, urban and long distance operation	30,000 - 80,000	A, B, C, D	A, B, C, D, E
Fire appliances	Local operation. Varied duty cycle. Idle, low load operation with sustained high power and load over short duration	10,000 - 15,000	A, B, C, D	A, B, C, D, E

Table 1 – Service types and intervals for common vehicle groups

A = Smoke check, B = Visual inspection of exhaust system, C = Check FBC level and refill, D = Function check of dosing system and alarms, E = Remove SiC filter for cleaning and replace

## 9 FBC operating conditions

The EminoX FBC system depends upon the use of Satacen 3<sup>®</sup> additive to aid regeneration of the filter, preventing large accumulations of soot and eventual filter blockage. The system is not designed to work with any other additive! Use of the incorrect additive, poor vehicle maintenance and excessive engine smoke or oil consumption can prevent the FBC system from operating satisfactorily.

- Under no circumstances should the vehicle be operated without Satacen 3<sup>®</sup> additive.
- The vehicle must be serviced according to manufacturer's recommendations in order to maintain the optimal engine performance.

### 9.1 Satacen 3<sup>®</sup> Additive

Satacen 3<sup>®</sup> is a fuel borne catalyst developed by the Innospec Inc who are one of the world's leading fuel treatment specialists. Without the Satacen 3<sup>®</sup> additive the system will not function correctly and excessive uncatalysed soot will build up on the filter. This will have an adverse effect on fuel consumption and over prolonged periods could cause damage to engine components.

- Only Satacen 3<sup>®</sup> and no other additive should be used in the FBC system.
- The vehicle should not be driven if the Satacen 3<sup>®</sup> tank is allowed to run dry.
- The FBC system will require priming if the Satacen 3<sup>®</sup> storage tank is allowed to run dry or the dosing system is repaired or replaced.

### 9.2 Fuel specification

- The EminoX FBC system is sulphur tolerant and does not require ultra low sulphur fuel.
- EminoX approves the use of EN590:2004 specification (Euro 4) diesel fuel, which meets the fuel requirements according to the directive 2003/17/EC.
- Do not use fuel additives other than those already incorporated in general commercial diesel fuel supplies.

### 9.3 Engine smoke

The level of smoke produced by the engine should not exceed the maximum limits set by the engine manufacturer.

### 9.4 Engine oil

Low ash oils are recommended to maintain the filter service interval and optimal FBC system performance.

- Ensure engine oil consumption is within engine manufacturer's limits, typically less than 1 litre per 1,000km.
- During normal operation, ash, (which is an incombustible material - mainly the residue of burnt engine oil), can gradually build up in the filter. This is removed by regular servicing.

## 10 System alarm functions

The dash indicator (Figure 11) reports the system status to the driver/operator of the vehicle. At ignition ON the lamp shows a one second lamp test. If any alarm is sensed the lamp will stay on. The controller then identifies the alarm type by a sequence of blinks (LED turned off momentarily) cycling every eight seconds around each tripped alarm should there be more than one. See section 10.6 & 10.7 for full fault codes and LED indications.



Figure 15 – Dash Light

### 10.1 High pressure alarm

#### 5 blinks Alarm type – momentary

The Eminox back pressure monitoring algorithm is proprietary data and therefore unique to the Eminox FBC system. It is designed to be set and operate within engine manufacturer's guidelines. The pressure alarm is reset when the back pressure has been below the set point for five seconds or when the ignition is turned off.

### 10.2 Low additive alarm

#### 4 blinks Alarm type – momentary

When the ignition is ON the level sensor monitors the fluid level in the tank. It is a normally closed circuit so that when the additive level is OK, no fault signal is shown. The polarity of the connection can be changed in the diagnostics page of the ECU program. If a computer connection is not available then it is simply remedied by changing the wire connections. No additive = DASH lamp fault signal and a RED ECU LED. When Satacen 3® additive is added to the tank the dash lamp fault signal should stop and the ECU LED should be GREEN.

### 10.3 Pump fail alarm

#### 3 blinks Alarm type – latched

The controller monitors the electrical drive to the pump for open and short circuits. The alarm is latched on when there has been five faults detected, and can be reset by turning the ignition off.

### 10.4 No pressure alarm

#### 2 blinks Alarm type – momentary

After the ignition has been ON, the controller signals an alarm when the back pressure is below the NO PRESSURE ALARM pressure. This can be an indication that the back pressure hose connection has failed or the hose is blocked. This function is disabled during the system conditioning period.

## 10.5 Ash alarm

### 1 blink Alarm type – latched

The ECU program contains a proprietary algorithm unique to Eminox which monitors back pressure data. The filter will regenerate and clear its soot collection automatically. After each regeneration event a small residual amount of ash is left in the filter. Over time and after a large number of regeneration events, the build-up of ash will reduce the filter's capacity for storing soot. The filter will require removal and cleaning at regular intervals. The controller advises when a filter service may be necessary. This function is disabled during the system conditioning period.

## 10.6 ECU LED indicator status

ECU-LED-Status	Description
Green ON	Power OK
Red ON	Alarm fault – check dash light for fault code
Green or Red Blink OFF	Pump pulse
Green or Red 2 x Blink OFF	Pump pulse in conditioning mode
Green or Red 3 x Blink OFF	Pump pulse in priming mode
Red & Green alternating	Engineer's mode

Table 2 - ECU LED status

## 10.7 Dash lamp indicator status

Dash lamp signal	Fault description	Action
Ignition ON Lamp ON for 1 second	System check OK	None – this is normal
Ignition ON Lamp fails to blink	System check error in FBC manual	Consult fault finding chart
Lamp ON followed by any of the following sequences		
5 Blinks	High back pressure alarm	Consult fault finding chart in FBC manual
4 Blinks	Low additive level alarm	Top up with Satacen 3® only
3 Blinks	Pump circuit failure	Consult fault finding chart in FBC manual
2 Blinks	No pressure alarm	Check integrity of BP hose and clean
1 Blinks	Ash alarm	Filter requires cleaning – Call for service

Table 3 – Dash light indicator descriptions

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## 11 Fault diagnosis and solutions

The following section describes the possible servicing functions and what to do in the event of a dash lamp alarm condition occurring. The operator should **NOT** interfere with the operation or visibility of the warning lamp. If illuminated – a problem of some kind exists!

### 11.1 How to Prime the Eminox FBC Dosing System

If the dosing system is not functioning efficiently it will be necessary to prime the additive dosing pump as detailed below. The PRIME function operates the dosing pump at one stroke per second.

- Check the level in the additive tank. If low, top up with Satacen 3®.
- Mark the level of Satacen 3® additive in the tank.
- Turn the vehicle ignition ON.
- The PRIME function is activated by passing a magnet over an internal reed switch located in the top centre of the ECU. See Figure 13 below.
- The pump should now be operating once every second for 5 minutes.
- Check the level in the fluid tank has dropped and that the translucent filter before the dosing pump has brown fluid in it.
- Start the prime process again if required.
- The dosing system is now primed.



Figure 17 - Reed switch location

## 11.2 FBC dosing system. diagnosis decision tree

Below is a flow chart for diagnosis of FBC faults and corrective actions.

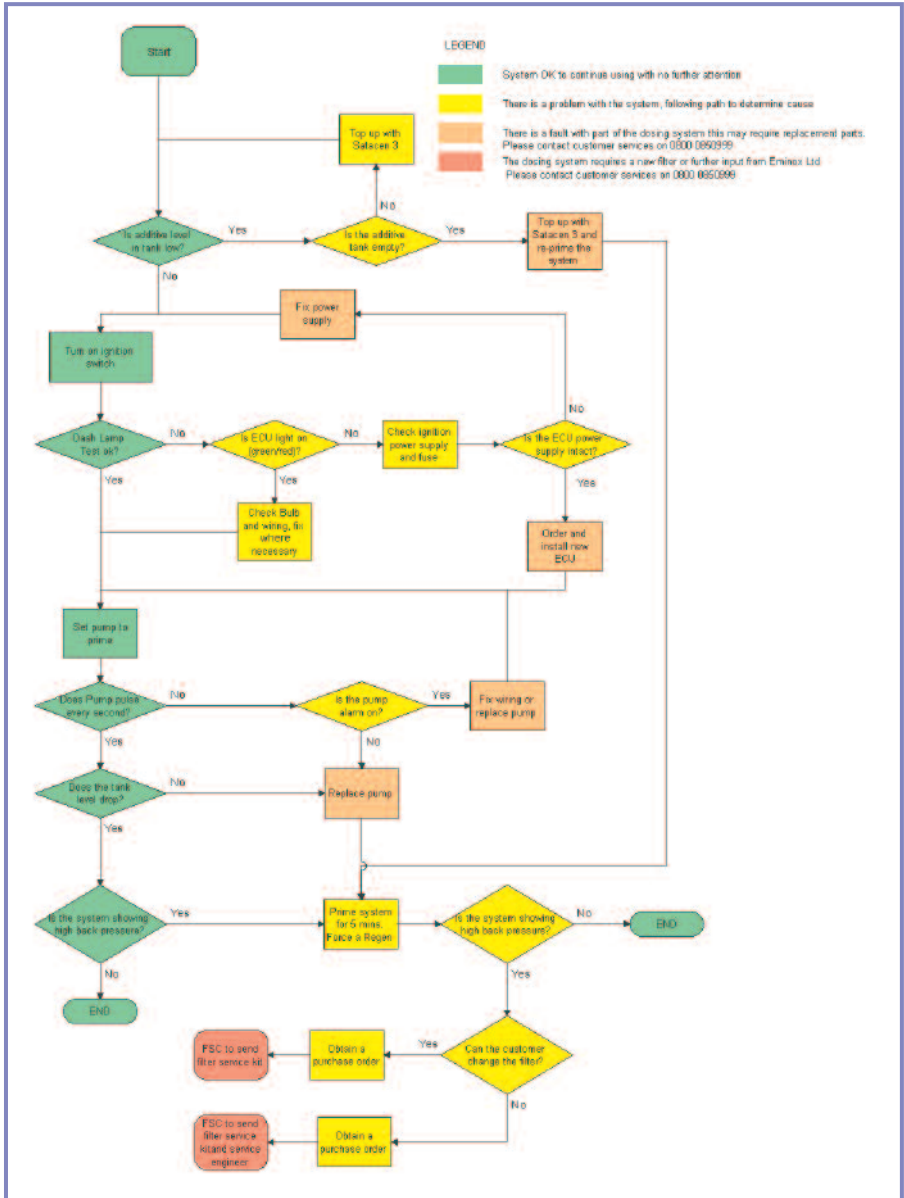


Figure 16 – FBC system fault diagnosis tree

## 11.3 How to encourage a diesel particulate filter regeneration event

If the vehicle duty cycle has been such that the filter has collected a volume of soot without regenerating, it is possible to force a regeneration event in the filter. This will clean the filter of soot and return the DPF system to its normal operation. Before attempting to force a regeneration the dosing system should be inspected to ensure it is functioning efficiently and that the filter is receiving catalysed soot. Refer to the Eminox FBC Dosing System Decision Tree, Figure 12.

Eminox FBC filters can be regenerated when full of soot. They will not exotherm. Follow the simple steps detailed below to force a regeneration event.

- Add Satacen 3® to the vehicle diesel fuel tank, 0.5ml per litre of diesel.
- The process will be helped if the vehicle has a secured payload in place.
- The engine needs to be run to get it to its optimum operating temperature.
- Drive the vehicle hard in a controlled manner to get the exhaust temperature as hot as possible. It may be necessary to drive along a dual carriageway or main road for 10 to 15 minutes.
- After a hard acceleration or prolonged running, lift off the throttle and let the engine go on to over-run.
- This action provides a surge of oxygen into the gas stream and subsequently onto the hot filter face.
- High temperature, oxygen and the fuel (catalysed soot) on the filter will create the regeneration and clean the filter.
- Locate a suitable place to pull over and let the engine idle for a couple of minutes.

To summarise:

- Accelerate hard keeping the engine at peak power and rpm.
- Back off and let the engine drop to over-run or idle.
- Repeat as required.

This process is normally enough to encourage a regeneration event to take place within the filter. If however the soot has not been catalysed, the dosing system must be serviced and the vehicle may need running through this process a number of times.

## 11.4 Fuel borne catalyst top up

Satacen 3® additive (FBC) is available directly from EminoX. It is supplied in easy to handle 2.5 litre (UN approved) plastic containers (Figure 14). Do not use any other additive.

All dosing system tanks are provided with filler breather caps that can be removed without the need for tools. Fill with care directly from the plastic containers. Filter system and vehicle performance may be impaired if either the additive tank is allowed to run dry or an alternative additive is used.



Figure 18 – Sample additive containers

## 12 Servicing the FBC filter

The following instructions provide advice on how to access and remove the silicon carbide filter module for inspection and cleaning.

### 12.1 Removing the silicon carbide filter module

All EminoX DPF systems are installed using a modular clamp ring system which allows removal of the filter from the system without the need to completely remove either the silencer or pipe work arrangements. An example drawing of the clamp arrangement follows (Figure 15). Two single bolt - "v" clamp units are released in order to allow removal of the central filter section.

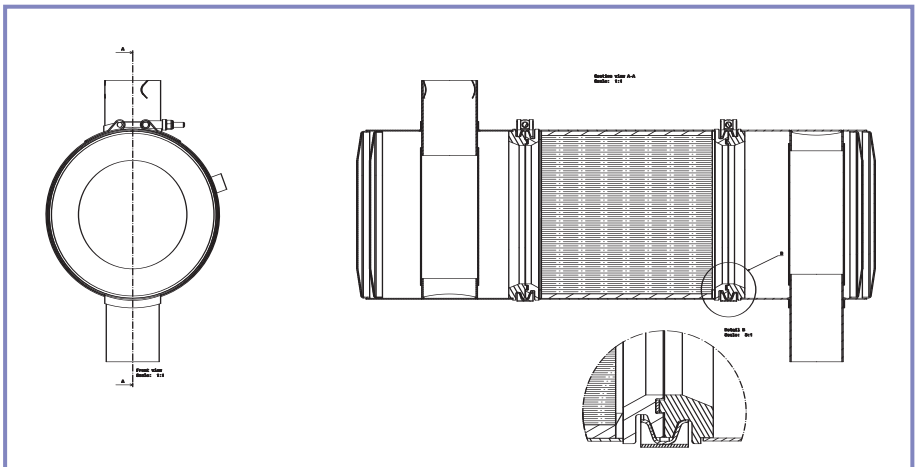


Figure 19 - Typical SiC filter module clamping arrangement

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Care should be taken to adequately support the filter while removing it. Filter units are heavy and should not be dropped. The Eminox clamping system provides male / female clamp rings which positively locate the filter and utilise a gasket for a secure gas tight connection.

It is not recommended that used filters be reversed as this will allow residual ash to be blown out of the filter into the environment.

When replacing a filter please ensure that either the original gaskets are in good condition or are replaced.

## 12.2 Filter inspection

Filters that have been removed for inspection should be handled with care and with the appropriate use of personal protection equipment such as protective glasses and gloves. A visual inspection of the inlet and outlet faces of the filter should indicate a clear difference in colour between the two faces.

The inlet face of the filter will be coated with soot (Figure 16). The inlet channels of the filter should not show signs of plugging. If plugging exists, the filter should be returned to Eminox for cleaning.

The outlet face and channels of the filter should not be plugged with soot. Essentially the outlet face of the filter should be clean and without significant deposits or traces of soot (Figure 17). Significant deposits of soot on the outlet face or around the circumference of the outlet face of the filter would indicate a problem. In this case the filter should be returned to Eminox for inspection.

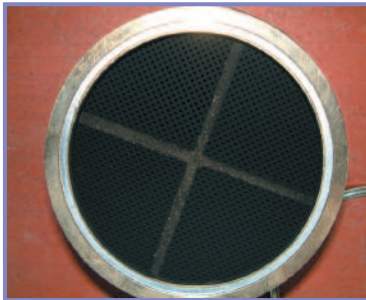


Figure 20- Inlet face of a used filter



Figure 21 - Outlet face of a used filter

### 12.3 Eminox filter service exchange

Filter cleaning and removal of ash can only be achieved with specialist cleaning equipment so it is strongly recommended that an Eminox Service Exchange Filter is used. A service can be arranged as a direct supply to the operator's workshop or through an on-site fitting service. In each case these fully reconditioned units benefit from a 12 month guarantee.

Details may be obtained from the Eminox Filter Service Centre. More details can be found at [www.eminox.com](http://www.eminox.com).

The exchange programme minimises downtime and removes the need to handle dirty filters and manage the waste disposal. The specially developed cleaning process helps maintain the service interval and improves the longevity of the filter.

## 13 Additional regular service items

### 13.1 Visual inspection of the exhaust pipe work

It is recommended that whenever the exhaust system is being worked on during a normal service, a visual inspection of the pipe work integrity should be completed. Many Eminox FBC systems incorporate a length of stainless steel flexible pipe to isolate the transfer of engine vibration to the filter system (Figure 18). Flexible pipe in the exhaust stream is considered to be a normal wear item and will require periodic replacement.

If the flexible pipe is split or leaking significantly - the component will need to be replaced. Check clamp joints in pipe work for tightness. A small amount of leakage is normal in metal to metal joints and is only considered significant if noise is observed.



Figure 22 - Typical flexible pipe used to isolate vibration

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## 13.2 Smoke check

Eminox FBC systems qualify for Reduced Pollution Certification (RPC) within the UK Vehicle Certification Agency - Vehicle Excise Duty emission reduction scheme. A requirement for annual renewal of the RPC is a smoke test at an approved Vehicle Inspectorate testing centre.

As a general guideline – smoke opacity levels exceeding an average k value after the filter of 0.2 m-1, should be inspected for filter integrity.

## 13.3 Active regeneration maintenance

The active system can only be serviced by an Eminox Service Engineer as the controls are in the ECU which cannot be accessed by the operator. The operator can however check the glow plugs and wiring for signs of wear using the following process.

- Turn off ignition. Please be aware that the glow plugs operate on a large current, please ensure all normal electrical safety procedures are taken before continuing. If in any doubt about the actions detailed below please consult Eminox Ltd for assistance.
- Remove power cable from plug.
- Remove plug from filter
- Check plug for excess wear. Figure 5 shows a normally wearing tip. Figure 6 shows a worn tip.



Tip length 3 - 8 mm indicates good condition.

Figure 23 showing a normally wearing tip



Worn out tip, only 1 - 2mm of it left.

Figure 24 showing a worn out glow plug

Typically the tip of the plug should be 3-8mm long. If the tip is shorter than this then the glow plug will not work and needs to be replaced. The glow plugs are considered to be wear part and will need to be replaced from time to time.

- Check the integrity of the wiring to the glow plug for physical damage.
- Reassemble the glow plug into the filter and re-attach wiring.

## **14 Safety**

Care should be taken when handling Satacen 3<sup>®</sup> FBC products. Please refer to the safety data sheet. Gloves, splash protection and safety glasses are minimum recommendations for the safe handling of Satacen 3<sup>®</sup> products.

# Eminox - FBC Active Fuel Borne Catalyst System

## 15 ECU technical specifications

### Case

IP65 thermoplastic (Nylon 66), 134mm x 118mm x 36mm  
2 x Ø7.2 mm mounting holes 102 mm apart

### Supply

12/24 VDC, at 15mA acquiescent, 'brown out' detection at < 9.0 VDC

### Inputs

Level Volt free contact from the level sensor in the additive tank -  
low level = OC

### Outputs

Pump Output at 12v return to controller or chassis return  
Rated at max nominal 1.8 Amp continuous short circuit protected at 5 Amp  
Open/short load sensed as pump fault

### Dash indicator

Output at vehicle supply voltage to chassis return  
Rated at max nominal 1.8 Amp continuous short circuit protected at 5 Amp

### Heat control relay drive

Output at vehicle supply voltage to chassis return  
Rated at max nominal 1.8 Amp continuous short circuit protected at 5 Amp  
Total output current protected by internal auto-reset fuse  
6A trip, 3A hold

### RS232 port

Diagnostics interface connection using windows hyper terminal

Bits per second =	9600
Data bits =	8
Parity =	none
Stop bits =	1
Flow control =	Xon/Xoff
Function keys =	Terminal keys
Emulation =	ANSI

### Harness

Pre assembled connector with 5 m cables  
See electrical hook up diagram Section 5.5.4 (Figure 9)



## **Customer Support Contacts**

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