Andhra Pradesh State Road Transport Corporation

Office of the Managing Director, RTC House, Vijayawada-13.

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Sub: MAINTENANCE – Introduction of **Ashok Leyland 222" WB EURO-IV compliant i-EGR Buses in APSRTC** – Salient features and maintenance aspects communicated - Reg.

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APSRTC has recently introduced 300 Nos., **222" Wheel Base, i-EGR, EURO-IV compliant** buses of **Ashok Leyland** make in various brands viz., Super luxury, Express, Ultra Deluxe and Palle Velugu buses. The product is same in all technical features and maintenance aspects as that of the **210'' WB** Saptagiri express buses(166 Nos- Euro IV) inducted in APSRTC a couple of years back. The only difference is in respect of the Wheel Base, Overall Chassis Length, Front and Rear Overhang and type of suspension system.

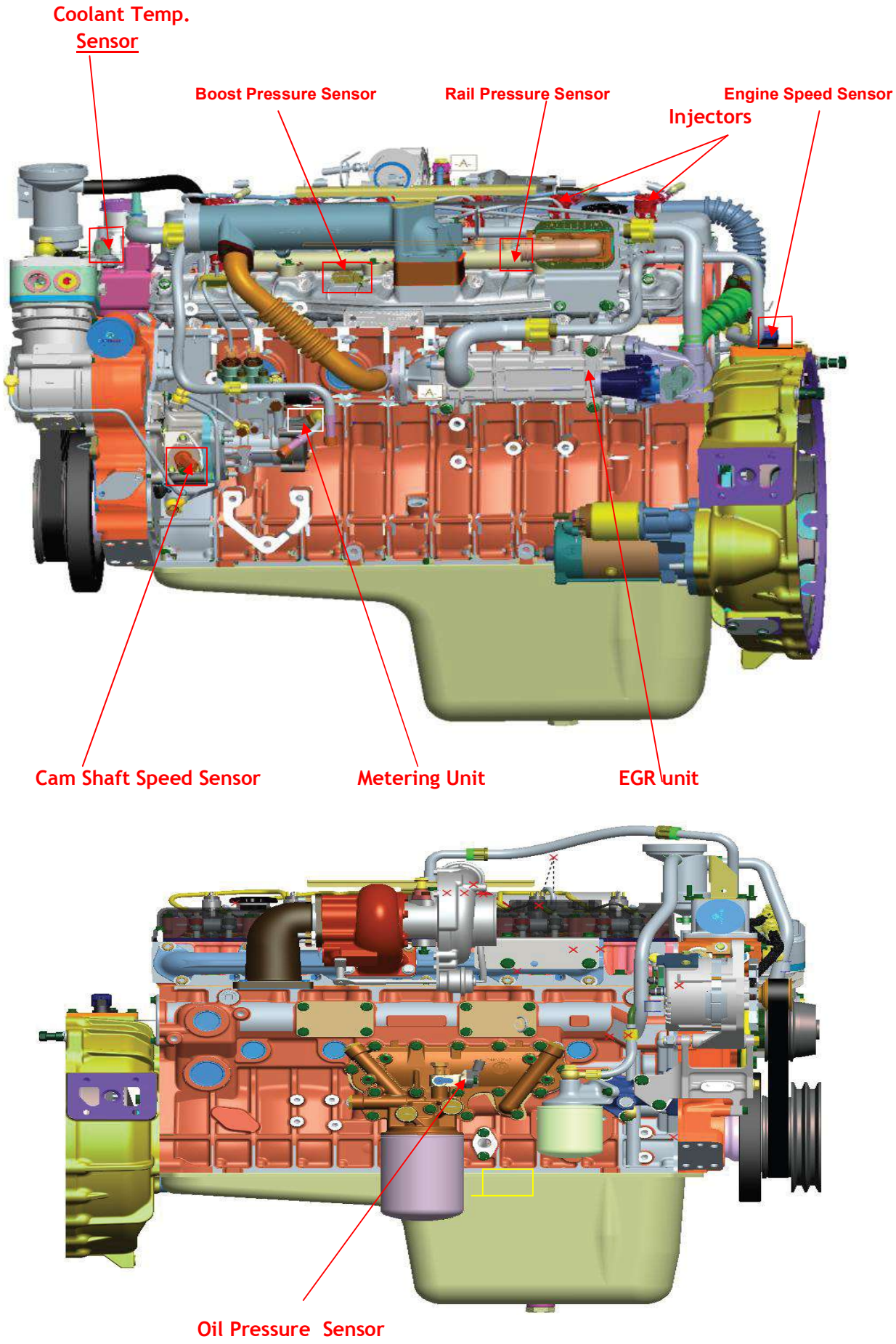
The technical specifications, salient features & maintenance systems of these buses are furnished hereunder.

1.0 Dimensions (in mm)

Description	222'' WB Viking	210'' WB Cheetah
Wheelbase	5639	5334
Overall Chassis Length	10859	9946
Overall Chassis Width	2440	2440
Front overhang with Bumper	1912	1486
Rear overhang	3308	3126
Front Track	1963	1963
Rear Track	1816	1816
Frame Width	864	864
Suspension	Weveller (262) / Air (38) suspension	Shackle suspension

2.00 **Engine**

- Engine Model : H Series H6E4ED118 OBD-II Engine
- Type : Common Rail Diesel Injection 4 Stroke 6 Cylinder Direct injection, Inline Over-head valve
- Max Power : 118 kW @ 2400 rpm
- Max Torque : 550 Nm @ 1200 - 1900 rpm
- Bore and Stroke : 104 x 113 mm
- Piston displacement : 5.759 liters
- Compression Ratio : 16.2 : 1
- Firing order : 1-4-2-6-3-5
- Valve Clearance : Intake - 0.30 mm (0.012")
  : Exhaust - 0.45 mm (0.018")

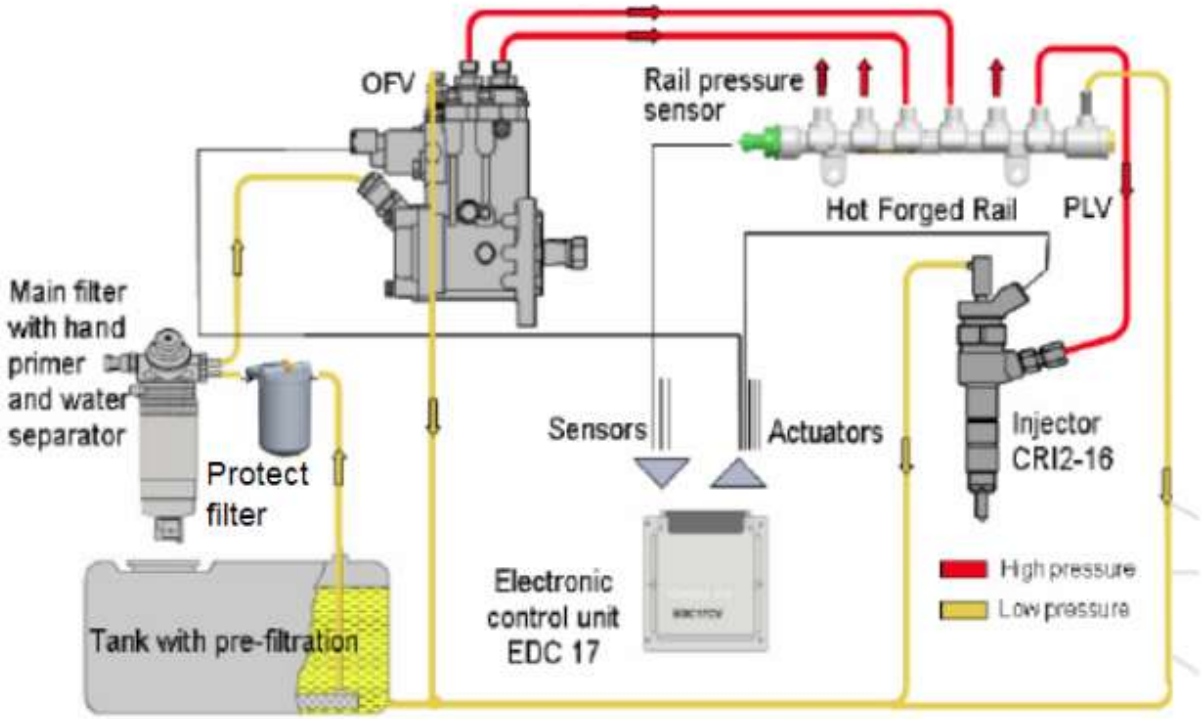

Coolant Temp.
Sensor
Boost Pressure Sensor
Rail Pressure Sensor
Engine Speed Sensor
Injectors
Cam Shaft Speed Sensor
Metering Unit
EGR unit
Oil Pressure Sensor

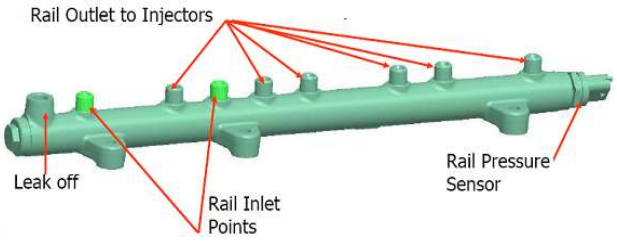
3.00 Fuel System

This is an electronically controlled common rail fuel system (CRS). The firing order is 1-4-2-6-3-5. The injection pressure is up to 1600 bar. The amount of fuel and injection timing are controlled electronically via Electronic Control Unit (ECU) which receives signals from number of sensors.

- Fuel Injection Equipment : Common Rail System, CB 18 (CRS)
- Injection Nozzle : CRS Electronic type
- Idling Speed : 600 ± 50 rpm
- Fuel Tank : 240 liters
- Number of Sensors : 9 Sensors, 2 Switches & 3 Actuators.

3.1 Fuel Line Diagram





Following are the critical components of CRS system.

1. High Pressure Pump
2. Rail
3. Injector
4. Common Rail pressure sensor

3.2 Electronic Control Unit (EDC 17)

In EDC system, the driver has no direct control over the injected fuel quantity through the accelerator pedal

The injected fuel quantity is based on:

1. The vehicle response desired by the driver communicated through the accelerator pedal sensor with the help of ECU.
2. The engine operating conditions
3. The engine operating coolant temperature
4. Boost pressure
5. Engine speed

3.2.1 **EDC system is subdivided into:** 1. Sensors 2. Actuators 3. Switches and 4. ECU

3.2.1.a. Sensors: Detect the engine operating conditions and the driver's demand. They convert physical variables into electrical signals.

S.NO	Sensors	Location	Function
1	Engine Speed Sensor	On flywheel housing	Monitors Engine Speed & Cylinder TDC (for start of injection)
2	Cam Speed Sensor	On mounting flange of FIP	Monitors FIP Cam Speed & 1st cylinder TDC (for start of injection)
3	Vehicle Speed Sensor	Near Gear box output shaft.	Monitors vehicle speed
4	Boost Pressure & Temperature Sensor	Above Intake manifold	Monitors intake air pressure & Temperature
5	Rail Pressure Sensor	Rear side of Common Rail	Monitors rail pressure
6	Oil Pressure & Temperature Sensor	On Engine oil cooler module	Monitors the engine oil pressure & Temperature
7	Accelerator Pedal Sensor	In Accelerator Pedal (operating pedal)	Monitors Driver demand and send information to ECU
8	Coolant Temperature Sensor	Above Thermostat Housing	Monitors the coolant temperature
9	Water in Fuel Sensor	Below Main filter cum water separator	Informs engine ECU about presence of water in filter

3.2.1.b. Actuators: Convert the electrical signal from the ECU into physical variable.

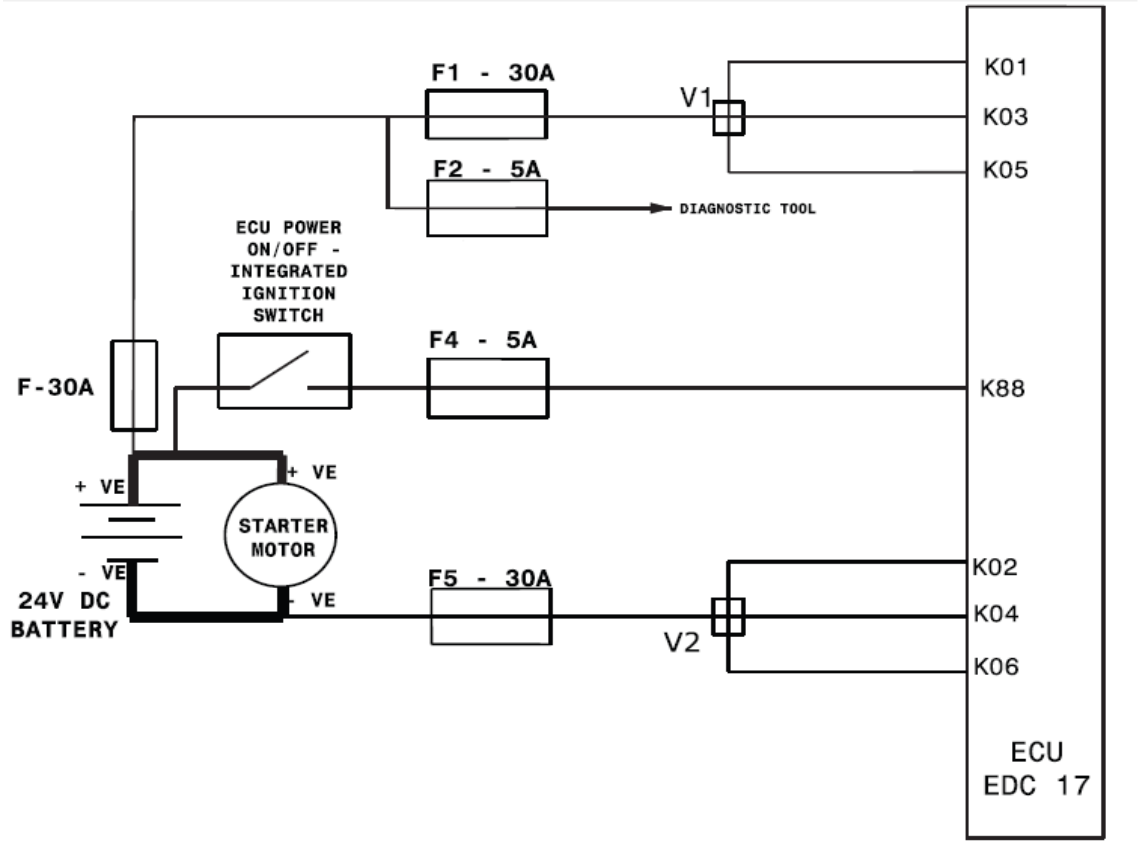
S.NO	Actuator	Location	Function
1	Fuel Injectors	On the cylinder head	Solenoid valve opens on receipt of signal from ECU. The opening time of the injector determines the amount of fuel injected with respect to Rail pressure.
2	Metering Unit	On the high pressure pump	To control the fuel quantity inflow in to high pressure pump from Low pressure pump.
3	EGR Valve	Near EGR Cooler Assembly(Below intake manifold)	Controls inflow of exhaust gas to EGR cooler assembly as per the signal from ECU

3.2.1.c. Switches: Monitor the application of control functions like clutch and brake

S.No	Switch	Location	Function
1	Brake Switches	On Dual Brake valve	Monitors the application of brake
2	Clutch Switches	Near clutch linkages	Monitors the application of clutch

3.2.1.d. Electronic Control Unit (ECU): The ECU is the brain of the systems that process the requirements through sensors and the accelerator pedal movement with the fuel mappings already calibrated in the ECU and decides on the quantity of fuel delivery through injectors. It operates on 24V DC. It also provides interfaces with other systems like diagnostic tool, ABS etc.

3.2.2. EDC Circuit Diagram



4. EDC Related Error Diagnostics

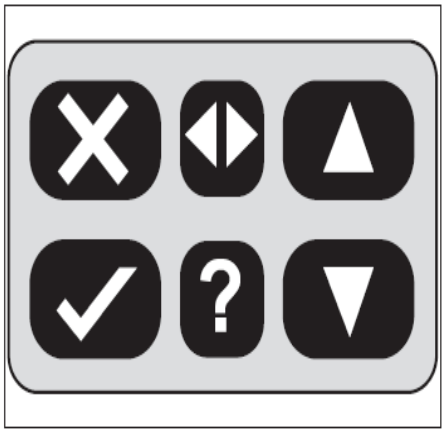
EDC related errors can be diagnosed through two methods. Both Methods are explained below.

4.1. Through Scan Tool(recommended scan tool version v2.60)

The same scan tool being used so far for Euro- III Indra buses(old) can be used for these Euro-IV buses also by getting the software updated by M/s Ashok Leyland.

The scan tool is to be connected to the ECU through a power cable via the diagnostic connector located on the dash board, on to the left side in the instrument panel .

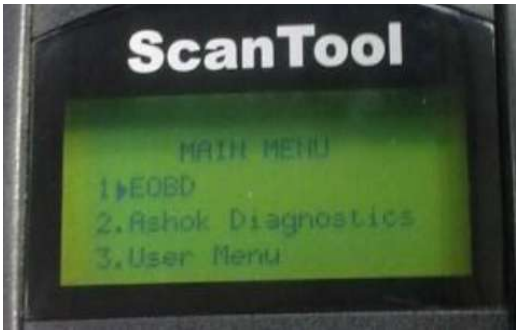
The scan tool is operated via 6 - button keyboard shown below and the table showing details of the keypad buttons and their functionality.



Key	Function
✓	Select a menu option, Continue or Yes
✗	Exit a menu or No.
▲	Scroll up within a menu or text
▼	Scroll down within a menu or text.
◆	Scroll left and right.
?	Provide context sensitive help (where available).

Operating Scan Tool

Step 1: Select **"2. Ashok Diagnostics"** from Main Menu.



Main menu	
1.	**EOBD**
2.	**Ashok Diagnostics**
3.	**User menu**

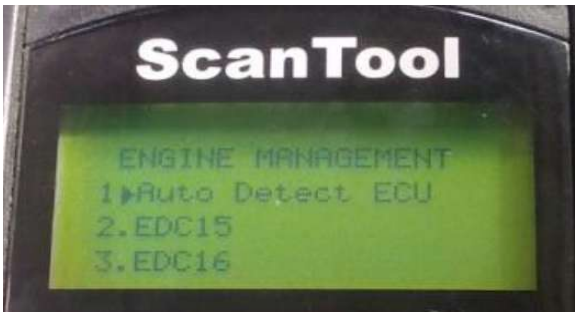
Step 2: Select **"1. Engine"** from Ashok Diagnostics menu.

Ashok Diagnostics	
1	Engine
2	Vehicle
3	Read logs
4	Clear logs

Step 3: Select **"1.Diesel"** Engine menu.

Engine Menu	
1	Diesel
2	CNG

Step 4: Select "**1. Auto Detect ECU**" form Engine Management Menu. After searching few seconds it finds the EDC15/16/17 which is connected to it.



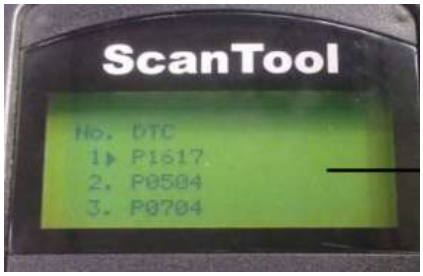
Engine Management	
1	Auto detect ECU
2	EDC 15
3	EDC 16
4	EDC 17
5	Delphi
6	Denso

Step 5: EDC Menu will be displayed. For BS4 EGR vehicle EDC 17 EGR will be displayed.

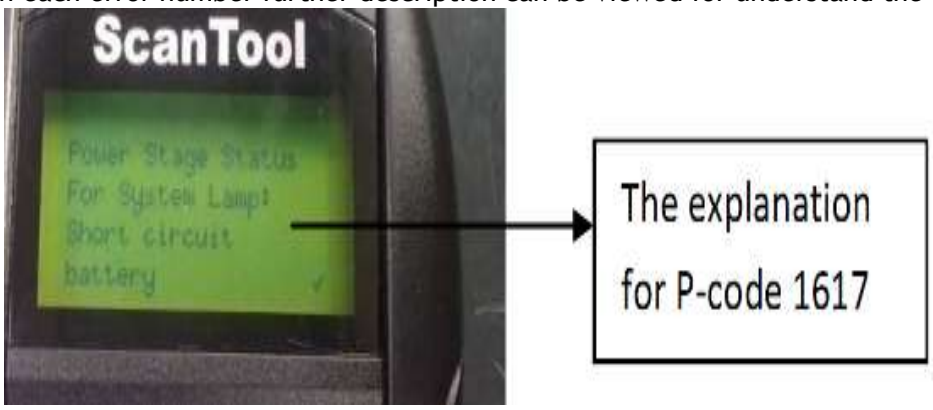
EDC 17 EGR			
1	Read ECU Id	7	Adjustment ADRR
2	View DTCs	8	Actuators
3	Erase DTCs	9	Save log
4	Live Data	10	Red logs
5	Freeze data	11	Clear logs
6	Adjustment parameter		

Option 1. Read ECU ID is to see the data set version and programming details.

Option 2. View DTC is to view the diagnostic trouble codes recorded by ECU(For checking errors).



If clicked on each error number further description can be viewed for understand the failure.



Option 3. Erase DTC is for deleting the error codes after rectifying the complaints.

Option 4. Live Data is for viewing live parameters of engine like Engine speed, accelerator position, vehicle speed etc.

4.2. Using EDC blink code

In normal condition after ignition key is on the EDC lamp in the instrumental panel will appear for 3 seconds and goes off. EDC lamp will glow continuously if any error codes registered in ECU.

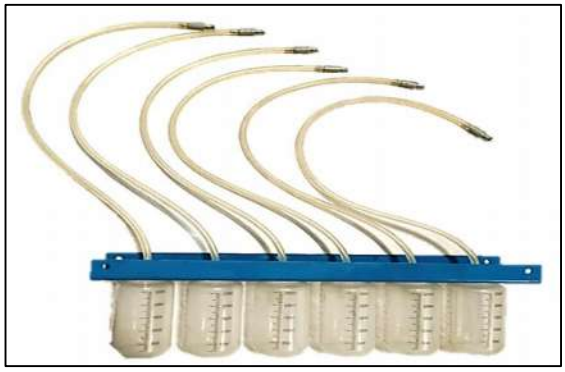
For diagnosing the error, EDC request switch available at right side in dash board as shown above is to be pressed for two seconds and released. The EDC lamp will start blinking. The number of blinks from the Warning lamp to be counted and noted till blinking stops. After a small pause, again warning lamp blinks and the number of blinks to be counted and noted till blinking stops. These two numbers indicate the fault code and this code to be verified with DTC chart at Annexure-4 to findout the actual error. The fault codes are in two digits form.

For example, initially if the warning lamp blinks 3 times followed by a small pause (approximately for 2 seconds) and if it blinks 5 times after the pause, then the error code is 35 and the error description is " Maximum negative rail pressure deviation with metering unit on lower limit is exceeded (Actual rail pressure exceeded at set point)".

5.0. INJECTOR TESTING WITH BACK LEAK TESTER FOR CB18 INJECTORS:

Back-leak tester is a tool to check condition of CB18 Injectors on vehicle. This will help to identify the injector condition by checking the back flow quantity of injectors on the vehicle in static condition to identify the defective injectors.

The Injector Back leak tester has graduated standard plastic container, Nozzle with O ring, silicon flexible tube and Holding plate as shown below.



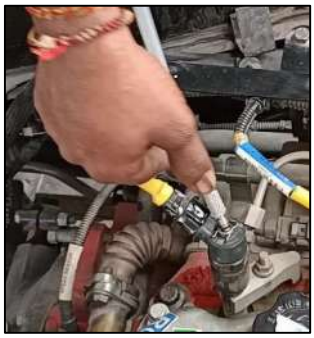
Before removing the CB 18 injectors from engine, the back flow quantity should be measured using back leak tester and the Injectors having back leak over and above the specified quantity needs to be removed for further testing on the test bench.

Procedure for checking Injector back leak using **"Injector Back leak tester":**

a. Park the vehicle at dust free area and ensure Hand brake is in applied condition
b. Position the wheel chocks closely against the wheels
c. Clean the injectors leak off pipe connectors area with soft cloth.
d. Start the engine and warm up the engine up to 85°C
e. Remove the OE fitted back leak pipes carefully by releasing the lock from the injector back leak connector one by one.

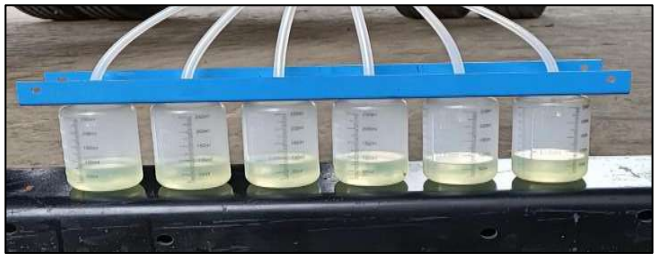
a.

f. Connect one end of the back leak kit tube (with nozzle) to the injector side where the fuel return end is connected and other end of the flexible tube to the graduated standard plastic container.



i.

g. Start the engine and run it in idling speed for 30 sec.
h. Ensure that there is no leakage from the connector on injector side.
i. Stop the engine and discharge the collected fuel from the container.
j. Ensure that the hose and container are empty.
k. Again start the engine and run it in idle for 30 sec.
l. Watch the fuel return through injector leak off line and collected in each container
m. Slowly accelerate the engine and maintain 2200 rpm for 150 seconds (2 min 30 sec) use stop watch to monitor the time
n. After 150 seconds, release the accelerator. Engine will be back to idling rpm. After that switch off the engine. Make sure that the fuel in the back leak hoses is drained into the containers completely.
o. Record the back flow quantity collected in the containers.



p. Upper limit for good injector is 140 ml and any injector reading crossing more than 140 ml is considered for removal from the engine for further testing and replace the injector with the good conditioned injector.

q. Remove the back flow tester from the engine and fit back the OE injector leak off connectors with pipe carefully.

a. 

r. Start the engine and confirm that there is no external leak from the injector leak off connector.

s. The removed injectors must be checked at test bench for correction.

t. BACK LEAK TESTER-CB18 INJECTOR Part Number : PK500594

6.0. Air Intake System

- Air cleaner: Dry type two stage Air filters with Service Indicator
- Turbocharger(TC): Radial flow and Waste gate arrangement
- Do not apply Anabond at the joints for packing of lubricating pipes as the remains of Anabond will block the passages of full floating Turbo Charger shaft bushes and due to lack of lubrication, the Turbo Charger fails. Use the recommended gasket only.

7.0. Lubrication system:

- Full flow pressure circulation is similar to the existing BS-III model vehicles. In order to increase heat dissipation capacity of engine oil the no. of plates on the oil cooler is increased from 5 to 8.
- A modified compressed asbestos gasket (Steel plate sandwiched) is used for these oil coolers and the old Euro -III gasket should not be used.
- Oil filter : Spin on type is fitted
- Lubricating oil total capacity : 18 Liters
- Max. oil pressure : Full-load 4.5/4.8 kg/cm^2
  : Idling 1.2/1.6 kg/cm^2

8.0. Cooling system:

- Type : Forced circulation by volute pump, 55 mm dia ball and roller bearing.
- Impeller Dia : 100 mm
- Radiator : Aluminum core
- Thermostat : Single thermostat, Wax type, Bottom bypass system, open at 82°± 2°C
- Coolant capacity : 22.5 ± 1 Liters
- Drive belt tension : Deflection of 10-15 mm when pressed midway at longest point between pulleys
- Always maintain the coolant level to MAX position marked on DAT tank
- Recommended coolant in 1:1 ratio should be used to avoid overheating and tank rusting complaints
- **Check & ensure the working stroke of thermostat (7.5 mm at 95°C) with the help of Vernier Caliper.**

9.0. Clutch

Mechanical linkage clutch operating system with 353 mm Dia Single Plate Dry Type clutch disc – Organic lining

- Clutch Type : Single dry plate 14" RDC (Four finger)
- Actuation : Mechanical
- Facing dia (mm) : 353
- Thickness (mm) : 14.4
- Total frictional area cm^2 : 1180

10.0. Gear box

- Type: ZF-S6 36 Six speed Synchromesh Gear Box
- No. of speeds: 6 forward (including overdrive) and 1 reverse
- Oil capacity : 6.5 Liters
- Gear Ratio: 1^{st} – 6.93, 2^{nd} – 4.43, 3^{rd} – 2.63, 4^{th} – 1.51, 5^{th} – 1, 6^{th} (OD) – 0.84, Reverse – 6.22

11.0. Front Axle

- Type:ALFA-90, Heavy duty forged I Beam, Reverse Elliot type
- Hub end play (mm): 0.025 to 0.1
- Axle arm end play (mm): 0.025 to 0.1

12.0. Rear Axle

- Type: 60SHO-Dana, Fully floating single reduction hypoid gear, Heavy duty pressed beam banjo type
- Axle Ratio: 5.57:1
- Hub end play (mm) : 0.025 to 0.1

13.0. Steering

- ZF/Rane Power Steering

14.0. Suspension

For 210" WB Saptagiri buses: shackle suspension in Front & Rear.
For 222" WB Buses, Weveller type, Rubber ended leaf spring in Front and Rear.

15.0. Brakes

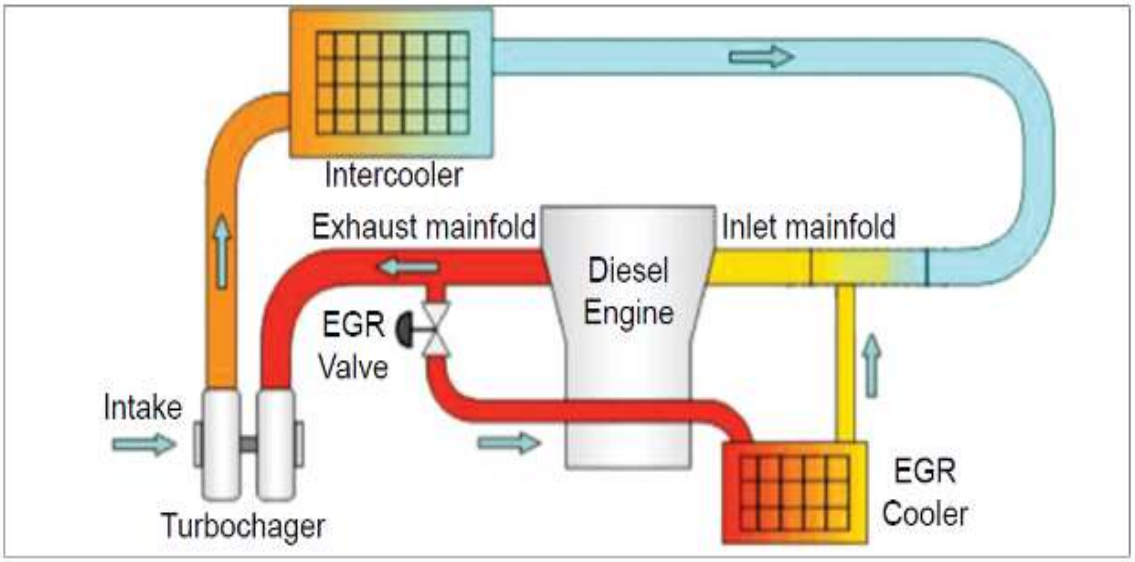
1) Foot operated Engine Exhaust brake
2) Service brake
    - Type: S'cam dual Air brake system with ABS
    - Air compressor: 160 cc Air cooled
    - Slack adjuster: Automatic

16.0. EGR (Exhaust Gases Recirculation) System to meet Euro-IV Emission Norms:

EGR is a technology that works by re-circulating a portion of engine's exhaust gas back to the engine cylinders to reduce NOx (Oxides of Nitrogen) emission.

NOx is produced at peak temperature inside combustion chamber. Exhaust gas recirculation to combustion chamber dilutes oxygen (O2) content and reduce peak temperature.

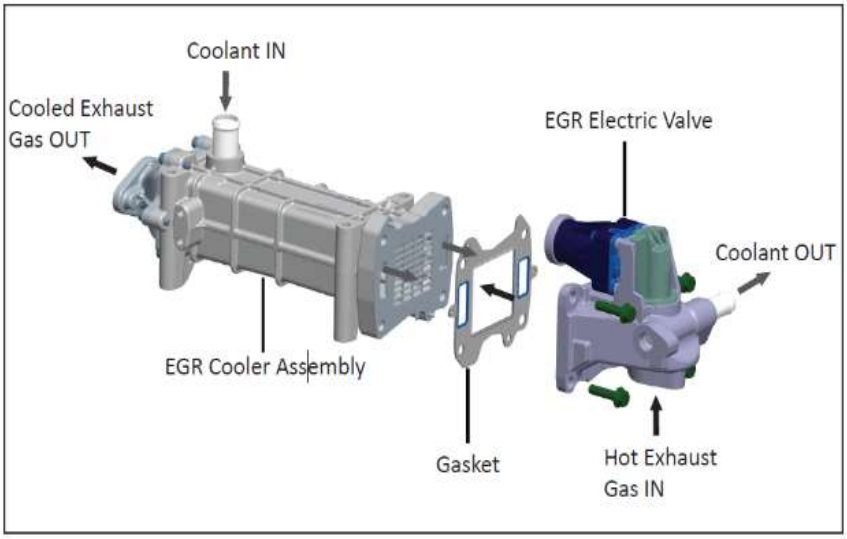
EGR Working Principle:



16.1 EGR Cooler and EGR Valve

The amount of exhaust gas sent to the inlet manifold is controlled by EGR valve. This valve is electrically operated and controlled by ECU.

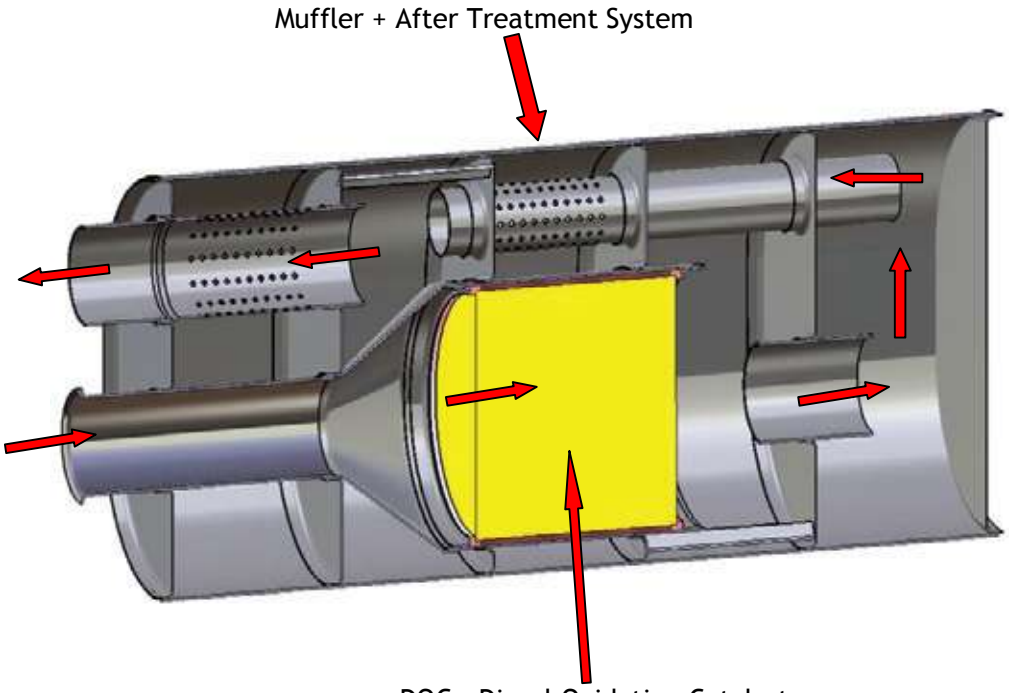
Exhaust gas is then cooled in the EGR cooler to allow greater mass of exhaust gas in the engine cylinders. EGR Cooler is a cross flow type heat exchanger where exhaust gas is passed through pipes in the middle and coolant is passed between walls surrounding the pipes, to absorb the heat.

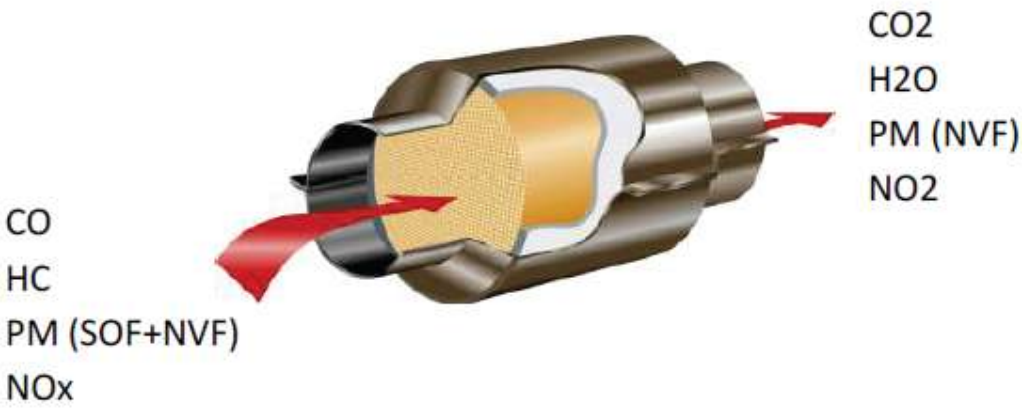


16.2 EXHAUST GAS AFTER TREATMENT SYSTEM (ATS)

Diesel Oxidation Catalyst (DOC)

- Consist of a stainless steel canister that contains a honeycomb structure called a substrate.
- The interior surface is coated with catalytic metal that oxidizes the soluble organic fraction of particulate matter, specifically carbon monoxide, gaseous hydrocarbons and the liquid hydrocarbons absorbed on carbon particles.
- The result is carbon dioxide and water.
- Oxidizes HC & CO.
- Residual amount of Oxides of Nitrogen (NOx) getting converted to NO2





Note: Do not remove the catalyst inside the silencer muffler or replace with ordinary muffler

17.0. Anti-Lock Braking System (ABS-4S 3M)

Anti-lock braking System (ABS) is an automobile safety system which prevents the wheels from locking up (ceasing rotation), avoids uncontrolled skidding and enables better vehicle control during braking. In the event of a malfunction in the system, the ABS in the affected wheel(s) is disabled and the wheel will have normal braking. All other wheels keep the ABS function.

ABS consists an Electronic Control Unit, number of wheel sensors and modulator valves depending upon vehicle configuration. The ECU constantly monitors the rotational speed of all wheels through speed sensors and if a wheel rotates significantly slower than others then it indicates impending wheel lock situation. Under such condition the ECU will actuate the modulator to reduce the air pressure to the brake at the affected wheel thus reduces the braking force.

17.1. Major Components in ABS

17.1.1. ABS ECU (Electronic Control Unit)

The Electronic Control Unit (ABS ECU) receives and processes signals from the wheel speed sensors. When ECU detects a wheel lockup through wheel speed signals from the sensors, triggers the appropriate modulator valve to modulate the air pressure to the brake actuator during ABS function.

17.1.2. Pole wheel

Pole wheel is a toothed wheel made of ferrous material and it is fitted (interference) on the wheel hub. It rotates along with the hub and cuts the magnetic flux generated by the wheel speed sensors

17.1.3 Wheel speed sensor

ABS Wheel speed sensor is a magnetic type sensor which measures the wheel speed to which it is attached. It consists of a permanent magnet with a coil wound around it and works in conjunction with pole wheel to measure the wheel speed. The sensor

continuously generates magnetic pulses in proportional to wheel speed and sends the signal to the ECU. . It is mounted on the anchor plate. To mount, push the sensor till it touches the pole wheel, rotate the hub clock wise and anti clock wise.

17.1.4 Modulator Valve

It is an electro pneumatic solenoid valve which modulates the air pressure supplied to the brake chamber or spring brake actuator at three states i.e Apply, Hold and Release according to the command received from the ECU. It is normally open. It is fitted between DB valve and brake chambers.

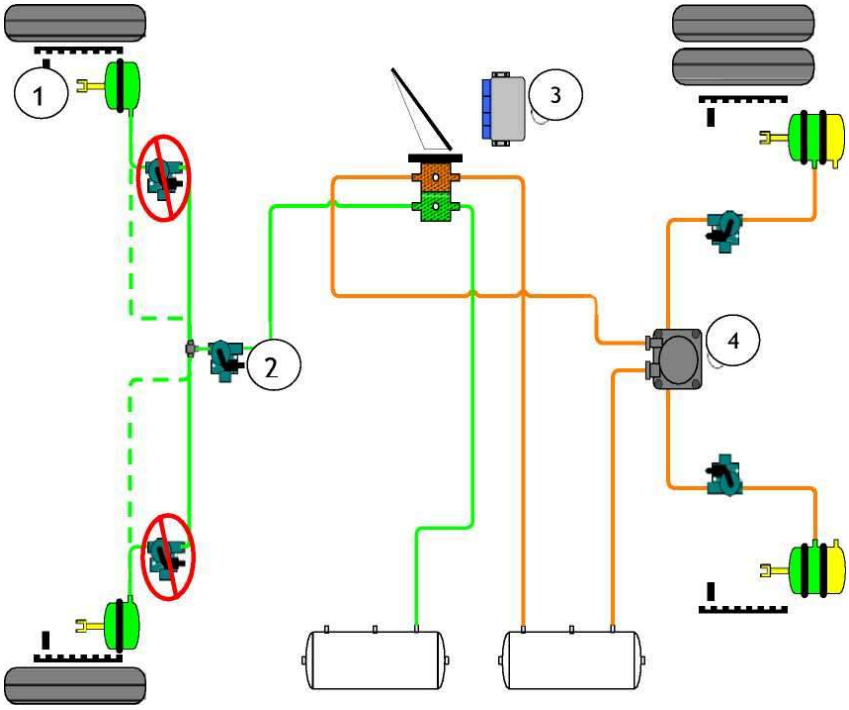
17.2.0 Functioning of ABS

Whenever the ABS ECU senses differential speed between two wheels of same axle, ECU recognize as wheel lock situation in the wheel which is rotating at lower speed and ABS ECU actuates modulator valve and modulates air supply to those specific wheel ends and prevents wheel lock, ensures vehicle stability & steerability.

17.3.0 Functionality check for ABS system

To check the functionality of ABS system, keep the vehicle in stationary condition, press brake pedal and switch 'ON' the Ignition key, observe for the actuation noise of individual solenoids. Every solenoid (modulator) will be actuated and air will be released from the bottom of modulator. For example for 4S3M variants – actuation noise of 3 solenoids will be heard followed by air release. The above check will confirm that ABS circuit is intact.

ABS Schematic Diagram



1	Pole wheel
2	Modulator valve
3	ECU
4	Relay valve

17.4.0 Troubleshooting

Blink code diagnostics procedure should be used to read and clear the error codes.

To read blink codes:

- Keep the vehicle in static condition and switch 'ON' Ignition.
- Warning lamp comes 'ON' and goes 'OFF', if there is no active error.
- If there are active errors, Warning lamp will remain in 'ON' condition.
- Press and hold the blink code switch for a second and then release it.
- Then, ABS Warning lamp will start blinking according to the failure mode.
- The number of blinks from the Warning lamp to be counted and noted till blinking stops. After a small pause, again warning lamp blinks and the number of blinks to be counted and noted till blinking stops. These two numbers indicate the error code and this code to be verified with Error code chart shown below to findout the actual error. For example, initially if the warning lamp blinks twice followed by a small pause and one blink after the pause (i.e in two segments) then the error code is 2 -1.

ABS – Warning lamp

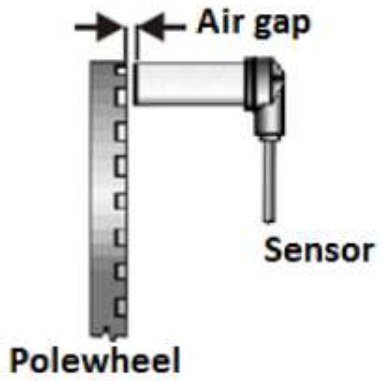
ABS - Blink code switch

17.4.1 Error code chart

Slow blink	Quick blink
1 - No faults	1. No faults
2 - ABS Modulator valve	1 - Front Right (FR) 2 - Front Left (FL) 3 - Rear Right (RR) 4 - Rear Left (RL)
3 - Sensor Air Gap	
4 - Sensor Short / Open	
5 - Sensor Intermittence	
6 – Pole wheel Sensor	
7 - System function	1 - Engine Control data link 3 - Third brake relay short / broken wire 4 - Warning lamp
8 – ECU	1 - Battery under voltage 2 - Battery over voltage 3 - Internal fault 4 - Configuration error 5 - Ground

17.5.0 Air gap

Between pole wheel and sensor, air gap of minimum 0.2 mm to 0.7 mm should be maintained. During assembly, pole wheel sensor is to be pushed against the pole wheel such that it touches the pole wheel. Afterwards rotate the hub manually which will push back the sensor and ensure working gap of 0.2 to 0.7 mm.



18.0. Wheel & Tyre

Rim size : 7.5" HD x 20"
Tyre Size :10 R 20 - 16 PR Radial

19.0. Electrical system

- Battery: 2 x 12v – 150 AH (20 hr rating)
- Alternator: 24v 55A, belt driven
- Starter type: 24 V - 4.5 kW pre-engaged with thermal cut off

20.0. Performance

Max Speed : 92.0 (Max Speed Limited to 80 kmph)
Gradability(Restart) : 19.51 (with 5.57 RAR, 10R20 Tyres & S6 36 OD GB 6.93 FGR)
Gradability (Running) : 22.47 (with 5.57 RAR, 10R20 Tyres & S6 36 OD GB 6.93 FGR)

21.0. RECOMMENDED LUBRICANTS, COOLANT & CLUTCH FLUID

Aggregate	Specification	Gulf Oil Product Name	IOCL Product Name	Capacity
Engine Oil	API CI-4, SAE15W40	Gulf Super fleet LE Dura Max 15W-40	Servo Pride ALT Plus 15W40	18 ltr
Gear Box oil	SAE 80W90 API GL5	Gulf Gear XP Dura Max 80W-90	Servo Gear ALT 80W-90 (LL)	6.5 Ltrs
Differential Oil	SAE 85W140 API GL5	Gulf Gear DB Dura Max 85W-140	Servo Gear Axle ALT 85W-140	14 ltr
Power Steering oil	DEXTRON IID	Gulf Power Steering Dura Max	Servo Transdex II	Rane /ZF 4 /4.5ltr
Wheel Brg Grease	IS 12203	Gulf Crown LX Dura Max NLGI 3	Servoplex ALT 3	Front hub - 450 ± 25 gms/hub
				Rear Hub- 350 ± 25 gms/hub
Coolant		Euro cool LL max 40	--	23.5 ltr

LUBRICANTS, COOLANT & FILTERS CHANGE PERIODICITIES		
1	Change Engine Oil & Filter	80,000 kms
2	Fuel filter cum Water separator replacement	40,000 kms
3	Both Fuel filter elements (Engine mounted, Spin on) replacement	40,000 kms
4	Replace Gear Box oil	1,20,000 kms
5	Replace Differential Gear oil	80,000 kms
6	Replace Power Steering Oil filter	80,000 kms
	Replace Power Steering Oil	1,60,000 kms
7	Replace Wheel Bearing Grease (Lithium base grease)	80,000 kms
8	Air Cleaner Primary replacement	72000 kms or Whenever the vacuum indicator shows red band which ever is earlier
9	Air Cleaner safety replacement	At the time of every third replacement of primary filter element or 2,16,000 kms which ever is earlier
10	Antifreeze Coolant replacement (applicable for Recommended coolant (pre-mixed) with coolant filter	2,00,000 kms

22.0 The list of essential spare parts required for maintenance of the buses is furnished at Annexure-1

23.0 The list of Preventive maintenance schedules of the buses is furnished at Annexure-2

24.0 The list of Do's & Don'ts to be followed in respect of ECU and electrical wiring harness, during the maintenance of the buses is furnished at Annexure-3

25.0 The Error codes list, both P-codes and Blink codes, is furnished for reference in Annexure-4

26.0 ADDITIONAL TOOLS REQUIRED FOR MAINTENANCE

S.NO	PART NAME	PART NO
1	Special tool for 14" clutch	0201007
2	Diagnostic Tester – BS III/IV Tool Kit	FN201100

27.0 The Dy.CMEs are advised to educate the staff on operation and maintenance of Euro-IV buses at the depots duly providing necessary tools required for day to day maintenance. They are advised to ensure to record, at depots, the repeated and unusual complaints, failure of units and sub-assemblies prematurely or at low mileages, faster wear and tear of the spares etc observed on these buses and monitor the performance regularly and furnish the feedback to MED Head Office at regular intervals.

28.0 The Controllers of Stores are advised to supply required spare parts to the Depots duly fixing the limits in consultation with respective DyCMEs.

29.0 The Depot Managers and Maintenance in-charges are advised to ensure proper maintenance to the vehicles and see that the vehicles are utilized to the full extent without any breakdown.

04/12/2020

EXECUTIVE DIRECTOR (E)

To
All Depot Managers

Copy to: ED (A), ED (O), FA&CAO for information.
Copt to: ED (VJA), ED (VZM), ED(NLR), ED(KDP) for information.
Copy to: All RMs for information.
Copy to: CME (M), CCOS, CME(C&B) & CE (IT) for information & n/action.
Copy to: OSD to VC&MD for information
Copy to: Dy.CME (M), Dy.CME (W), Dy.CME(C&B), Dy.CAO (SP&A), COS(C) for information.
Copy to: All Dy.CMEs, DVMs VZM & SKLM, WMs & COSs for necessary action.
Copy to: All Principals of ZSTCs & TA/VDPM for information.

LIST OF ESSENTIAL SPARES TO BE STOCKED AT DEPOT FOR AL BS-IV BUSES

SNO	ITEM DESCIPTION	PART NO.
1	ENGINE OIL FILTER	F7A05000
2	FUEL PRE FILTER INSERT	FHJ00400
3	FUEL MAIN FILTER INSERT	FHN00100
4	PRIMARY AIR FILTER	F8211200
5	SECONDARY AIR FILTER	F8211300
6	POWER STEERING OIL FILTER	P7A00010
7	PIPE, INJECTOR LEAK OFF	B2W00605
8	LEAK OFF PIPE RAIL TO TANK THROUGH P	B2W00606
9	FAN BELT	X0301650
10	FRONT BRAKE LINING KIT	P4317151
11	REAR BRAKE LINING KIT	P4317351
12	FRONT HUB INNER OIL SEAL	FA602100
13	REAR HUB INNER OIL SEAL	F2730200
14	REAR HUB OUTER OIL SEAL	FA602400
15	SENSOR - OIL PRESSURE & TEMP	X2009500
16	WATER LEVEL SENSOR	PF400025
17	BOOST PRESSURE SENSOR	X2009600
18	COOLANT TEMPERATURE SENSOR	X7472800
19	ENGINE SPEED SENSOR FOR CRS ENGINES	X7487500
20	VEHICLE SPEED SENSOR	FF406100
21	PINION OIL SEAL	P4900127
22	ACCLERATOR SENSOR	F8201160
23	5 AMPS FUSE	F8314400
24	10 AMPS FUSE	F2205200
25	15 AMPS FUSE	F8334800
26	20 AMPS FUSE	F2205100
27	30 AMPS FUSE	F8314300

PREVENTIVE MAINTENANCE SCHEDULES

Description of Activity	Sch-II	Sch-III	Sch-IV
ENGINE			
Check Engine oil level & arrest leakage if necessary	✓	✓	✓
Check & adjust Valve clearance	□	□	✓
Check and tighten front and rear engine mounting / other peripheral bolts	□	✓	✓
Check Damper Pulley and attend if necessary	□	✓	✓
Drain water from Water separator	**3**-6 hours after a fresh fill of the diesel tank / Daily		
Clean Fuel tank inside & Tank strainer	□	□	✓
Check function of radiator cap	✓	✓	✓
Check Fan belts for damage/looseness	✓	✓	✓
Check Exhaust pipes and mounting	□	✓	✓
Check Radiator coolant level	✓	✓	✓
ELECTRONIC DIESEL CONTROL	□	□	□
Check for engine full acceleration (Throttle response)	✓	✓	✓
Check tightness of all mating connectors and ensure they are connected properly	□	✓	✓
Check and secure wiring harness away from temperature zones on the engine/vehicle	□	✓	✓
Check functioning of EDC and sensors with diagnostic tool	□	□	✓
Check tightness of engine speed sensors and clean the sensor tip for any dirt/dust deposits	□	✓	✓
Check functioning of warning EDC light	✓	✓	✓
TURBOCHARGER & INTERCOOLER			
Check Air duct connections, hoses and gaskets	□	✓	✓
Check charge air cooler for any blockage of fins and clean the cooler if necessary (@ 2.5 kg/cm2)	□	□	✓
CLUTCH	□	□	□
Check function of clutch system	✓	✓	✓
Check Clutch pedal free play	✓	✓	✓
Check and adjust clutch pressure plate height using 'H' gauge	□	✓	✓
TRANSMISSION	□	□	□
Check Gear box oil level	✓	✓	✓
Check Looseness in gear control mechanism	✓	✓	✓
PROPELLER SHAFT	□	□	□
Check Propeller shaft nuts tightness	✓	✓	✓
Check Universal joint and splines for wear	✓	✓	✓
Universal joint and splines Greasing	✓	✓	✓
ELECTRICAL EQUIPMENT	□	□	□
Check Battery Specific gravity	✓	✓	✓
Check Function of starter motor	□	✓	✓
Starter motor brushes for wear	□	□	✓
Check Function of Alternator	□	✓	✓
Check Terminal of wiring harness for damage and looseness	□	✓	✓

CHASSIS LUBRICATION	□	□	□
Lubricate all Grease points	✓	✓	✓
TYRES			
Check Tyre inflation pressures	✓	✓	✓
Remove Trapped stones, replace Tyres at 2mm NSD	✓	✓	✓
Tyre rotation and Wheel nuts	□	✓	✓
EGR system			
Check EGR valve working	✓	✓	✓

ANNEXURE-3

Do's & Don'ts in respect of ECU and Electrical wiring harness.

DO's:

1. Keep the Ignition "Switch Off" while removing the battery connections in the vehicle
2. Connectors of ECU must be connected or disconnected only when the power is switched off/Ignition switch is in OFF position
3. Before and during welding :
   A. Disconnect battery terminals (positive and negative terminals of 24V supply)
   B. Disconnect two connectors of the ECU and have the panel cover refitted
4. **Reverse polarity protection:** Care needs to be taken while removing the battery connection and reconnect the terminals with correct polarity
5. Ensure proper connectivity of ECU/Sensor connectors with wiring harness
6. Ensure Diagnostic connector cap is present always to avoid dust/water entry and shorting. Protect Diagnostic connector from tampering/damage
7. Run engine always with batteries connected
8. Check if the relays and fuses are properly inserted in the relay/fuse module respectively, in reference to circuit diagram provided
9. Ensure proper fitment of 15A fuse of the battery positive cable. Spare fuses (30A – 1 no. & 5A – 2 nos.) is available in the relay/fuse module
10. Ensure that the Ignition switch and the battery **isolator switch is OFF** when the vehicle is parked condition
11. Battery cables (battery positive to isolator switch, Isolator switch to starter motor, battery negative cable and intermediate cable) length should be less than 5M
12. Avoid falling of hot weld spatters on wiring harness, sensors and accelerator pedal module
13. Instrument cluster to be covered during body building. Ensure reconnection of all connections on post body building
14. High and Medium current carrying cables of body electrical loads are (without fuse protection) to be routed separately and should not be bundled with EDC cables
15. Provide rubber sleeve/grommets in sharp edges/holes while routing the wiring harness in the roof and panels
16. Ensure pre-fuse and connectors of the EDC system power cable (closer to the battery cable terminal ends) are kept inside the battery box
17. If any deviation in the above points, it has to be informed to M/s Ashok Leyland

DON'Ts

1. Do not change mounting position of the ECU/EDC panel
2. Do not cut or extend battery cables. Chassis harness routing should not be disturbed
3. Do not jump start the vehicle (by connecting external batteries – Master/Slave method) this will cause serious damage to the ECU
4. Electrical tapping not allowed: tapping should not be taken as this can severely affect the performance of the ECU and Sensors (discourage use of 12V by center tapping method from batteries for additional loads)
5. Do not direct pressurized water on to the ECU, Accelerator pedal sensor and other electrical components/sensors/devices
6. Do not touch the pins of the ECU to avoid damage due to Electrostatic discharge
7. Do no test (continuity check) ECU pins with Multi meter
8. Do not paint the Electrical and Electronic components/devices
9. Do not use Accelerator pedal as a support
10. Do not disturb the clamps of EDC system wiring harness unless it is very essential. If necessary to remove, ensure it is replaced/refitted properly
11. Do not disturb/remove the connected DC negative connection of EDC system. DC negative is connected at two places (a) Chassis and (b) Engine block – Starter motor negative
12. Do not sharp bend or fold the cables while coiling or bending
13. Do not lift harness bunch by the end connector

ANNEXURE - 4

DIAGNOSTIC SYSTEM MANAGEMENT - DTC'S
H6 Series Engine BS IV i-EGR - EDC 17 CV54 - CB18 & CB28 System

S.No	P code	Blink Code	Error Description	Effect on Engine Performance
1	P0336	51	Crankshaft sensor signal Error - disturbed signal	Engine rpm limitation at 1750.
2	P0337 P0336(OBD)	51	Crankshaft sensor signal Error - no signal	Engine rpm limitation at 1750.
3	P0341 P0344(OBD)	52	Camshaft sensor signal Error - disturbed signal	Engine rpm limitation at 1750.
4	P0342 P340(OBD)	52	Camshaft sensor signal Error - no signal	Engine rpm limitation at 1750.
5	P0016	53	Camshaft to Crankshaft offset angle exceeded	Engine rpm limitation at 1750. 40 % Torque Limitation
6	P0238	61	Boost pressure sensor signal voltage above upper limit	Vehicle Pickup loss
7	P0237	61	Boost pressure sensor signal voltage below lower limit	Vehicle Pickup loss
8	P0236	61	Boost Pressure sensor High plausibility error	Vehicle Pickup loss
9	P0235	61	Boost Pressure sensor low plausibility error	Vehicle Pickup loss
10	P0193	23	Rail Pressure Sensor signal voltage above upper limit	40% Torque limitation / PRV open
11	P0192	23	Rail Pressure Sensor signal voltage below lower limit	40% Torque limitation / PRV open
12	P1104 (Ms code) P0087 (OBD)	31	Maximum positive deviation of rail pressure exceeded (Actual Rail pressure below the set point)	40% Torque limitation
13	P1106 (Ms code) P0088(OBD)	35	Maximum negative rail pressure deviation with metering unit on lower limit is exceeded (Actual Rail pressure exceeded the set point)	40% Torque Limitation
14	P1108 (Ms code) P0088(OBD)	37	Maximum rail pressure exceeded	40% Torque Limitation
15	P1117 (Ms code) P0089(OBD)	34	Set point of metering unit in idle mode not plausible	40% Torque Limitation
16	P1123 (Ms code) P0088(OBD)	38	Maximum rail pressure exceeded (second stage)	Engine Shut Off
17	P0118	41	Coolant temperature sensor signal voltage above upper limit	40% Torque Limitation
18	P0117	41	Coolant temperature sensor signal voltage below lower limit	40% Torque Limitation
19	P0524	82	Minimum oil pressure error in plausibility check	80% Torque Limitation
20	P0522	82	Oil pressure sensor signal voltage below lower limit	Engine rpm limitation at 1750. 40% Torque limitation
21	P0523	82	Oil pressure sensor signal voltage above upper limit	Engine rpm limitation at 1750. 40% Torque limitation
22	P0090 P0251(OBD)	21	Metering unit output open load error	40% Torque Limitation / PRV Open
23	P1119 (Ms code) P0254(OBD)	21	Metering unit high side short circuit to battery error	40% Torque Limitation / PRV Open
24	P1120 (Ms code) P0253(OBD)	21	Metering unit high side short circuit to ground error	40% Torque Limitation / PRV Open
31	P0262	22	Injector 1 general short circuit	Engine rpm limitation at 1750.

32	P0265	22	Injector 2 general short circuit	Engine rpm limitation at 1750.
33	P0268	22	Injector 3 general short circuit	Engine rpm limitation at 1750.
34	P0271	22	Injector 4 general short circuit	Engine rpm limitation at 1750.
35	P0274	22	Injector 5 general short circuit	Engine rpm limitation at 1750.
36	P0277	22	Injector 6 general short circuit	Engine rpm limitation at 1750.
43	P2148	22	Injector Bank 1 short circuit	Engine rpm limitation at 1750.
44	P2151	22	Injector Bank 2 short circuit	Engine rpm limitation at 1750.
45	P0123 (Ms code)	11	Accelerator pedal sensor 1 signal voltage above upper limit	Accelerator Pedal loss of response till repress
46	P0122 (Ms code)	11	Accelerator pedal sensor 1 signal voltage below lower limit	Accelerator Pedal loss of response till repress
47	P0223 (Ms code)	11	Accelerator pedal sensor 2 signal voltage above upper limit	Accelerator Pedal loss of response till repress
48	P0222 (Ms code)	11	Accelerator pedal sensor 2 signal voltage below lower limit	Accelerator Pedal loss of response till repress
49	P2135 (Ms code)	11	Non-plausibility error between APP1 & APP2	Limp home function (1350rpm)
50	P0501	16	Plausibility defect for vehicle speed	Vehicle Speed limitation/ Engine Speed limitation w. r. to drive line configuration
51	P1608 (MS code) P062B(OBD)	22	ECU Defective - CY33X is defect (injector chip error)	Injector bank / Engine shut off
52	P1800 (Ms code) P0641(OBD)	76	Error Sensor power supply 1	Engine rpm limitation at 1350 rpm
53	P1801 (Ms code) P0651 (OBD)	77	Error Sensor power supply 2	Engine rpm limitation at 1350 rpm
54	P1802 (Ms code) P0697(OBD)	78	Error Sensor power supply 3	PRV Open
55	P1126 (Ms code)	39	Set point of metering unit in overrun mode not plausible	40% Torque Limitation
56	P1100 (Ms code)	25	PRV open	40% Torque Limitation
57	P1111 (Ms code)	25	PRV reached maximum allowed open time	40% Torque Limitation
58	P1110 (Ms code)	25	PRV reached maximum allowed opening count	40% Torque Limitation
59	P1523 (Ms code)	87	Water in Fuel Detection	40% Torque Limitation
60	P1103 (Ms code) P0252(OBD)	21	Metering unit (ECU) Over temperature error	40% Torque Limitation
61	P1121 (Ms code) P0254(OBD)	21	Metering unit output short circuit to battery error	40% Torque Limitation
62	P1122 (Ms code) P0253(OBD)	21	Metering unit output short circuit to ground error	40% Torque Limitation
63	P0215	71	Injection cut off demand (ICO) for shut off coordinator	Engine shut off
64	P1136 P0113 (OBD)	25	Averaged rail pressure is outside the expected tolerance range	40% Torque Limitation
65	P0401	93	EGR valve position governor deviation max / EGR valve jammed at closed position	No reaction. Error Cannot be erased till 9600hrs

66	P0402	93	EGR valve position governor deviation min / EGR valve jammed at open position	No reaction. Error Cannot be erased till 9600hrs
67	P0490	91	EGR valve Short circuit to battery at Out1 / out2	No reaction. Error Cannot be erased till 9600hrs
68	P0489	91	EGR valve Short circuit to ground at Out1 / out2	No reaction. Error Cannot be erased till 9600hrs
69	P0487	91	EGR Valve Open load error	No reaction. Error Cannot be erased till 9600hrs
70	P0405	92	EGR Valve position sensor signal voltage below lower limit	40% Torque Limitation after 50 hours. Errors cannot be erased till 9600hrs.
71	P0406	92	EGR Valve position sensor signal voltage above upper limit	40% Torque Limitation after 50 hours. Errors cannot be erased till 9600hrs.
72	P0191(OBD) P25E6	0	Rail pressure raw value is below minimum offset	Engine speed limitation at 1750rpm
73	P0191 (OBD) P25E5	0	Rail pressure raw value is below Maximum offset	Engine speed limitation at 1750rpm
74	P0116 (OBD) P251D (MS Code)	0	Defect fault check for Absolute plausibility test (CTS)	40% Torque Limitation
75	P0116(OBD) P251E (MS Code)	0	Defect fault check for dynamic plausibility test (CTS)	40% Torque Limitation

Scan tool Menu

Main menu: ↓	**Sub Menu** →				
1. EOBD					
2. Ashok Diagnostics →	1. Engine →	1. Diesel →	1. Auto detect ECU		
			2. EDC 15		
			3. EDC 16		
			4. EDC 17 →	1. EDC 17	
				2. EDC 17 EGR →	1. Read ECU ID
					2. View DTCs ↴
					3. Erase DTCs ↴
					4. Live data
					5. Freeze data
					6. Adjustment parameter
					7. Adjustmetn ADR
					8. Actuatores
					9. Save log
					10. Read logs
					11. Clear logs
				3. EDC 17 SCR	. --do--
			5. Delphi		
			6. Denso		
		2. CNG			
	2. Vehicle →	1.ACU → (After treatment Control Unit) - only for SCR	1. Read ECU Id		
			2. View DTC		
			3. Erase DTC		
			4. Live data		
			5. Freeze data		
			6. Adjustment parameter		
			7. Actuators		
			8. Save log		
			9. Read logs		
			10. Clear logs		
		2. BCU - Truck			
		3. AMT			
		4. ABS	1. Read ECU		
			2. View DTC		
			3. Erase DTC		
			4. Live data		
			5. Actuators		
			6. Adjustment parameter		
		5. Cummins			
		6. BCU- Bus			
	3. Read logs				
	4. Clear logs				
3. User menu	1. OBD DTC look up				
	2. Language menu				
	3. Tester set up				
	4. Self test				
	5. Software version				
	6. Security				

The path generally used in depots is :

Main menu --> Ashok Diagnostics ---> Engine ---> Diesel ---> EDC 17 ---> EDC 17 EGR --> View DTCs --> Erase DTCs