



**Andhra Pradesh State Road Transport Corporation**  
Office of the Managing Director, Bus Bhavan, Hyderabad - 500 0624.

No: OP3/261(03)/2009-MED

**CIRCULAR No.27/2009-MED, Dt 17.11.2009**

Sub : **MAINTENANCE** - Introduction of Bharat Stage -III compliant vehicles by M/s Ashok Leyland Ltd - Salient features and maintenance aspects communicated - Reg.

- Ref : 1) Circular No. 15/2006-MED, dt.24.11.06  
2) This office Lr.No. OP3/463(7)/2006-MED, dt.26.02.07  
3) Circular No. 02/2007-MED, dt.23.01.07  
4) Circular No. 17/2007-MED, dt.26.07.07  
5) Circular No. 17/2008-MED, dt.16.07.08  
6) Circular No. 21/2008-MED, dt.22.09.08  
7) Circular No. 23/2008-MED, dt.29.09.08  
8) Circular No. 06/2009-MED, dt.20.04.09  
9) Circular No. 14/2009-MED, dt.26.06.09

**1.00** M/s Ashok Leyland Ltd has introduced Bharat Stage-III vehicles complying with the prevailing emission norms notified by the Ministry of Road Transport & Highways. Presently, the following types of Ashok Leyland vehicles fitted with BS-III Diesel engines are being deployed in Hyderabad City Zone.

- 1) Semi-Low Floor A/c Buses (Seetalhamsa)
- 2) Semi-Low Floor Non-A/c Buses (Metro Express)
- 3) Vestibule Buses

**2.00 TECHNICAL SPECIFICATIONS OF ENGINE**

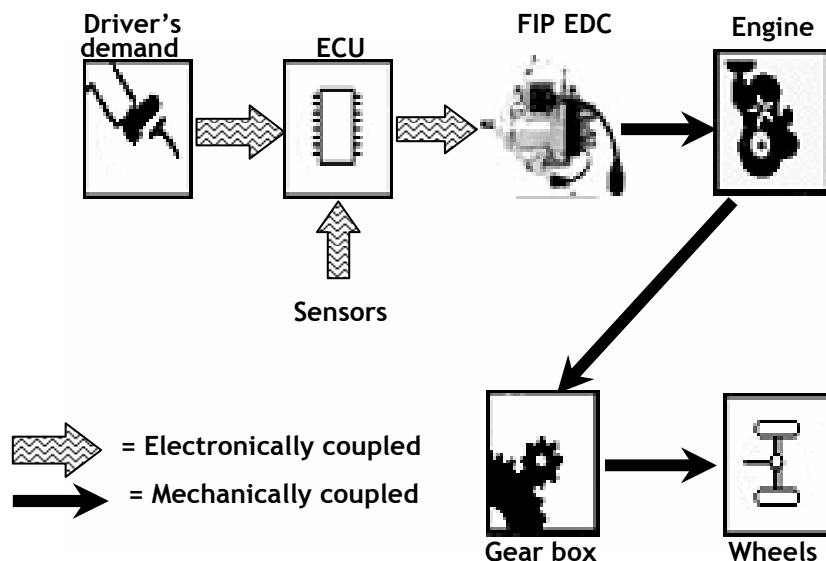
The type of the Engine fitted to the above vehicles is designated as HA6DTI3N in which the major change is installation of Electronic Diesel Control (EDC) system with Distributor type Fuel Injection Pump.

- |                              |  |
|------------------------------|--|
| a. Aspiration                | : Turbocharged with inter cooler   |
| b. Max output                | : 165 PS (122 Kw) @ 2400 rpm   |
| c. Max torque                | : 55 kg-m @ 1500 rpm   |
| d. Compression Ratio         | : 17.7 : 1   |
| e. Firing Order              | : 1-4-2-6-3-5  |
| f. Compression pressure      | : 29 - 32 kg/cm <sup>2</sup> @ 280 rpm (Limit - 24 kg/cm <sup>2</sup> )        |
| g. Valve Clearance           | : Intake 0.30 mm, Exhaust 0.45 mm  |
| h. Idling rpm                | : 575 ± 25 rpm   |
| i. Engine Oil Cooler         | : Multi Plate type (no of plates - 5) water cooled                             |
| j. Fuel Injection Equipment: | VP37 EDC - Electronic Rotary Distributor type (BOSCH) (Part No: 0 460 426 993) |
| k. Injection timing          | : 0.2 ± 0.02 mm plunger lift at TDC with No.1 Cylinder on compression stroke   |

- l. Injection Nozzle : Multi hole nozzle type (six holes) -  
6 x 0.18 x 146 (Injector Part No : F 002 C7Z 120;  
Nozzle Part No: 0 433 175 443/ DSLA 146 P 1465,  
Nozzle Holder Pt.No: F 002 C70 02/  
KBEL 103 P 262)
- m. Nozzle opening pressure : 248 to 260 bar
- n. Fuel Filter : Spin-on type with Water separator
- o. High Pressure Pipe : (OD x ID x Length) 6.35 x 1.8 x 750 mm
- p. Coolant Pump : Type Forced circulation by volute pump,  
55 mm dia ball and roller bearing Drive By  
V-belt, Impeller dia 85 mm
- q. Starter motor : 24V, Axial type, pre-engaged, Model: GBS24P & 9M14
- r. Alternator : 24V - 55 Amps (JNnurm FE-SLF 24V-100Amps)
- s. Fuel Tank : 165 liter capacity

2.01 The major modifications introduced in BS-III engines are furnished below

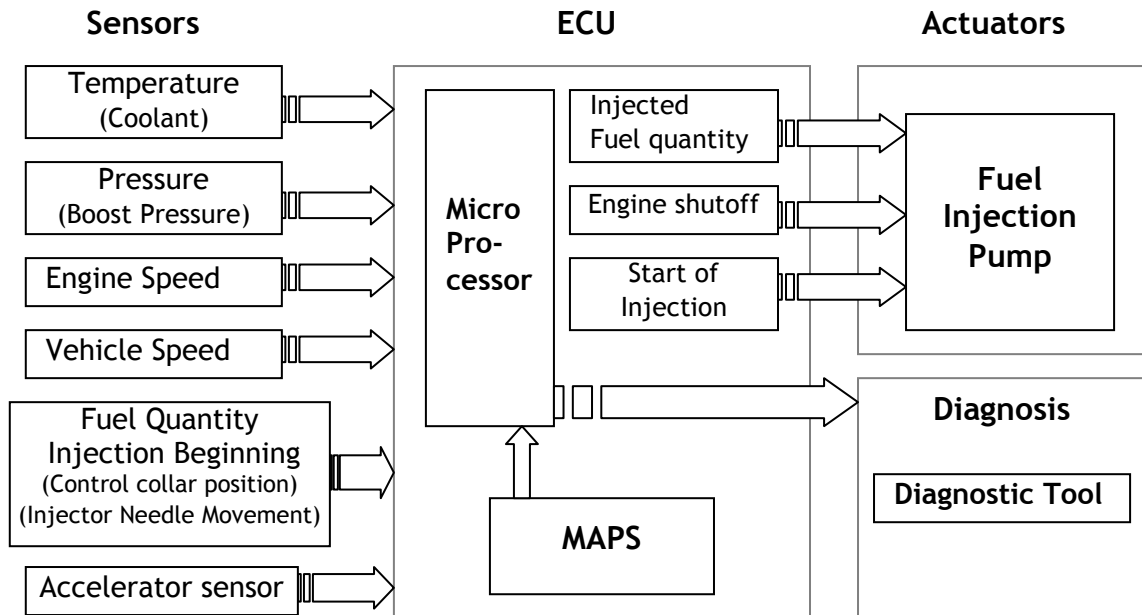
Electronic fuel injection equipment is used along with sensors for precise control of injected fuel quantity and injection timing thereby achieving stringent BS III emission norms. The electronic fuel injection equipment is controlled by an Electronic Control Unit (ECU) and there are no control lever and mechanical linkages to FIE. Hence called "Drive by Wire Technology". The schematic diagram showing the EDC working system is given below.



2.02 **ELECTRONIC DIESEL CONTROL:** In order to get the optimum engine performance and emission levels, the following parameters are precisely controlled by the Electronic Diesel Control system.

- Start of Injection
- Quantity of Fuel Injected
- Duration of Fuel injected
- Faster response to change in operating variables like coolant temperature, Engine speed, Boost pressure in the intake manifold.

## ELECTRONIC DIESEL CONTROL SYSTEM



EDC system works on 12V DC. A DC-DC converter is used to step down supply voltage from 24V to 12V DC. (Location: LH side of the front entry door in EDC panel)

EDC system is subdivided into

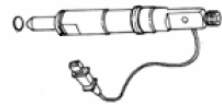
- I. **Sensors:** Detects the engine operating conditions and the driver's demand. They convert physical variables into electrical signals.

The following are the sensors used in the EDC system

1. **Engine Speed Sensor (DG6)** - This is an inductive type sensor mounted on the flywheel housing. Electrical pulses are generated when the formed slots on the flywheel pass through the sensor axis. The Electric pulse frequency (Sine wave) generated by the sensor is proportional to the engine speed.
2. **Accelerator Pedal Position Sensor (Fitted in Vehicle)(PWG3)** - The sensor measures demand from the driver and communicates to the ECU. It detects the pedal position by means of potentiometer and transfers the information to the ECU in terms of Voltage. It consists of two potentiometers for measuring the position of accelerator pedal module from 0% travel position to 100% travel position. The second potentiometer is incorporated as redundant and reports error in case of malfunction of the first potentiometer.
3. **Engine Coolant Temperature Sensor (WTF)** - It is a thermistor, mounted on coolant return line from cylinder head. It measures the engine operating temperature.



4. Needle Movement Sensor (Instrumented Injector) (NBF) - It is connected to the 1<sup>st</sup> Injector which sends signal to the ECU to consider the start of fuel injection.



5. Boost Pressure Sensor - Engine Boost Pressure sensor is mounted on the intake manifold to measure the absolute intake manifold pressure.



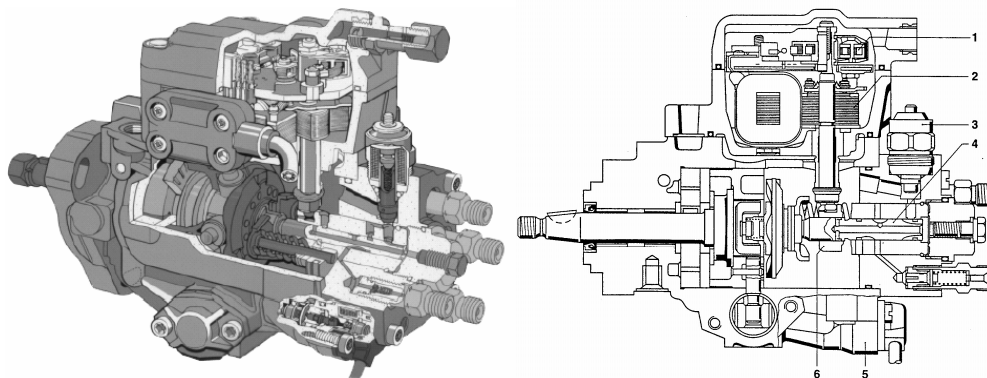
6. Vehicle Speed Sensor - This is mounted on the gearbox at Speedo drive output or remote mounted on frame and connected with a short drive cable. It works on Hall-effect principle, produces 8 pulses per revolution. Pulse output is used for calculating the distance traveled and the speed of the vehicle.

7. Brake Switch - The switch is of electro-pneumatic type mounted on the DB Valve. It indicates the altered voltage level from the switch and output is fed to ECU as information. The switch operates for pressure greater than 0.5 Bar. This information is used by ECU to activate the limp home mode in case of defective accelerator sensor.

II. **Electronic Control Unit (ECU):** It is the heart of the system that compares the requirements by processing the information received from the sensors and the accelerator pedal movement. It controls the actuators through electrical output signals based on the fuel mappings already stored in the ECU, deciding the fuel delivery. It also provides interfaces to other systems and with the vehicle diagnostic system.

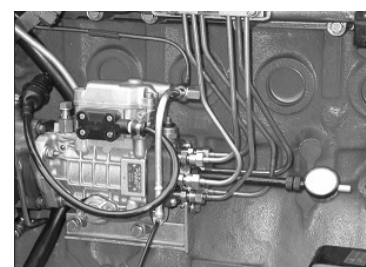
III. **Actuators:** Convert the electrical signals from the ECU into physical variables. Example: actuation of FIP control collar.

**Fuel Injection Pump:** VP37 EDC - Electronic Rotary Distributor type FIP of M/s BOSCH has been introduced. The electronic fuel injection equipment is controlled by an Electronic Control Unit (ECU).



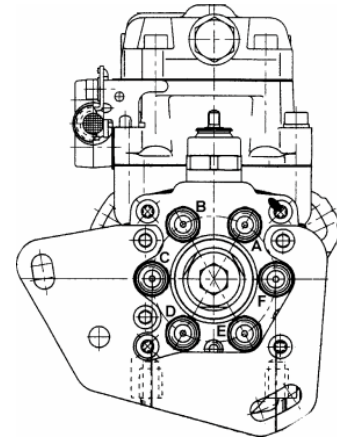
1 - Control-Collar- Position sensor, 2 - Solenoid actuator for the injected fuel quantity, 3 - Electromagnetic shut-off valve, 4 - Delivery plunger, 5 - Solenoid for start-of- injection timing, 6 - Control Collar

The procedure of removal, fitment of FIP, Plunger lift setting with dial gauge and the special tools are similar to that of BS-II rotary pump as described vide circular No:17/2007-MED, dt. 26.07.2007. But it should be remembered that the Plunger lift in the case of BS-III vehicles with EDC Rotary pump is **0.2 mm** against 1.30mm of BS-II.



Engine driven **Feed pump** with hand primer is provided. The Part Number of the Feed pump is F 002 A50 026

Fitment of Injector High Pressure Pipes at distributor head of the FIP would be identified with alphabets A-B-C-D-E-F as shown in Figure, which is similar to that of Rotary pumps in BS-II vehicles. The fuel outlet on the pump corresponding to each Engine cylinder is given in the table below



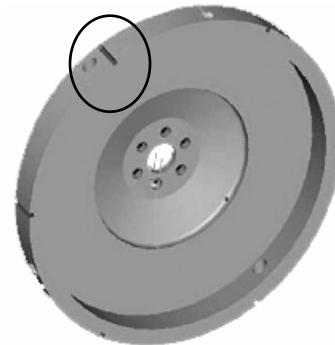
**Connection Sequence**

Engine Cylinder no.	1	2	3	4	5	6
Fuel Outlet on the pump	A	C	E	B	F	D

**Injectors** : 1st cylinder - instrumented injector. 2nd to 6th cylinder are normal injectors. The part Number of 1<sup>st</sup> Injector is 0 432 193 464



**Flywheel** : Flywheel is machined with 6 slots on the periphery to facilitate engine speed sensing by engine speed sensor. These slots are equispaced and dimensions are controlled to achieve perfect speed pulse output waveform from the speed sensor.

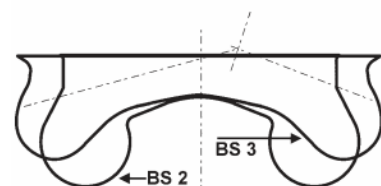


**Note:** Ensure that there is no fouling of speed sensor with flywheel after fitment of sensor. Also ensure gap between flywheel and speed sensor is 0.3 - 1.8 mm by using depth gauge method.

**Flywheel housing:** Flywheel housing is fitted with sensor mounting holder to facilitate fitment of engine speed sensor over the flywheel for engine speed sensing. Aluminium is used for the holder as non-magnetic base for the magnetic pulse pickup to avoid signal disturbances.

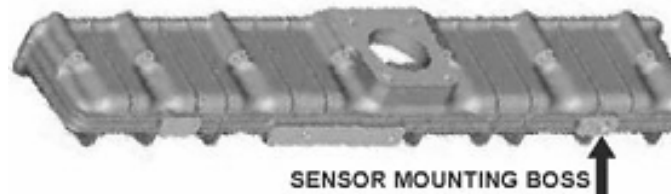


**Pistons** : Alfin Pistons made of special grade aluminium alloy with cast iron insert in the first compression ring seat is used. The combustion chamber design is shallow type for better combustion efficiency and reduction in soot emissions.



**Timing Gear Train** : Timing Gear Train with higher drive torque requirement of VE pump, wider gears are provided for crank gear, idler gear and FIP gear.

**Intake Manifold** : Provision for fitment of Boost pressure cum temperature sensor is made on the Intake manifold as shown in the figure.



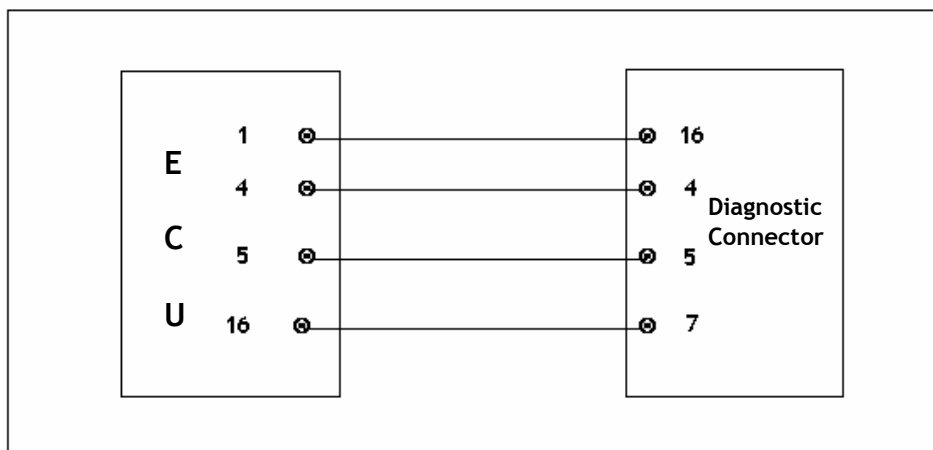
2.03 **LIMP HOME FUNCTIONS:** This function enables the vehicle to reach the nearest depot/ service point for attention in case of any sensor failure/malfunctioning. Maximum engine speed during this condition will be 1000-1200 rpm. The following table indicates the details of sensor failures and its effect on the vehicle.

Sl. No	Description	Effect on the vehicle
1	Coolant temperature sensor malfunction	Loss of Pickup/ Acceleration and loss of Engine Power, since full load Fuel quantity is limited to 80%. Cold Start ability is disturbed
2	Boost Pressure sensor malfunction	Less Pickup due to loss in Engine Power as Fuel quantity is limited
3	Engine Speed sensor failure	Engine stops
4	No Needle lift pulse	Emission affected. Vehicle continues to run
5	Vehicle speed sensor failure	Vehicle performance will not be affected
6	Accelerator Pedal sensor malfunction	Engine idling rpm will be increased to 1000/ 1200 rpm. No further increase in Engine rpm through pedal movement
7	Brake Switch	During mechanical stuck/ binding of accelerator pedal sensor and when brake is pressed, Limp Home function is activated. Max Engine speed during this condition is set to 1000 - 1200 rpm.

#### 2.04 **DIAGNOSTIC INTERFACE**

A communication interface is needed for "off - board testers" to identify defect for a complaint. Jointly with M/s Dearborn Electronics a tool has been developed for Ashok Leyland vehicles. A separate manual describing its functions and usage is enclosed. A standard universal diagnostic tool also can be used to read the stored error codes. Dearborn diagnostic tool refers the DTC (Diagnostic trouble codes) and the universal tool like Crypton-ACT II address OBD codes in reference to SAE standards.

## DIAGNOSTIC CONNECTOR Connection Details



### DIAGNOSTIC CONNECTOR PIN CONFIGURATION

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16

Various Fault codes, its effects and possible causes are described in the annexure-C.

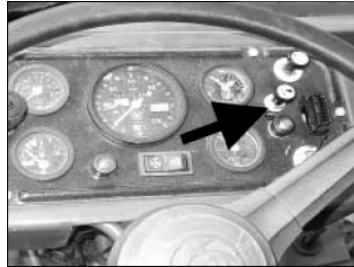
## 2.05 PRECAUTIONS TO BE TAKEN FOR TROUBLE-FREE OPERATION OF ECU

- \* Electrical tapping other than specified shall never be allowed. Tapping will severely affect the performance of ECU and Sensors (additional current drawn by the new load will drain the battery faster/ damage the DC-DC converter).
- \* Care should be taken while washing the vehicle. Water shall not be splashed directly on the ECU, Accelerator Pedal Sensor and other Electrical components.
- \* Diagnostic connector should not be left hanging loose. Protective cap shall be removed only when the diagnostic tester is connected.
- \* Reverse polarity shall never be allowed
- \* Proper connectivity of ECU/ Sensors with wiring Harness shall be ensured and harness clamps shall be maintained
- \* Ignition Switch shall be kept in 'OFF' position while removing & fitment of Battery connections in the vehicle
- \* ECU location shall not be changed
- \* Connection/ disconnection of ECU shall be allowed only when the ignition switch is in 'OFF' position
- \* The EDC components, sensors and actuators shall be kept clean from dust and dirt.
- \* Disconnection of connectors shall be done by pulling them in a straight line, disengaging the lock by holding the housing.
- \* Connectors shall never be disconnected by pulling the wires or twisting them as this could bend the contacts.

The Circuit diagram showing the Fuses and relays is given at annexure-E

## 2.06 ENGINE START PROCEDURE:

1. Switch On the ECU-Ignition/Reset (**Push-Pull type**) switch - Marked 'R' (Located inside Yellow Bordering) for Electronic Control Unit ON.
2. Insert the **Ignition key**, turn clockwise for 24V supply ON to the vehicle Electricals
3. Wait for 10 seconds before cranking
4. After 10 sec turn Ignition Key further to crank the engine.



**NOTE:** In case engine does not start, Switch off the Reset switch and wait for 5-10 sec and then restart.

## 2.07 ENGINE STOP PROCEDURE

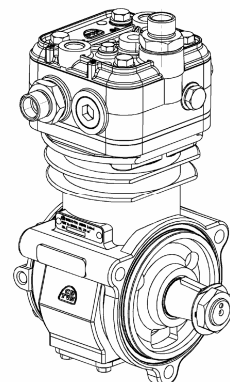
1. Switch Off the ECU-Ignition/Reset (**Push-Pull type**) switch - Marked 'R' (Located inside Yellow Bordering) for Electronic Control Unit Off.
2. Switch OFF the **Ignition Key Switch** by turning anti-clockwise once.

## 2.08 Dos and Don'ts:

- **Idle the Engine always for 60 Seconds after starting and before Switching off** the Engine.
- **Do not Switch-off the Engine through gears.**
- **Do not operate the starter motor for more than 10 sec. continuously.** Wait for 30-60 Seconds before trying again.
- **Do not Park / leave the Vehicle with ECU-Ignition/Reset (Push-Pull type) switch, switched ON.**
- **Do not remove/ tamper the Engine Stop solenoid actuator under any circumstance.**
- **Always use genuine fuses of rated capacity only.** Never use wires in place of fuses under any circumstance.
- **Never tap electrical connections from main wiring harness.** For any additional loads take the connection from Battery Cut-off switch only.

## 3.00 BRAKE SYSTEM

The major change in the BS-III vehicles is introduction of water cooled Air Compressor in place of air cooled one for longer life. Water cooling line is provided for AC head by tapping from the Water pump outlet and re-circulated into the radiator through separate pipes. Water circulation in the cylinder head reduces the delivery air temperature whereby the life of the compressor increases significantly. Unlike the earlier models, the connecting rod is a single piece one. Ball bearing is provided at the front end instead of bush bearing. The Air compressor is designated as SC COMPRESSOR - NLC 230. The part numbers and other details are shown at annexure-A





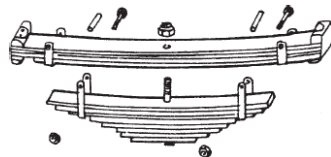
**4.00 FRONT SUSPENSION:** Weveller type leaf spring suspension is provided in the front. (Part Nos & maintenance: F4507710 & every 50,000 kms pads to be inspected. If worn out needs to be replaced.

No.of Leaves	10
Eye	60''
Spring Width	3''
Thickness of 1 <sup>st</sup> & 2 <sup>nd</sup> leaves	12.7 mm
Thickness for 3 <sup>rd</sup> to 10 <sup>th</sup> leaves	11.1 mm

Free Camber	214 mm
Laden Camber	128 ± 6 mm
Deflection	86.2 mm

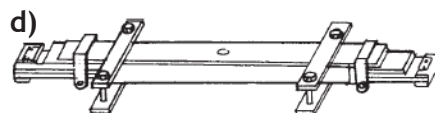
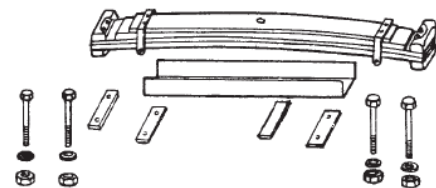
### Assembly Procedure

a) Place the spring assembly.



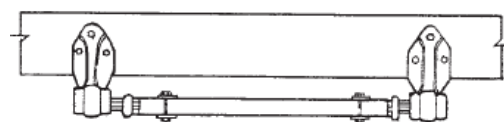
b) Remove centre bolt, two inner clamp bolts and remove the top 4 leaves assembled with end scuff plates separately.

c) Invert 4 leaves assembly and place centrally on spring clamp channel and straighten the 4 leaves assembly using spring clamp bottom top plates and fasteners.



e) Smear the rubber element with rubber lubricant to ease assembly.

f) Position the top half weveller rubber element on the top spring bracket.

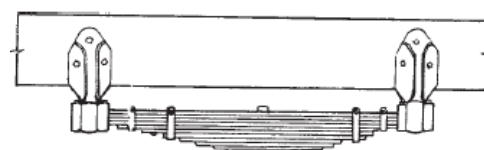


g) Invert the 4 leaves along with clamping channel such that main leaves on top side.

h) Position the 4 leaves with clamping channel on top half weveller rubber element centrally to locate the rivets and dimples.

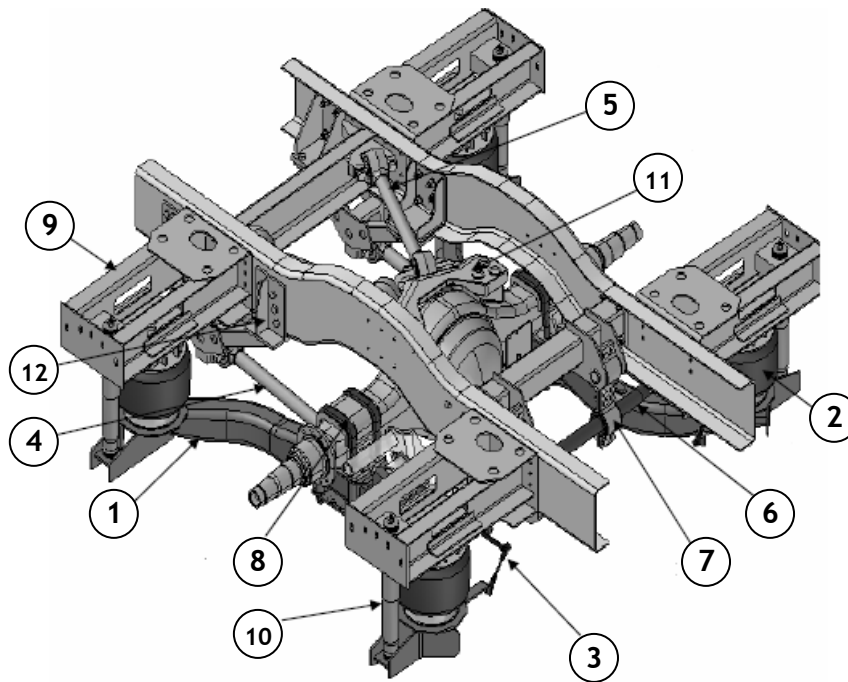
i) Position the bottom half weveller rubber element on bottom scuff plate with bottom half spring brackets.

j) Release the clamp evenly from the 4 leaves



k) Assemble the balance leaves along with centre bolt and spring clips. Use new split pins to castle nuts.

**5.00 REAR SUSPENSION:** Wheels India Ltd make under slung type Air suspension is provided in the rear. There is no change in the spare parts other than frame and Bellows. The details are shown below. For maintenance & repairs, the circular No:02/2007-MED, dt. 23.01.2007 may be referred.



**Rear Suspension: ASL 082 R**

- |                            |                           |
|----------------------------|---------------------------|
| 1. Cow horn assembly       | 7. Hanger link assy       |
| 2. Air spring assembly     | 8. 'U' bolt               |
| 3. Leveling valve assembly | 9. Out rigger bracket     |
| 4. Parallel link assy      | 10. Shock absorber        |
| 5. Radius rod assy         | 11. Rear axle top pad     |
| 6. Anti roll bar assembly  | 12. Parallel Link bracket |

**NOTE:** To remove the tyres, the Jack should be placed below the locating link clamp area on the Axle housing. Lifting the vehicle by jacking the Air suspension cross bearer shall never be allowed.

**6.00 CLUTCH:** Single plate dry type 14" four finger clutch

**7.00 GEAR BOX:** ZF-S5-36 (Synchromesh). The technical features, repairs and maintenance aspects are furnished in the Circular No.06/2009-MED.

**8.00 PROPELER SHAFTS:** In place of 1500 series SPICER PP shafts (as in the case of 222 WB BS-II vehicles), the 1600 series has been introduced in Semi-Low Floor BS-III vehicles. The part numbers are shown at annexure

**9.00 FRONT AXLE:** Forged I - section reverse elliot type, ALFA-90.

**10.00 REAR AXLE:** 60SHO Dana ,Fully floating single speed hypoid bevel gear. The details have already been communicated through Cir No.14/2009-MED.

Note: Some changes have been made to the foundation Brake components like Brake shoes, Liners etc., in both Front & Rear Wheels.

**11.00 STEERING SYSTEM:** Integral Power Steering.

**12.00 PNEUMATIC DOORS:** Make - Janatics, 54mm dia, Double acting cylinders.  
The Pneumatic lay out and the parts list are shown at annexure-D

### **13.00 HUBNER COUPLING OF VESTIBULE BUSES**

Owing to several advantages of the articulated buses in City operations, Corporation has introduced 10 nos of **Ashok Leyland Vestibule buses** in Hyderabad City Zone. These buses are basically designed on the principle of Tractor & Trailer mechanism. The two Articulation halves of the Bus are coupled by means of **Hubner** Coupling with a circular platform, center hoop, stabilizers and PU Folding bellows.

The Technical features, mounting sequence, maintenance and stocking of spare parts etc of the Articulation unit are detailed hereunder.

#### **13.01 Technical Specification**

HKG 750 is the HUBNER articulation system used in the above vehicles.

**13.02 Design:** puller vehicle with integrated rear axle steering. The special construction of this articulation system includes a simple connection of two articulation halves by ball and socket. Both articulation halves are designed as easy welding constructions. An exceeding of the motion angle is acoustically or optically signalized.

- Height of platform : > 750 mm
- Integrated center hoop control
- Bending angle :  $\psi = \pm 35^\circ$  in regular operation, max.  $\pm 40^\circ$
- Pitching angle :  $\theta = \pm 8^\circ$
- Rolling angle :  $\phi = \pm 4^\circ$

The rear axle is controlled by means of a lever system which transmits the bending motion of the articulation to the wheels of the rear car.

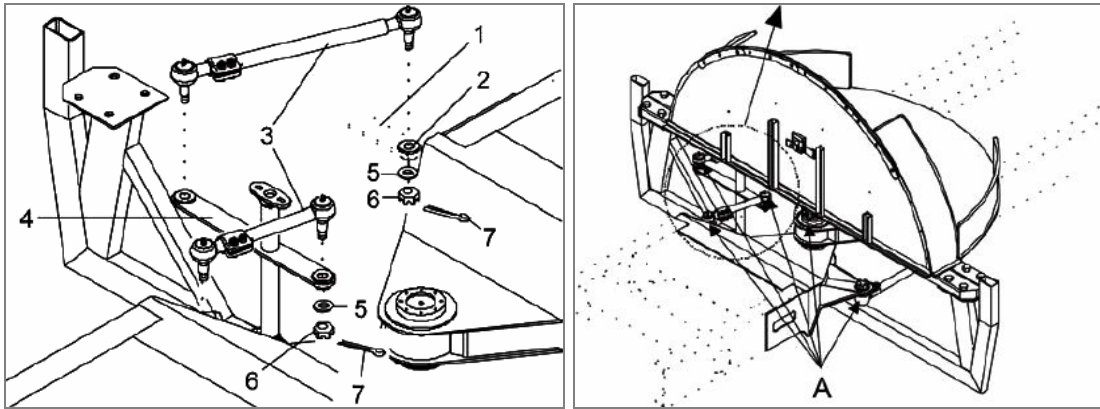
The centre hoop is also controlled by a lever system. This system ensures that the center hoop is always on the bisectrix of the bending angle. The center hoop is furthermore fixed by the roof stabilizers that are arranged cross-shapely.

The aluminium platform is firmly connected to the center hoop segment. Front and rear car of the bus are sealed in the area of the articulation unit by means of PU folding bellows.

#### **13.03 PREVENTIVE MAINTENANCE**

To obtain better service life of the articulation components the following preventive maintenance shall be carried out.

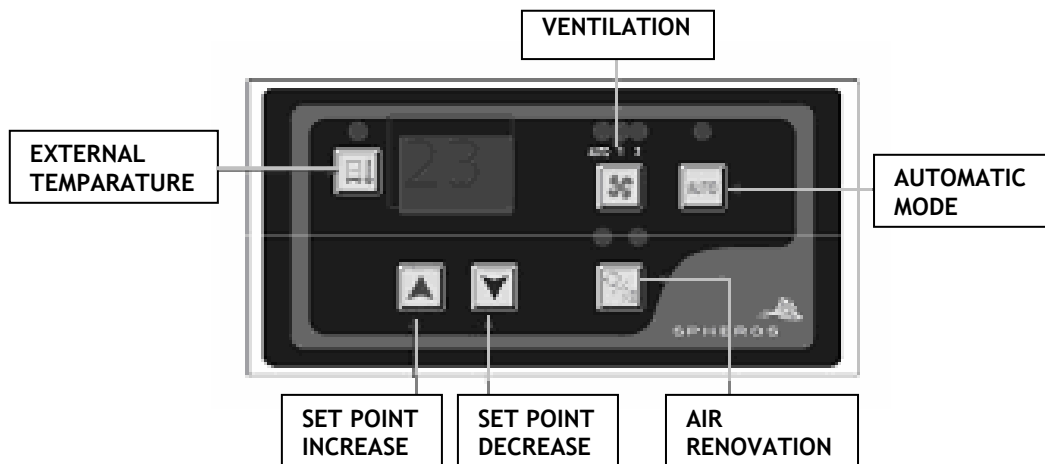
- i. Clean the articulation area and to check the screws with regard to firm seat every six months.
- ii. Apply graphitic grease to the ball joint and the steering rods on the provided lubricating points (Figure 6/A) once in every two months.



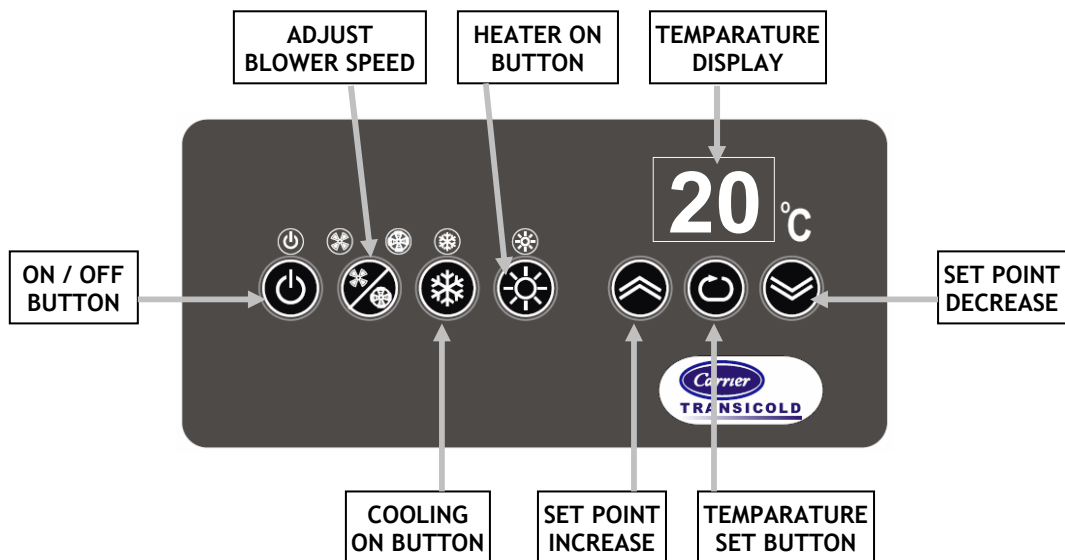
13.04 **SAFETY:** All repair works have to be carried out in consultation with the Service Engineers of M/s Ashok Leyland Ltd in order to ensure the safety of the passengers and of the vehicle. The mandatory tightening torques has to be strictly followed for all fastening parts. No modifications on components shall be allowed without the approval of the vehicle manufacturer.

#### 14.00 AIR CONDITIONER IN SEMILOWFLOOR A/C BUSES :Spheros & Carrier

##### FEATURES OF DASH-BOARD CONTROL OF SPHEROS SYSTEM



##### FEATURES OF DASH-BOARD CONTROL OF CARRIER SYSTEM



**15.00 PREVENTIVE MAINTENANCE WITH SPECIFIC REFERENCE TO BS-III SLF BUSES (For other items the existing circular instructions shall be followed)**

<b>LUBRICANTS, COOLANT &amp; FILTERS CHANGE PERIODICITIES</b>		
1	Engine Oil (15w40 CH4 grade) & E.Oil Filter	24,000 kms - City 36,000 kms - Mof
2	Spin-on Fuel Filter	25,000 kms
3	Strainer (Baby Filter)	50,000 kms
4	Gear oil (Synchromesh) SAE-90, API GL 4 with Anglamol 99 additive	40,000 kms
5	Gear oil (Hypoid gears) AE 85W140 API GL5 oil with special additive Anglamol 99	48,000 kms
6	Power Steering Oil	80,000 kms
7	Wheel Bearing Grease (RR3)	48,000 kms
8	Air Cleaner Primary	72,000 kms
9	Air Cleaner Secondary	2,16,000 kms
10	Antifreeze Coolant for Aluminum Radiator (1:1)	75,000 kms

<b>ELECTRONIC DIESEL CONTROL</b>		
1	Check tightness of all mating connectors & ensure proper connection	Sch-III & Sch-IV
2	Check & ensure wiring harness away from high temperature zone on the engine/ vehicle	Sch-III & Sch-IV
3	Check tightness of engine speed sensors and clean the sensor tip for any dirt & dust	Sch-III & Sch-IV
4	Check functioning of EDC & Sensors with diagnostic tool	96,000 kms or During FC

<b>WATER COOLED AIR COMPRESSOR</b>		
1	Check for leakage from Lub oil connection & rectify	Sch-III & Sch-IV
2	Check for leakages in water cooling line and rectify	Sch-III & Sch-IV
3	Check compressor inlet & delivery rubber hoses and pipes of deterioration & replace if necessary	Sch-III & Sch-IV
4	Check & tighten cylinder head mounting bolts & end cover bolts for correct torque values	Sch-III & Sch-IV
5	Check for leak from oil seal and rectify	Sch-III & Sch-IV
6	Remove Cyl.Head and check for excessive carbon deposit, condition of reed valve rivets, decarbonize Cyl. Head and overhaul if necessary	96,000 kms or During FC
7	Check for Carbon deposit in delivery pipe line	96,000 kms or During FC
8	Overhaul the assembly	1,60,000 kms or 2 years whichever is earlier

<b>AIR SUPSPENSION SYSTEM</b>		
1	Check Levelling valve (Overhaul if necessary)	96,000 kms or During FC
2	Check Shock Absorber & bushes (Replace if necessary)	Sch-IV
3	Check Spherilastic Bushes (Replace if necessary)	Sch-IV
4	Check Split bushes (Replace if necessary)	Sch-IV
5	Check all mechanical joints & mountings for correct torque values	Sch-IV
6	Check Air Spring Static Height	Sch-III & Sch-IV
7	Check Anti Rollbar Bushes (Replace if necessary)	Sch-III & Sch-IV
8	Clean the Levelling Valve brass fiter	Sch-III & Sch-IV
9	Test Levelling valve operation	Sch-III & Sch-IV
10	Overhaul Air Bellow assembly	96,000 kms or During FC

<b>WEWELLER SPRINGS (FRONT)</b>		
1	Check "I" Bolts/"U" Bolts, Spring Clip fitment, Helper Spring brackets and Spring Shackle for tightness	Sch-I, Sch-II Sch-III & Sch-IV
2	Check and tighten shock absorber, rubber pads, mounting bracket bolts and nuts	Sch-II, Sch-III & Sch-IV

<b>PNEUMATIC DOORS</b>		
1	Operating area should be dust free	Daily
2	Check for air leakage from air pipes	Daily

<b>AIR CONDITIONER</b>		
1	Clean the Return Air Filter	Sch-II, III & IV
2	Check for Belt Tension	Sch-II, III & IV
3	Check the bracket fixation of compressor, tighten if necessary	Sch-III & Sch-IV
4	Check & re-tighten the electrical connector if necessary	Sch-III & Sch-IV

#### **16.00 UNIQUE SPARE PARTS TO BE STOCKED AT DEPOT :**

Part no	Parts Description	Qty/Veh
0 281 012 188	Electronic Control Unit (ECU)	1
0 281 002 203	Accelerator pedal module sensor	1
0 281 002 214	Engine Speed Sensor	1
0 281 002 209	Coolant Temperature Sensor	1
0 281 002 514	Boost Pressure Sensor	1
2467 413 025	Fuel Overflow valve	1

**UNIQUE SPARE PARTS Continued...**

Part no	Parts Description	Qty/Veh
F8306000/ F8358700	Main Relay 12V	1
F8355000/ F7819400/ F8358100	Ignition Relay 24V	1
F8307200	Hold Relay	1
F8307200	Blade Fuse 15A	1
F8307200	Blade Fuse 30A	2
F8307200	Blade Fuse 5A	1
F8040600	Head Lamp Relay24V	1
F2202400	DC-DC Converter 24 v to 12v	1
X0301650	BELT 8PK 1250 (ALT PART NO X0301750)	1
X7103022	ALTERNATOR BRACKET (REDESIGNED)	1
F0130711	ADAPTOR PIECE	1
F0130150	RUBBER ELEMENT (Weveller Springs)	8
F3581611	FRONT SPRING I-BOLT	4
F3581711	FRONT SPRING I-BOLT	4
P4316551	Brake Spring Kit	2
P4308651	Brake Cam shaft Repair Kit	1
P4318851	6" HLP BRK LINING KIT (Front)	1
P4317151	7" HLP BRK LINING KIT (Rear)	1
B7302014/ 620000100162	12" AIR SPRING ASSY	4
610000000089	12'' Rolling Diaphragm	4
B7500813	S/A OF STOPPER BRKT-LH FRONT (TRACTOR) (for Vestibule)	1
B7500814	S/A OF STOPPER BRACKET RH REAR (TRAILER) (for Vestibule)	1
B7500815	S/A OF STOPPER BRACKET-RH FRONT (TRACTOR) (for Vestibule)	1
B7500816	S/A OF STOPPER BRACKET LH REAR (TRAILER), (for Vestibule)	1
B7500817	S/A OF STEERING LINKAGE MTG. BRACKET (for Vestibule)	1
F3201310	Roof Stabilization mounting (for Vestibule)	2
F3201410	Roof Stabilization mounting bracket (for Vestibule)	2
B7500601	Hubner PU bellow (for Vestibule)	1
F0719510	Retaining rings (for Vestibule)	4
B7500515	Hubner linkage (for Vestibule)	1
B7500514	S/A of relay lever (for Vestibule)	1
B7500516	S/A of Fulcrum lever (for Vestibule)	1

#### 14.00 SPECIAL TOOLS REQUIRED:

Sl no	Special tools description	Qty
1	Diagnostic tool (Pragati) Pt.No. P2618551	1
2	Analog /Digital Multimeter	1
3	Rear hub spanner	SMT-3757

The Depot Managers and Maintenance incharges are advised to make note of the above features of Bharat Stage-III vehicles and educate all the Maintenance staff about the changes incorporated in the vehicles for proper maintenance.

The Dy.CMEs are advised to ensure proper maintenance of BS-II vehicles as indicated above during their inspection of Depots.

The Controllers of Stores are advised to stock & supply the unique spares required for day-to-day maintenance of BS-III vehicles duly fixing the limits in consultation with the respective Dy.CMEs & WMs. The WMs are advised to take necessary action to provide floats for new aggregates based on the fleet strength and requirement.

  
EXECUTIVE DIRECTOR (E&IT)

**Encl : As above.**

To

All Depot Managers of Ashok Leyland Area for necessary action.

Copy to: VC & MD for information.

Copy to: Dir (V&S), ED (E&IT), ED (O&MIS), ED (A&P), FA, CAO, ED (T&C) for infn.

Copt to: ED (AM&HCZ), ED (HYD), ED (KRMR), ED (V&V), ED (K&N) for information.

Copy to: All RMs for necessary action.

Copy to: CME (O), CCOS, CA, CFM, CME(C&B), CE (IT), CPM, CM (HRD) for information & n/action.

Copy to: DyCME (O), DyCME (P), DyCME(C&B), DyCME (IED), DyCAO (SP&A), CSTO, COS(C) I & II for information.

Copy to: All DyCMEs, WMs, COSs & DyCAOs for necessary action.

Copy to: All AOs & AMEs (T) for information & n/action.

Copy to: All Principals of ZSTCs, BTC, HPT & TA/HPT for information.

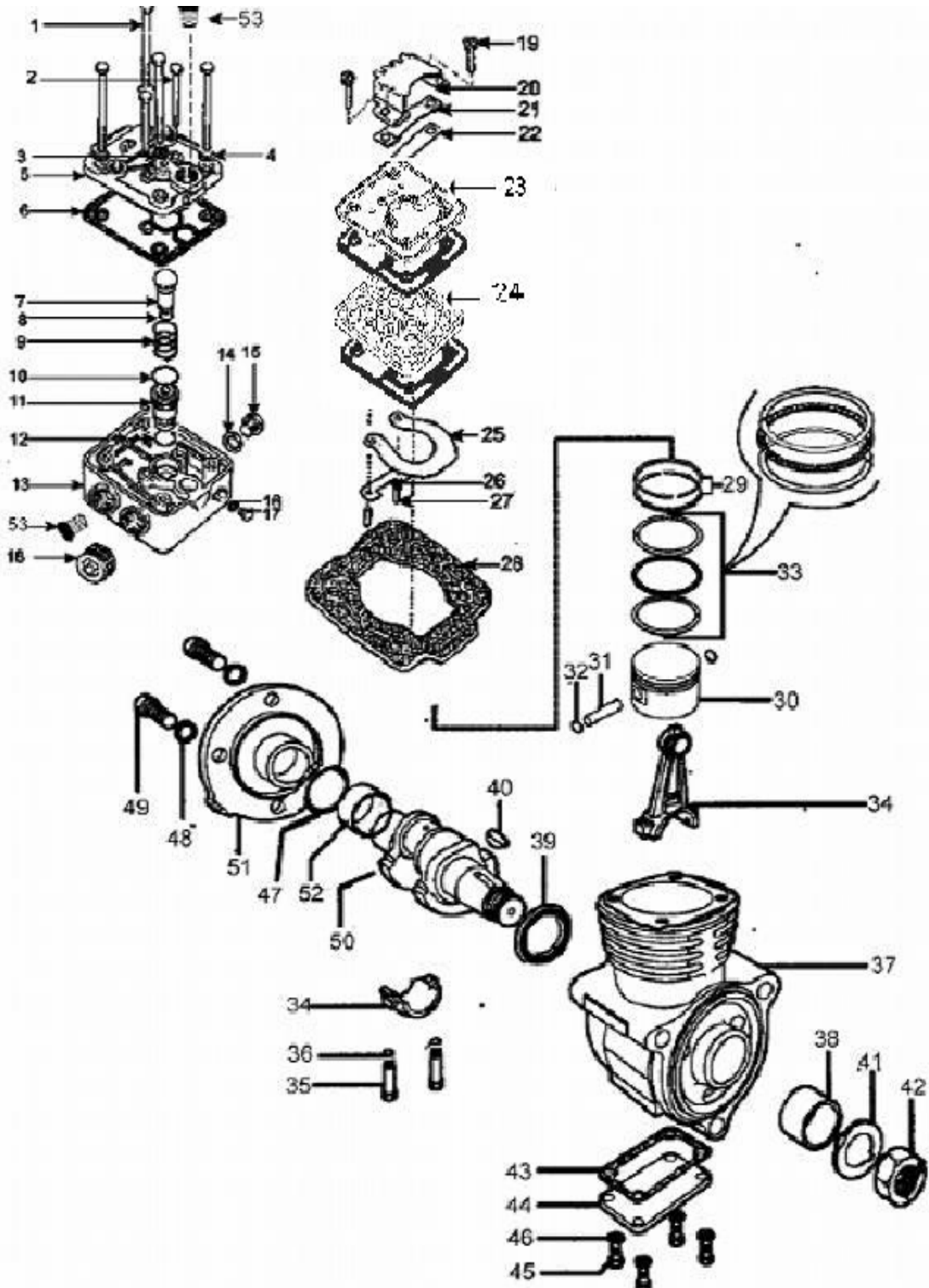
Copy to: All Depot Managers for necessary action.

Copy to: All Maintenance In-charges Leyland area depots for necessary action.

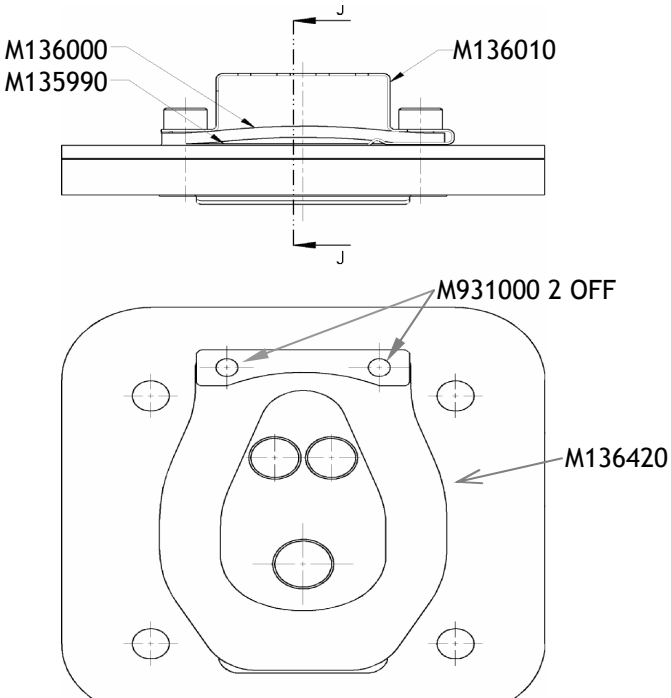
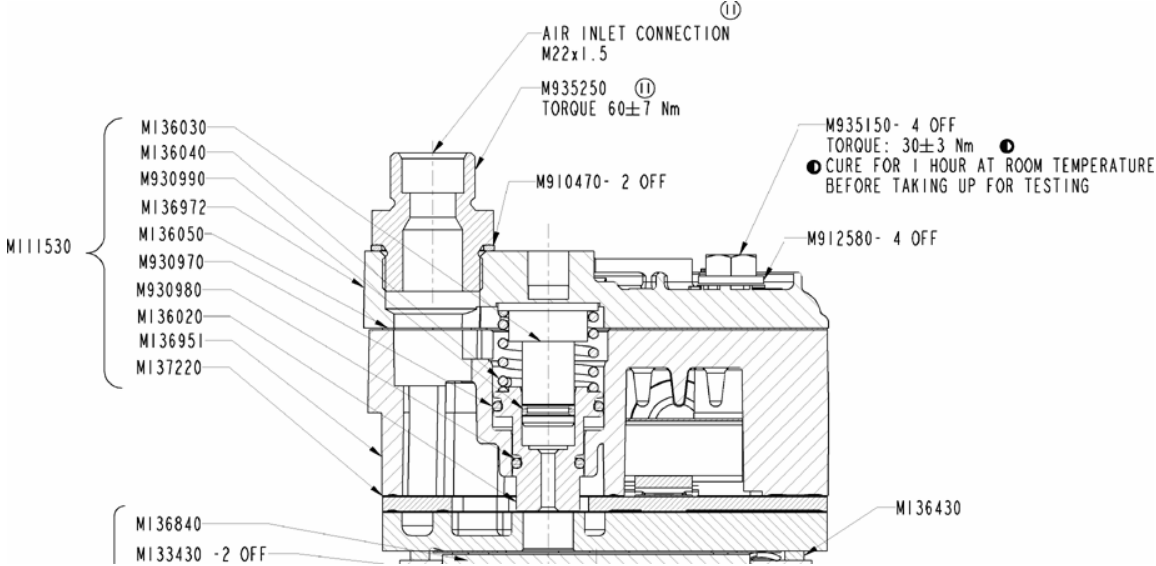
Copy to: In-charge, Manual Section for record.



WATER COOLED AIR COMPRESSOR (NLC 230)

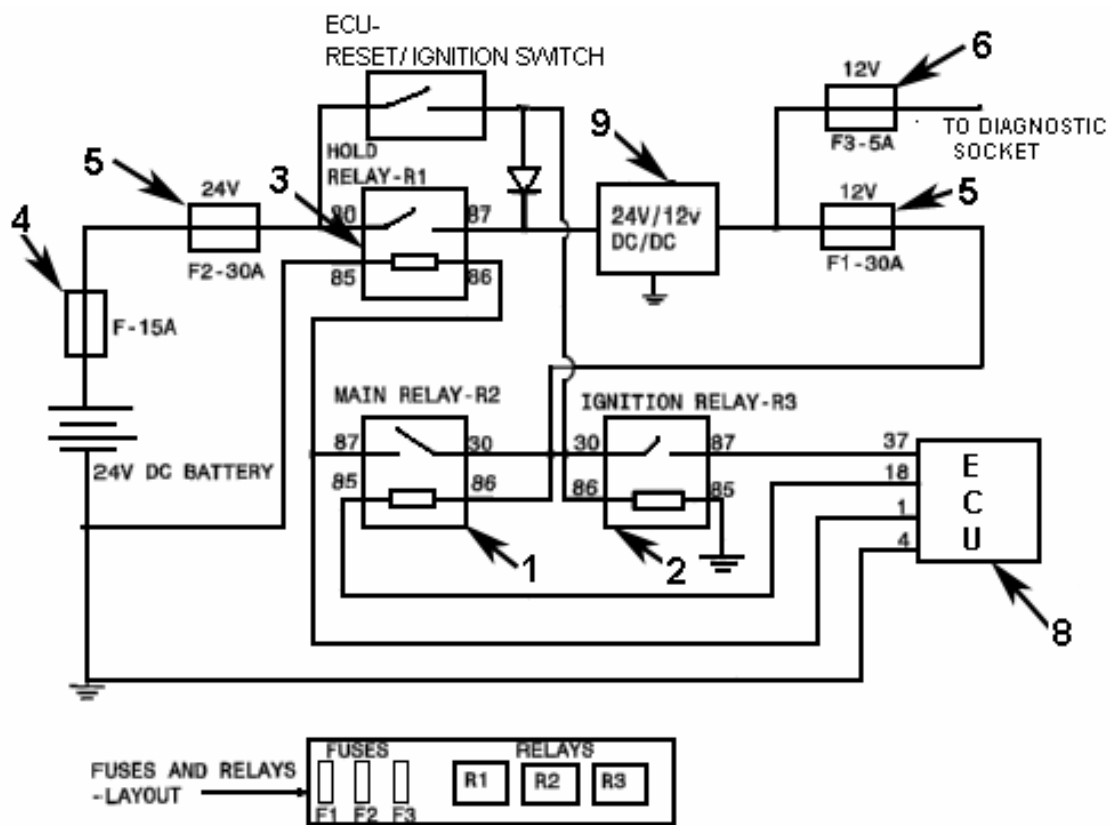


# AIR COMPRESSOR HEAD FOR WATER COOLED COMPRESSOR

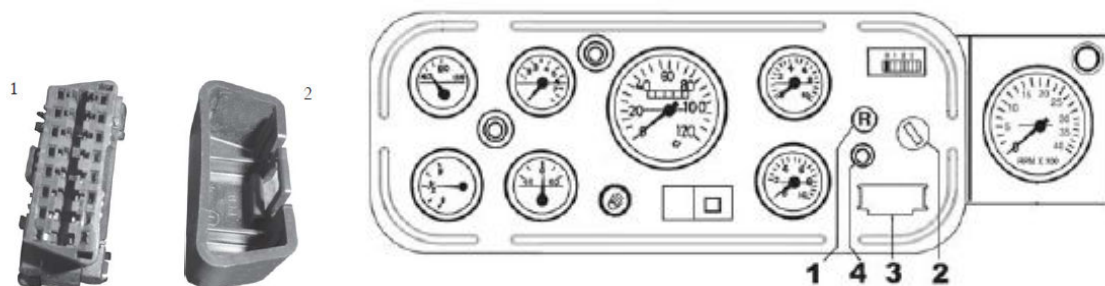


**Reed Valve Assembly - M111520**

**CIRCUIT DIAGRAM OF ECU**



**IDENTIFICATION OF FAULT CODES FOR RECTIFICATION**



**Diagnostic connector Female (Wiring Harness side)**

**Location on the Vehicle**

- 1 - Diagnostic connector.
- 2 - Diagnostic connector cap

- 1. ECU Ignition (Reset) Switch(Push - Pull Type)
- 2. Ignition Switch (Key Type)
- 3. Diagnostic Connector (Provided with Cap)
- 4. Diagnostic Lamp

**INSPECTION / CHECKING OF PARTS & CONNECTIONS AGAINST COMPLAINT**

**Required Instruments:**

- a) Diagnostic Tool (Dearborn / Crypton)
- b) Laptop / Desktop PC -in case use of Dearborn Diagnostic tool
- c) Analog / Digital Multimeter
- d) Test sockets with Flying leads - If required.
- e) Removal & Fitment of Sensors & Connectors - ESK

**REFERENCE CHART FOR FAULT IDENTIFICATION**

Dear born code	Crypton code	Component involved
P0235	P0237, P0238, 10FA, 10FB, 10FC	Boost pressure sensor (Ref: Item No-I)
P0105	P0107, P0108	Atmospheric pressure sensor - ECU (Ref: Item-XV)
P0314	P0300, P0301, P0302, P0303, P0304, P0305, P0306	Misfiring - Injectors (Ref: Item-XII)
P0571	P0572, P0573, P0624, P0504	Brake switch (Ref: Item-VII)
P105A	P1061, P1062, P1063	Diagnostic lamp (Ref: Item-VIII)
P0725	P0219, P0728, P0727	Engine speed sensor (Ref: Item-III)
P1063	P1064, P1065	Electrical shut off solenoid (Ref: Item-IX)
P1009, P1012, P10E1, P10AB, P1000, 1075, P1051, P107E	P1010, P1013, P1014, P1142, P1143, P1112, P1113, P1114, P1001, P1002, P1003, P1004, P1076, P1077, P1078, P1052, P1053, P1054, P1055, P1085, P1080	ECU related (Ref: Item XIV)
P0500	P0501, P1108, P1109, P1110	Vehicle speed sensor (Ref: Item-VI)
P1099, P0180, P10A2, P1087	P1100, P1101, P1115, P1116, P1082, P1083, P1081, P1103, P1104, P1105, P1106, P1088, P1089	FIP Related (Ref Item-X & XI)
P1024	P1025	Main relay shut off time high -ECU (Ref: Item-XIV)
P102D	P1034	Ignition switch
P106E	P1073, P1074	Needle movement sensor (Ref: Item-V)
P120, P220	P0222, P0223, P0224, P0221, P0122, P0123, P0124, P0121, P2299, P2135	Accelerator pedal sensor (Ref: Item-II)
P0560	P0562, P0563	Battery voltage (Ref: Item-XVI)
P0115	P0116, P0117, P0118, P0119	Coolant temperature sensor (Ref: Item-IV)
P1090	P1091, P1092	ECU (Ref: Item-XIV)

## I) ERROR CODES RELATED TO BOOST PRESSURE SENSOR

Dear born code	Crypton code
P0235	P0237, P0238, 10FA, 10FB, 10FC

Crypton code	Description
P0237	Signal low
P0238	Signal high
10FA	Supply voltage too low
10FB	Supply voltage too high
10FC	Plausibility vs. Atmospheric pressure sensor

### Effect of fault in Vehicle

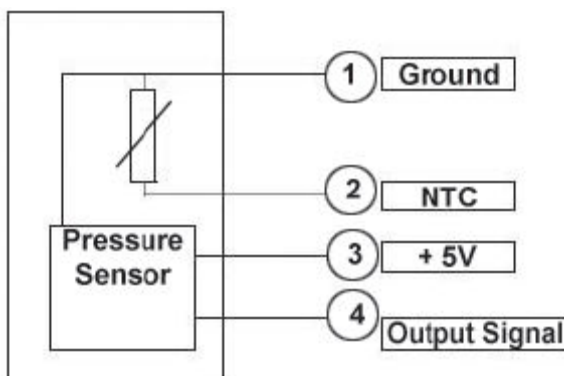
- Loss of power / vehicle speed limited to 40-50 Kmph as it would refer to the default value of 1050 Bar as set in the application.

### Possible cause of fault

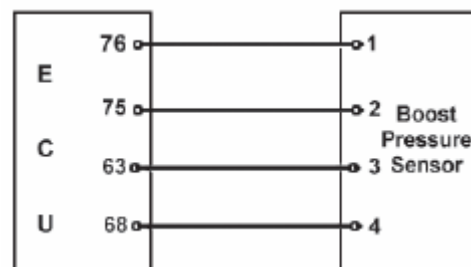
- Open circuit of signal wire / Earth wire & Short Circuit of Signal Wire to Earth wire.
- Boost Pressure sensor defective
- Loose connection of end fittings in the sensor side as well as in the ECU Side

### Service Recommendation

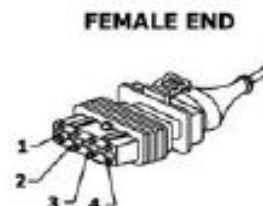
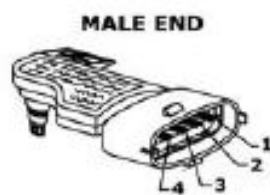
- Check resistance and continuity
- Measure the resistance between Pin 1 & 4 (Refer Table) at sensor end male connector.
- Measure the voltage between pin 3 & 1 for boost pressure sensor supply Voltage (5V DC) at sensor end male connector



**Circuit Diagram**



**Pin Configuration & Connection details**



Ambient temp. in °C	Resistance in ohms		
	Minimum	Nominal	Maximum
20 + / - 1	2308	2500	2726
30 + / - 1	1586	1715	1853
40 + / - 1	1113	1199	1291
50 + / - 1	729	851	913

## II) ERROR CODES RELATED ACCELERATOR PEDAL MODULE

Dear born code	Crypton code
P120, P220	P0222, P0223, P0224, P0221,
	P0122, P0123, P0124, P0121,
	P2299, P2135

Crypton code	Description
P0122	Input Signal low
P0123	Input Signal high
P0124	Supply voltage too low
P0121	Supply voltage too high
P2299	Plausibility error with brake
P2135	Plausibility error with redundant accelerator pedal position sensor 2

### Redundant sensor

P0222	Signal low
P0223	Signal high
P0224	Supply voltage too low
P0221	Supply voltage too high

**Effect of Plausibility fault :** Engine idling Rpm will get increased to 1200 Rpm and set. No further increase in Engine RPM irrespective of Pedal movement.

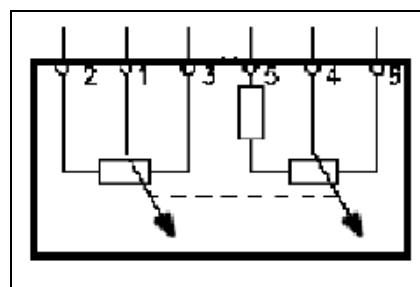
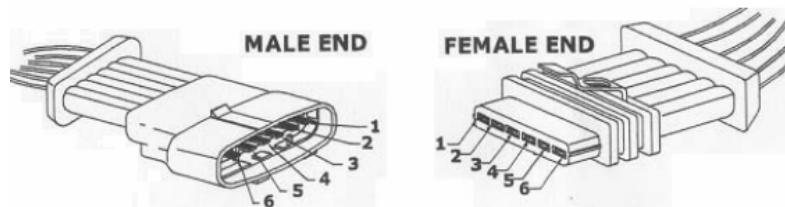
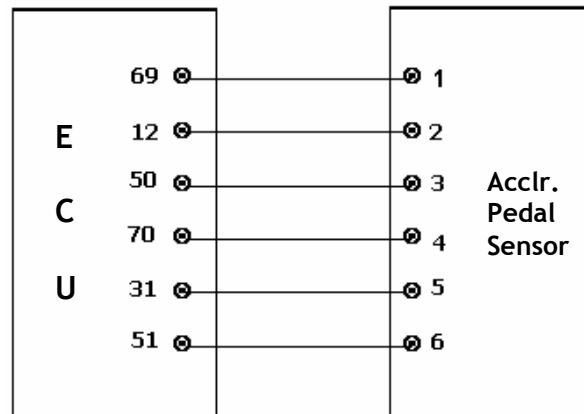
Sl. No	Possible causes of fault	Service Recommendation
1	Line interruption	Check continuity between 1 & 69, 2&12,3 & 50,4&70, 5&31 and 6 &51 of Sensor & ECU Respectively
2	Short circuit of Supply Voltage wire to earth wire	There should not be any Continuity between Pin 2 & 3 (Pot1) and Pin 5 & 6 (Pot2). Check for it.
3	Open circuit of Supply Voltage wire / Earth wire	Check continuity between 1 & 69, 2 & 12, 3 & 50, 4 & 70, 5 & 31 and 6 &51 of Sensor & ECU Respectively.
4	Sensor Defective	Measure resistance between pin 1& 3 for Pot1 and pin 4 & 6 for Pot2 (Refer below). Resistance to Vary progressively without interruption on a good sensor.

### Double - Potentiometer:

Potentiometer resistance

Potentiometer 1 :  $2.21 \text{ k}\Omega \pm 0.4 \text{ k}\Omega$  in Zero Position and  $1.44 \text{ k}\Omega \pm 0.4 \text{ k}\Omega$  in Max. Position.

Potentiometer 2 :  $2.80 \text{ k}\Omega \pm 0.4 \text{ k}\Omega$  in Zero Position and  $2.26 \text{ k}\Omega \pm 0.4 \text{ k}\Omega$  in Max. Position.



Pin 1 , 2 & 3 Main Potentiometer  
Pin 4 , 5 & 6 Redundant Potentiometer

### III) ERROR CODES RELATED ENGINE SPEED SENSOR

Dear born code	Crypton code
P0725	P0219, P0728, P0727

Crypton code	Description
P0219	Over speed-detection function
P0728	Dynamic plausibility
P0727	Static plausibility

#### Effect of fault

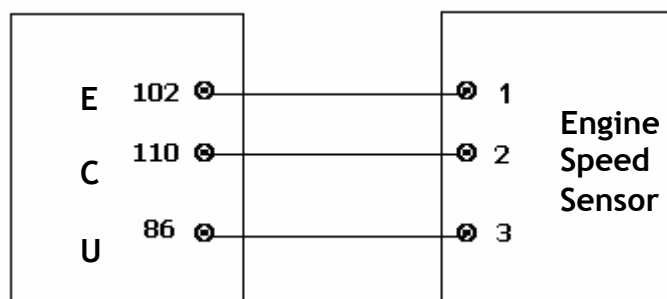
- Engine shut down

### Possible cause of fault

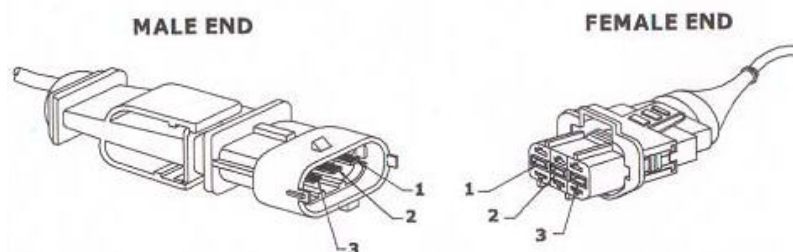
- Engine Over speed during Overrun operation
- Defective sensor
- Open Circuit of Signal Wire / Short circuit to earth
- Line interruption
- Increase in air gap (Spec: 1 to 2 mm)
- Dust accumulation on the sensor tip

### Service recommendation

- Measure resistance between pin 1 & 2
- Check continuity between Pin no 110 and 2 and Pin no 86 and 3.
- Keep Sensor Tip Free from dust, Grease / Oil and iron particles



### Connection Details of Engine Speed Sensor



## IV) ERROR CODES RELATED COOLANT TEMPERATURE SENSOR

Dear born code	Crypton code
P0115	P0116, P0117, P0118, P0119

Crypton code	Description
P0117	Signal low
P0118	Signal high
P0119	Temperature too low
P0116	Signal implausible (dynamic)



**Effect of fault:**

In case of sensor failure,

- 1) It has been programmed to switch over to default value of 96°C. The Default Value Specified in the control unit for such cases can lead to a fuel Quantity reduction and may produce white smoke output during cold start.
- 2) This reduction in fuel quantity will show an activated effect of limp home function - Refer Limp Home Function.

**Possible cause of fault:**

- Voltage Supply Line interruption
- Signal wire Short circuit to earth wire
- Sensor defective

**Service instruction**

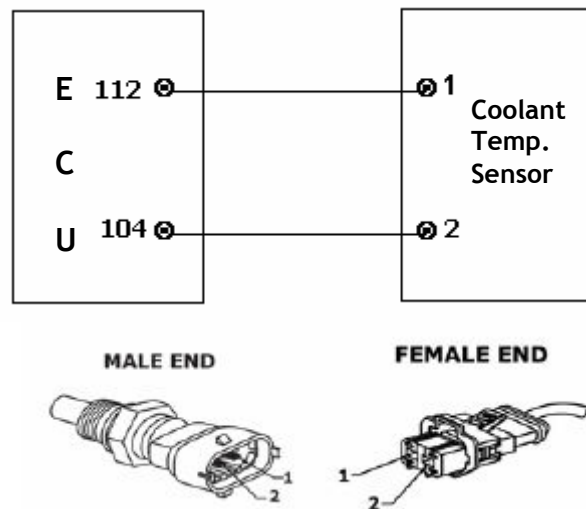
Measure Resistance between Pin 1 & 2

At 20°C - 2.315 to 2.649 Kilo Ohms

At 40°C - 1.118 to 1.231 Kilo Ohms

At 80°C - 0.313 to 0.332 kilo Ohms

Measure Voltage between Pin 104 & 112 and at the connector of the wiring harness near to sensor : > 4V



**V) ERROR CODES RELATED NEEDLE MOVEMENT SENSOR**

Dear born code	Crypton code
P106E	P1073, P1074

Crypton code	Description
P1073	Signal low
P1074	Signal high

**Effect of fault:**

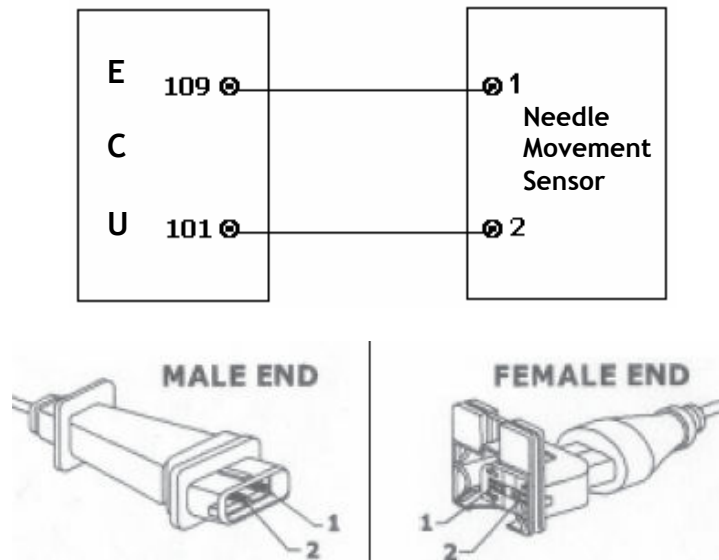
Selected timing as per the defined map with fixed values, all through the speed range. The performance may not be as that of normal. Smoke and misfire

**Possible cause of fault**

- Supply Voltage Line interruption
- Signal Wire Short circuit to earth / Negative
- Needle movement sensor defective

**Service instruction:**

- Measure the resistance between pin 1 & 2 - About 100 +/-10ohms (20 °C)
- Check continuity between point no. 109 and 1 & 101 and 2.
- As the effect disturbs the control of emission the complaint to be attended.



**VI) ERROR CODES RELATED VEHICLE SPEED SENSOR**

Dear born code	Crypton code
P0500	P0501, P1108, P1109, P1110

Crypton code	Description
P1108	Frequency too high
P0501	Signal high
-	Open Circuit

**Effect of fault:**

Nil - As such. To be decided after activating the vehicle set speed limitation.

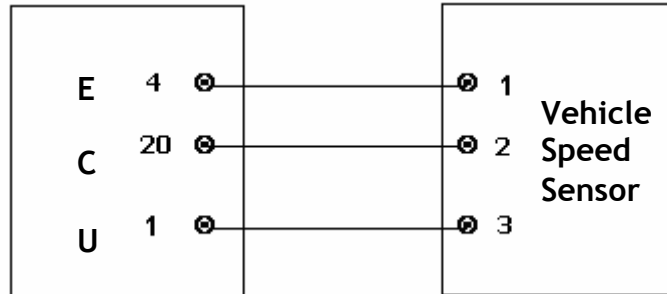
**Possible cause of fault:**

- Output Short circuit to earth / Negative
- No input Supply voltage ~ 12V
- Sensor defective

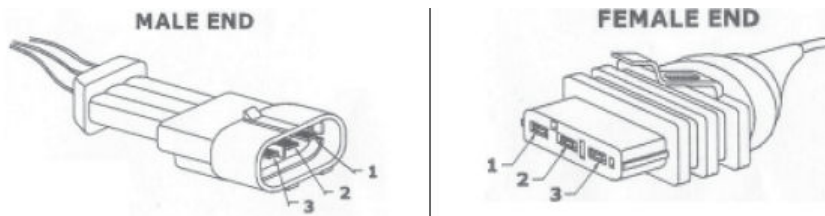
**Service instruction:**

- 1) Check for Supply voltage (12V) across terminal 1 & 2 of the male end - Wiring Harness side
- 2) Check for continuity between Sensor Ground and Battery negative / Earth

Combination	Speed Ratio 1:1.545					
	RAR 6.167 Tyre 9x20	RAR 6.167 Tyre 10x20	RAR 5.833 Tyre 9x20	RAR 5.833 Tyre 10x20	RAR 5.57 Tyre 9x20	RAR 5.57 Tyre 10x20



**Connection Details of Vehicle Speed Sensor**



## VII) ERROR CODES RELATED BRAKE SWITCH

Dear born code	Crypton code
P0571	P0572, P0573, P0624, P0504

Crypton code	Description
P0504	Plausibility with accelerator pedal sensor
P0624	Plausibility with second brake switch after ECU initialization
P0573	Input signal high
P0572	Input signal low

### Effect of fault:

Limp home function (Engine runs at 1000 Rpm) is activated in conjunction with defective accelerator pedal sensor.

Disconnected / absence of Brake switch will record DTC -P0504 and will not produce limp home function or Disturbance to normal operation when accelerator pedal sensor is in good working condition.

### Possible cause of fault:

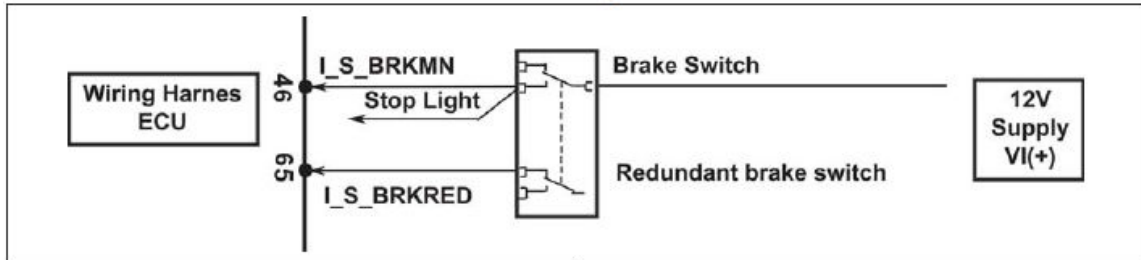
- Defective switch
- Open/short circuit of Supply voltage - 12V

**Service Instruction:**

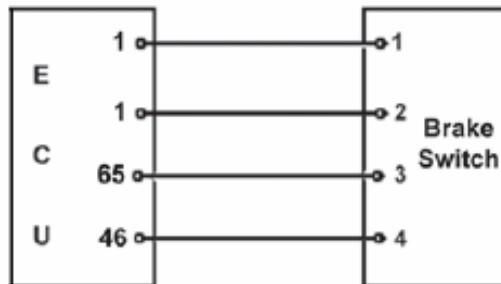
Check voltage as given below

- Pedal pressed pin 46 & ground - 12V
- Pedal pressed pin 65 & ground - 0V
- Pedal normal position pin 46 & ground - 0V
- Pedal normal position pin 65 & ground - 12V

**CIRCUIT DIAGRAM**



**Pin Configuration and Connection Details**



**VIII) ERROR CODES RELATED DIAGNOSTIC LAMP**

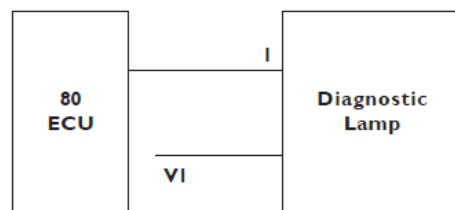
Diagnostic lamp is provided on the Dashboard. In event of any errors reported by the ECU in course of operation of the vehicle, the diagnostic lamp glows, indicating that there are errors reported in the system and recorded by the ECU. Only selected errors, which can have a direct effect on the engine /vehicle performance, are reported to the diagnostic lamp.

Depending on the criticality of the error reported, the ECU could either switch off the engine or change to limp home mode. Details of the errors can be viewed with the help of the diagnostic tool.

**NOTE:** Diagnostic lamp is only a indicator of any error reported.

Dear born code	Crypton code
P105A	P1061, P1062, P1063

Crypton code	Description
P105C	Lamp - Open Circuit
P105B	Lamp - Short Circuit
P105D	Plausibility Error



**Effect of fault**

No effect of fault. No visual indication for the driver in case of any error reported in the EDC System.

**Cause of fault**

- Loose connection
- Short circuit / Open Circuit

**Service instruction**

Use multimeter and measure voltage and continuity

**IX) ERROR CODES RELATED ELECTRICAL SHUT-OFF SOLENOID**

Dear born code	Crypton code
P1063	P1064, P1065

DTC	Description	Effect
P1064	Output Circuit Defect	Engine will not start - No fuel
P1065	Plausibility in ref. to Start Test	Repeated test cycle interruption till plausibility is corrected. Error is reported - No effect.

**Cause of fault**

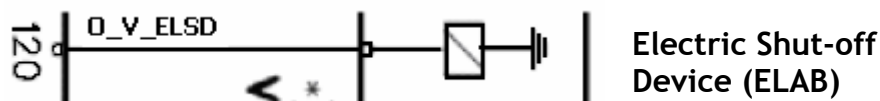
- Defective solenoid
- Open / short circuit
- Loose connection

**Function and Working**

It is a solenoid switch located on the distributor head of the fuel injection pump. The solenoid receives power supply (12V) from the ECU. When it is energized fuel will be supplied to the Pump Chamber.

**Service information****Check**

- 12V supply for the solenoid.
- Resistance 7.4 Ohms at 20°C (body earth)
- Continuity of cable from Point no 120 of ECU to solenoid.

**Circuit Diagram****X) ERROR CODES RELATED FUEL TIMING ACTUATOR (TIMER SOLENOID)**

Crypton code	Description
P1088	Short Circuit
P1089	Open Circuit

**Effect of fault**

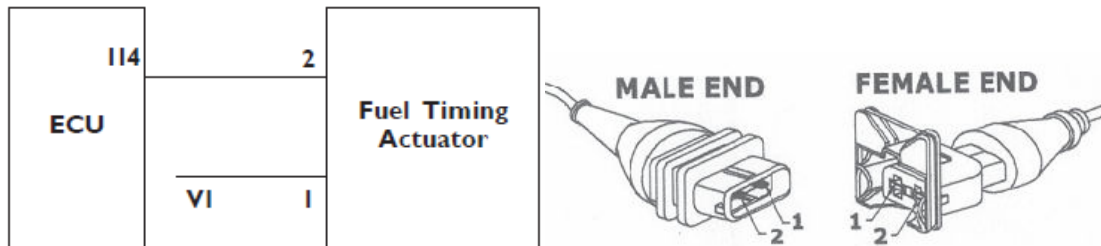
Selected timing as per the defined map with fixed values, all through the speed range. The performance may not be as that of normal. Emission would be affected. Fault to be rectified.

**Possible cause of fault**

- Defective solenoid
- Loose connection
- Short circuit / cable cut

**Service instruction:**

Check resistance between pin 1 & Pin 2 of the connector available at the FIP end. Check continuity between point no 1 & V1 and point no 1 & 114.



**XI) ERROR CODES RELATED FUEL QUANTITY ACTUATOR**

Dearborn Error Code	Effect of Fault	Error path
P10A2	Engine will shut down	Fuel Qty actuator. Negative and positive governor deviation in hot and cold condition
P10B4, P1099	Engine will shut down	Fuel actuator Governor feedback signal
P0180	Drop in engine power, Limp home	mode Fuel temperature sensor

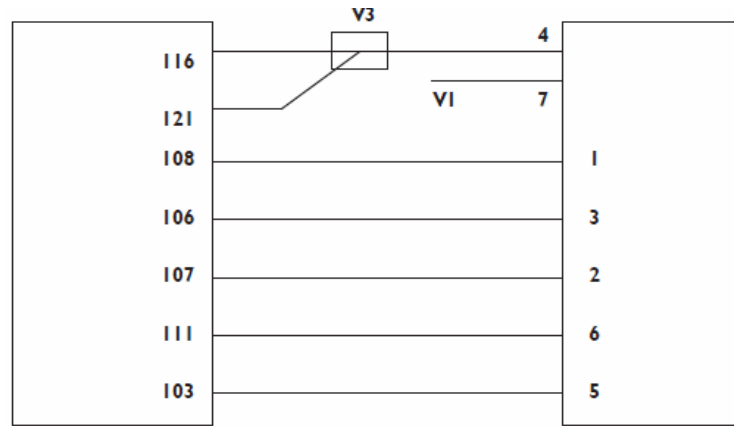
**Cause of fault**

- Defective actuator
- Defective temperature sensor
- Control collar stickiness
- Loose connection at connector end

**Service instruction:**

Check resistance at 15 - 35 °C

FIP end connector	Resistance value
Pin no 4 & 7	0.35 - 1.0 Ohms
Pin no 1 & 3	5.8 - 6.5 Ohms
Pin no 2 & 3	5.8 - 6.5 Ohms
Pin no 1 & 2	9.7 - 12.9 Ohms
Pin no 5 & 6 (fuel temp)	At 25 °C 0.5 - 3.5 Ohms
	At 60 °C 0.15 - 1.05 Ohms



## XII) MISFIRING - INJECTORS

P0314	P0300, P0301, P0302, P0303, P0304, P0305, P0306
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## XIII) FIP RELATED

P1099, P0180, P10A2, P1087	P1100, P1101, P1115, P1116, P1082, P1083, P1081, PP1103, P1104, P1105, P1106, P1088, P1089
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## XIV) ECU RELATED GROUP ERROR CODES

Dear born code	Crypton code
P1009, P1012,	P1010, P1013, P1014, P1142, P1143,
P10E1, P10AB,	P1112, P1113, P1114, P1001, P1002,
P1000, 1075,	P1003, P1004, P1076, P1077, P1078,
P1051, P107E	P1052, P1053, P1054, P1055, P1085, P1080

Dear born code	Crypton code	Error Path
P1000	P1001, P1002, P1003, P1004	Error encountered during overrun monitoring during overrun monitoring. Recovery from an erroneous state
P1009	P1010	Communication error between micro controller and EEPROM - Should not come in Production Series ECU
P1012	P1013	EEPROM
P1051	P1052, 1053, P1054, P1055	A/D CONVERTER
P1090	P1091, P1092	Reference voltage high / low
P10E1	P1142, P1143	Error path changing over to Kante
P1024	P1025	Main relay shut off time high -ECU
P102D	P1034	Ignition switch

**XV) Atmospheric Sensor - ECU**

Dear born code	Crypton code
P0105	P0107, P0108

**XVI) Battery Voltage**

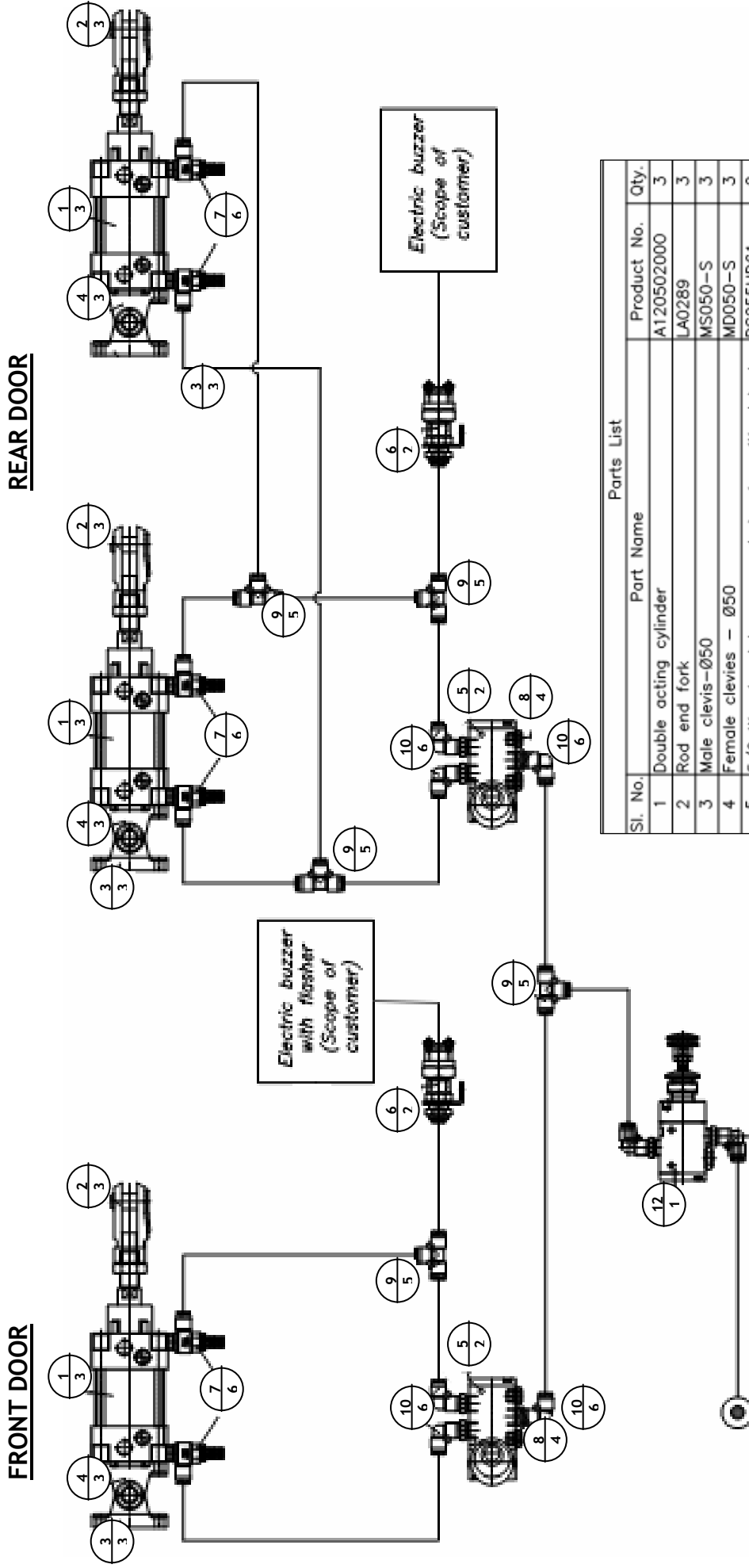
Dear born code	Crypton code
P0560	P0562, P0563
P1090	P1091, P1092

**Service Information**

- Verify and confirm supply voltage to ECU.
- Clear the errors with diagnostic tool after attending to the error related EDC parts
- Switch off the ignition ⇒ Switch on the ignition ⇒ start the engine
- Look for the errors ⇒ If the above errors repeat then replace the ECU/If the errors of frequent repeatable in nature, refer with MICO



LAYOUT FOR JANTICS PNEUMATIC DOOR SYSTEM



Parts List

Sl. No.	Part Name	Product No.	Qty.
1	Double acting cylinder	A120502000	3
2	Rod end fork	LA0289	3
3	Male clevis-Ø50	MS050-S	3
4	Female clevis - Ø50	MD050-S	3
5	5/2 Way hand lever operated valve with detent	DS255HD61	2
6	PE Converter with clamp	C7064	2
7	Flow Control Valve	GR5105106	6
8	Button Silencer	ASB0160	4
9	Union tee fittings	WP2300606	5
10	Male Elbow fittings	WP2210651	6
11	Ø6 Nylon tube	WH 01W06	60
12	1/4"-3/2 NO Push Pull detent valve with Fittings	MC4125	1

CIRCUIT DIAGRAM - FUSES & RELAYS

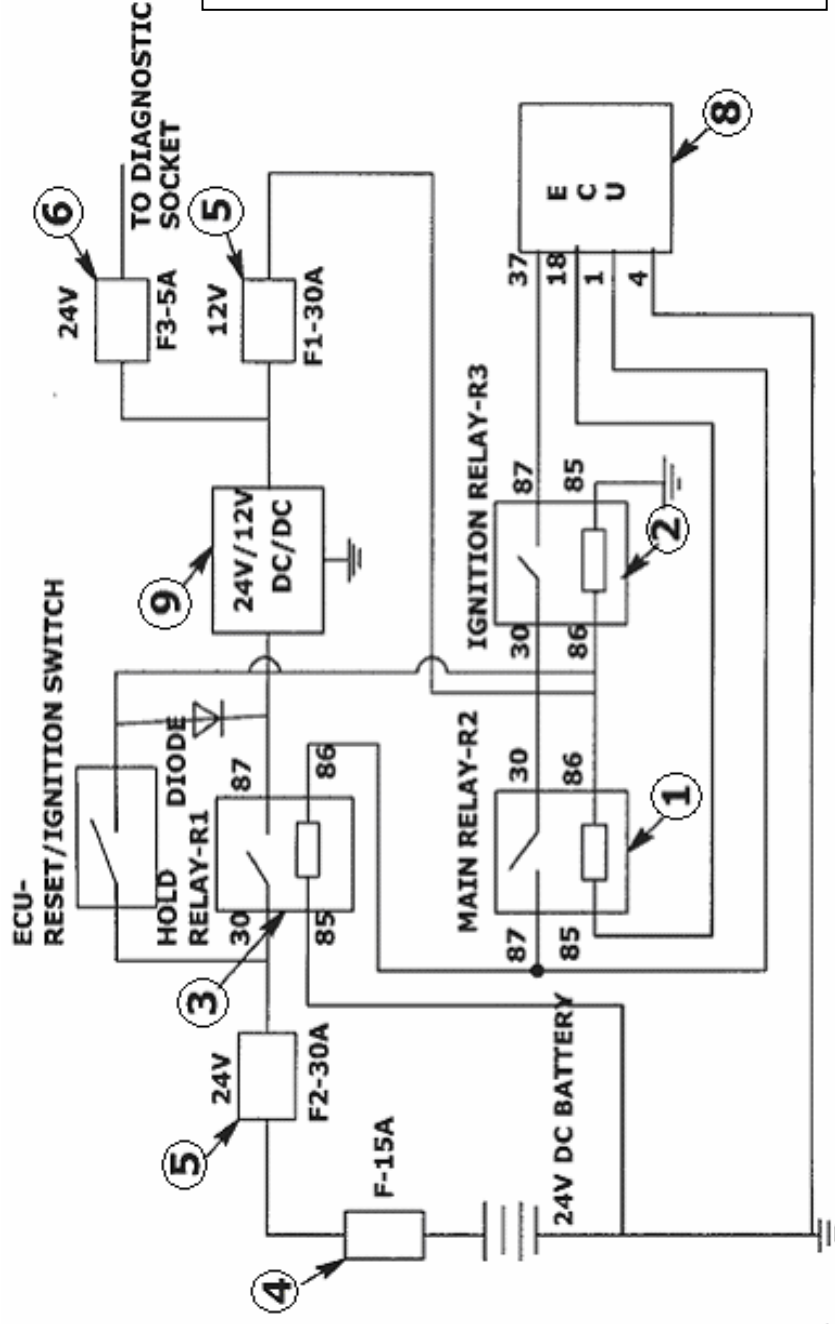


Fig Description &  
No. Part Number

- 1 - Main Relay 12V - E.1  
F8306000/ F8358700
- 2 - Ignition Relay 24V - E.1  
F8355000/ F7819400/ F8358100
- 3 - Hold Relay F8307200 - E.1
- 4 - Blade Fuse 15A F8307200 - E.1
- 5 - Blade Fuse 30A F8307200 - E.2
- 6 - Blade Fuse 5A F8307200 - E.1  
Head Lamp Relay24V - E.1  
F8040600
- 9 - DC-DC Converter F2202400 - E.1