



ANDHRA PRADESH STATE ROAD TRANSPORT CORPORATION
Mechanical Engineering Department
Office of the VC& MD, Bus Bhavan, Hyderabad - 624

No : Volvo/Mark3(1)/2008-MED

CIRCULAR NO. 19/2008 - MED Dt.05-09-2008

Sub: **VEHICLES** - Introduction of VOLVO make 9400 Inter City MARK-3 buses in our Corporation - Issuing of certain Instructions - Reg.

- Ref: 1. Circular No. 11/2003 - MED Dt 08.04.2003.
2. This Office Lr. No. OP3/462(12)/05-MED Dt. 11.04.2005.
3. Circular No. 17/2005 - MED Dt. 24.12.2005.
4. This Office Lr. No. Even Dt. 02.11.2006 & 20.11.06 of CME (O).
5. Circular No. 13/2007 - MED Dt. 12.05.2007.

1. INTRODUCTION:

To meet the demand of high-end customers another 20 vehicles MARK-3 (9400 series) Volvo vehicles were added to the existing Mark-1 & 2 vehicles. These 20 vehicles are allotted as replacement and augmentation to the following Depots:

- | | | | |
|-----------------------|-----|------------------------|-----|
| 1. Hyderabad-I Depot | - 2 | 6. Kakinada Depot | - 2 |
| 2. Picket Depot | - 2 | 7. Visakhapatnam Depot | - 2 |
| 3. Karimnagar-I Depot | - 2 | 8. Nellore-II Depot | - 2 |
| 4. Vijayawada Depot | - 4 | 9. Guntur-II Depot | - 1 |
| 5. Tirupati Depot | - 3 | | |

The salient features and maintenance aspects of Mark-1 & 2 vehicles were already communicated through circulars & letters as referred above. The Mark-3 vehicles are having additional features and improvements over Mark-1 & 2 vehicles, which are detailed hereunder:

2. SPECIAL FEATURES:

2.1. ELECTRONIC CONTROLS:

The new 9400 series B7R Volvo bus has advanced features with Electronic Control Unit (ECU), which controls eight systems in the vehicle. They are:

1. MID 128 EECU - Engine control unit
2. MID 136 EBS - Brake system control unit
3. MID 140 IECU - Instrument panel
4. MID 144 VECU - vehicle electronic control unit
5. MID 150 ECS - control unit for levelling system
6. MID 216 LCM - control unit for exterior lighting
7. MID 222 RECU - Retarder control unit
8. MID 249 BBM - Bodybuilder module

Message Identification Description (**MID**) is used to inform the control unit that sent the message. Each control unit has a unique number.

2.2 ENGINE:

The new Volvo D7E 290 engine with DCR type CRDI (Common Rail Direct Injection) technology (with a feeder pump and Two unit pumps) meeting the Euro-III norm with compact design is used in the vehicle. The specifications of the Engine are as follows:

1.	Engine Model	-	D7E 290
2.	Horse power	-	290 hp (213 kw) @ 2100 rpm
3.	Torque	-	1200 N-m @ 1350 rpm
4.	Weight	-	645 Kgs (weight reduced by 100 Kgs)
5.	Fuel Injection	-	CRDI (Common Rail Direct Injection) technology for high-pressure injection for low emission levels, with 2-stage injection per stroke for reduction of noise level.

Besides the above changes, the following modifications were carried as a product development.

- Turbocharger wheel material changed from steel to titanium for high temperature resistance.
- Engine suspension (4 instead of 6 nos) is made identical with truck version to have compatibility.
- Only one oil filter is used to reduce operating cost.
- Coolant tank moved from Centre to left hand side.
- Air Filter assembly moved from left Hand side to right hand side.
- The Air intake changed to higher level (just below the roof top) to prevent entry of dust and water.
- Belt tesioner is provided to increase the life.
- Fan with magnetic clutch provided to operate the engine at optimum temperature of 90 to 95° C.
- Water pump capacity increased for efficient cooling.

2.3 BRAKES:

The vehicle is provided with electronically operated EBS-5 model medium Disc brake system. It has anti-lock brake system (ABS), which is integrated to the vehicles electronic system. Because of these features, the stopping distance is shortened by 10-15 % from that of earlier versions. The advantages of EBS (Electronic Braking System) are:

- Brake blending- the wheel brakes and the auxiliary brake works collaboratively - reducing wear level in the brake lining.
- Drag torque control: while driving on slippery roads - the EBS activates the engine control - if the wheels loose grip.
- Hill start aid: while starting on a hill road (up gradient) - the brakes are released at a certain engine torque or when the clutch is released to avoid roll back.

- Wear indication: the driver gets an indication of the brake performance when it is too low.
- Panic brake assistance: shortens the distance when a panic situation arises and the brakes are used with extra force.
- Modulators: a magnetic control valve with built in electronics that acts like a relay valve and controls the supply of air to the brake cylinders.
- ABS anti-lock braking system: prevents the wheels from locking and helps maintain control when brakes are used with force.
- TCS anti-spin (Traction Control System): TCS acts as a differential brake when there is an uneven distribution of traction between the wheels.

2.3.1 RETARDER: Same as Mark-2 i.e., Voith RET 120 model. Five stage (0, A, 1, 2, 3) lever is provided to operate the retarder duly increasing the efficiency level. In '0' position the retarder is inactive, in 'A' position retarder will start working along with the application of service brake. In '1', '2' & '3' position the retarder function will start as and when the foot removed from accelerator pedal. The efficiency levels of retarder will be in ascending order of lever position. Hence **the retarder lever position should be kept in 2 position for better control of vehicle**, to increase the life of brake pads and to avoid premature failure of hub and consequential failures.

All the Dy.CMEs, Depot Managers, Maintenance-in-Charges are advised to educate the drivers to operate the Mark-3 Volvo vehicle retarder lever in '2' position and ensure the same to avoid untoward incidents and premature failure of brake & related parts.

2.4 SUSPENSION & STEERING:

Besides having the earlier features of Air Suspension with two air bellows in the front and four bellows in the rear the Mark-3 vehicle have "Electronically Controlled Suspension (ECS) with following features:

- i) ECS facilitates lifting of the entire vehicle by 70mm to increase ground clearance. This may be required when the vehicle is passing through rough roads and speed breakers. However, the vehicle has to be operated only at low speeds in the lifting position for shorter distance only.
- ii) Electronically controlled vehicle stabiliser on both front and rear axle to improve the vehicle stability at turnings in high speeds and uneven loading.
- iii) It has an improved power assisted steering system with circulated ball-and-nut type and a reduction ratio of 20.1 : 1, there by reducing the minimum turning radius to 10.25 Mtrs from that of 11.5 Mtrs of earlier version.

2.5 ELECTRICAL:

Mark-3 Volvo provided with Electronically operated control (LCM- Control unit for exterior lighting) system with two alternators (Melco A-RA 405-01 model) of 100 Ah each with 165 Ah power capacity to meet the high loads of electricity required for passenger bus operation. The details of Fuses and Relays provided in the vehicle are given at **Annexure-1**.

2.6 FUEL TANK CAPACITY:

Three fuel tanks made of plastic having a capacity of 600 ltrs (150 ltrs capacity tanks on both left and right sides and 300 ltrs capacity tank in centre) are provided. Fuel filling option is given on both sides.

2.7 BODY DESIGN:

Following changes were carried in the body structure from that of earlier versions.

- Increased profile size and thickness of structure for more stability.
- Anti-corrosive paint to protect the structure from corrosion.
- The luggage compartment space has been increased from 9.0 m³ to 9.5 m³.

Except the above, there are no changes in other aggregates and systems from that of earlier version i.e., Mark-2.

In view of the special feature, it is essential to allow only “trained” drivers to drive these vehicles to avoid untoward incidents and public complaints.

3. PREVENTIVE MAINTENANCE SCHEDULES:

The preventive maintenance schedules checklist of Volvo vehicle on daily, weekly and Basic & Annual maintenance are already given vide 4th cited reference, which are also applicable for Mark-3 vehicles till further instructions from this office. The Basic service schedule for Mark-1 & Mark-2 vehicles is for every 25,000 Kms, where as for Mark-3 vehicles it will be for every 30,000 Kms. Accordingly, the oil and filter changes are to be carried out for Mark-3 vehicles as per the periodicity given below:

- Engine oil (30 Ltrs) change at every 30,000 Kms.
- Engine oil filter (1) change at every 30,000 Kms.
- Diesel filter (1) change at every 30,000 Kms.
- Water separator (1) change at every 30,000 Kms.
- Power steering filter (1) change at every 90,000 Kms.
- Gear box oil (10 Ltrs) change at every 1,20,000 Kms.
- Rear axle oil (22 Ltrs) change at every 1,20,000 Kms.
- Air filter Insert (1) change at every 1,80,000 Kms.
- Air drier filter Insert (1) change at every 1,80,000 Kms.
- Retarder oil (4.5 Ltrs) change at every 2,40,000 Kms.
- Coolant (15 Ltrs) change at every 2,40,000 Kms.

Further, Engine oil, Gearbox oil, Retarder oil, Rear axle oil changes and Engine oil filter, Diesel filter, Water separator, Air Drier filter (insert) and Power steering filter changes are to be carried out after completion of **first 10,000 Kms** of Mark-3 vehicles.

4. **WARRANTY CONDITIONS:**

The free services for first six months and extended service for next six months on payment (Rs 12,500/-) is not available for Mark-3 vehicles. However the warranty on premature failure of spares remain unchanged.

5. **SPARES REQUIREMENT:**

The details of essential spares required for Mark-3 along with part numbers are listed at **Annexure - 2**.

The DMs of having Mark-3 Volvo vehicles are advised to follow the above instructions scrupulously and ensure proper maintenance of the vehicles. They are also advised to give feedback on the operation of these vehicles for taking further action at this end.

The Dy.CMEs are advised to ensure implementation of the above instructions without fail.

The RMs are advised to review the implementation of above instructions at the depots.



EXECUTIVE DIRECTOR (E&IT)

To
All Depot Managers.

Copy submitted to VC & MD for favour of information

Copy to: Dir(Vig. & security), ED (A&P), ED (O), FA, CAO & ED(T&C) for information

Copy to: All ED(Zones) for information.

Copy to: CCOS, CME (O), CME(C&B) & CE(IT) for information.

Copy to: All Regional Managers for necessary action.

Copy to: All Dy.CMEs/WMs/COSs for necessary action

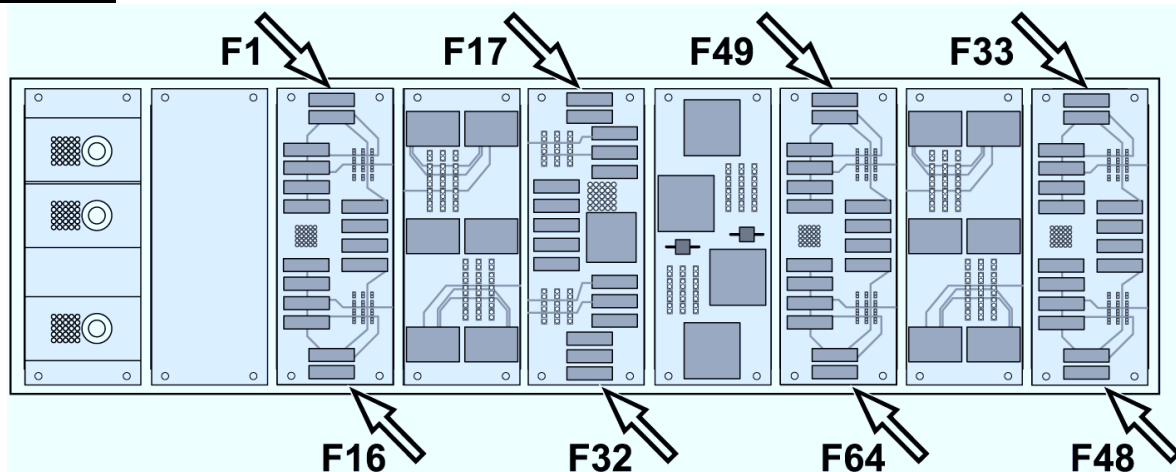
Copy to: All Dy.CAOs & AOs for information.

Copy to: Dy.CME(C&B), Dy,CME(IEU), Dy.CME(P) for information.

Copy to: Principal, TA/HPT, & all ZSTCs.

Copy to: Manual section, H.O.

Copy to: All Maintenance in-charges for necessary action.

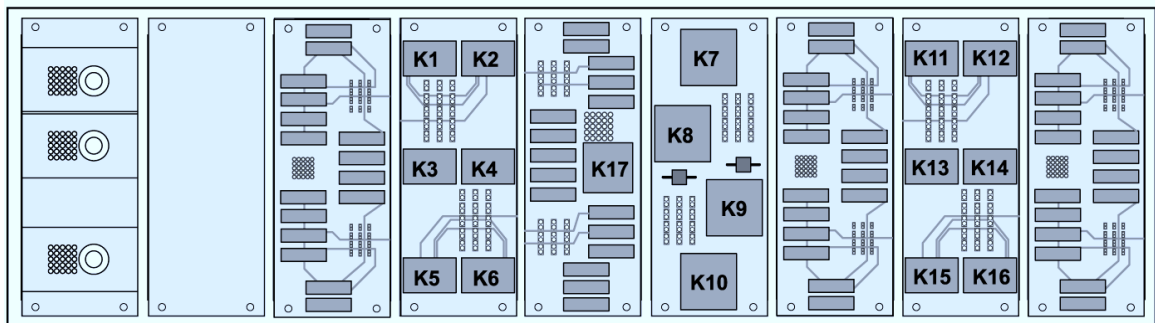
FUSES

Fuse	Rating	Designation
F1	5 A	ECS (electronic controlled air suspension)
F2	10 A	BIC (instrument), control switch
F3	15 A	Starting signal, starter motor
F4	20 A	EBS (brake control unit)
F5	5 A	Horn
F6	5 A	Emergency parking brake release
	30 A	Starting switch (alternative)
F7 ¹	15 A	TECU (transmission control unit), gearbox I-shift
F8 ¹	5 A	GECU (gear selector control unit), I-shift
F9	5 A	Starting switch, engine compartment
F10	5 A	Fire Alarm
F11 ¹	10 A	Dynafleet (option)
F12	5 A	Supply, main switch (+30) to body-builder outlet
F14	5 A	BBM (body-builder module)
F15	15 A	EECU (engine control unit), regulator valve, radiator fan
F16	5 A	VECU (vehicle electronic control unit)
F17	5 A	Lighting, switch for level control
F18	5 A	Alternator 1, 2, 3
F19 ¹	10 A	Pre-heating relay
F20	10 A	EBS (brake control unit)
F21	15 A	Wiper motor, windscreen
F22 ¹	5 A	TECU (transmission control unit), Voith automatic gearbox
F23 ¹	5 A	ACC
F24	5 A	BIC (instrument)
F25	15 A	Wiper motor, headlights

Fuse	Rating	Designation
F26	5 A	ECS (electronic controlled air suspension)
F27 ¹	10 A	Manual gearbox, EGS
F28 ¹	10 A	RECU (retarder control unit)
F29	5 A	Supply, ignition (+15) to body-builder outlet
F30 ¹	5 A	Radio, voltage converter 24-12V (+15)
F31 ¹	5 A	Hydraulic oil level, hydraulic oil filter
F32 ¹	5 A	Tachograph
F33	5 A	BIC (instrument)
F34 ¹	10 A	Tachograph
F35	25 A	LCM (external lighting control unit)
F36	25 A	LCM (external lighting control unit)
F37	25 A	LCM (external lighting control unit)
F38	5 A	Inverted +15
F42	5 A	Emergency stop switch, main switch
F44	25 A	LCM (external lighting control unit)
F45	25 A	LCM (external lighting control unit)
F46	25 A	LCM (external lighting control unit)
F47	5 A	Side position light, right
F48	5 A	Side position light, left
F49	5 A	Fuel shut-off valve
F50 ¹	10 A	RECU (retarder control unit)
F51	20A	Radio, voltage converter 24–12V (+30)
F52 ¹	10 A	Baggage hold lighting
F53 ¹	5 A	Tag axle
F54 ¹	5 A	Engine/luggage compartment door
F55 ¹	10 A	VCB (compression brakes), EPG (exhaust pressure control)
F56 ¹	10 A	Pre-heating element
F59 ¹	10 A	TECU (transmission control unit), Voith automatic gearbox
F61 ¹	10 A	Baggage hold lighting

¹ Dependent on variant

RELAYS :



Relay	Designation
K1	VECU (vehicle control unit), EECU (engine control unit)
K2	Inverted +15
K3	Self-holding relay, ECS
K4 ¹	TECU (transmission control unit), GECU (gear selector control unit) gearbox I-shift
K5 ¹	Manual gearbox EGS
K6 ¹	Manual gearbox EGS
K7 ¹	Baggage hold lighting
	Starting signal, starter motor (alternative)
K8 ¹	Inverting relay, neutral signal (Only automatic gearboxes)
K9	Intermittent relay, wiper motor
K10	Inverting relay, neutral signal (Only automatic gearboxes)
K11	Start inhibit relay
K12 ¹	Starting signal, starter motor
	Luggage compartment lighting (alternative)
K13	Emergency stop
K14 ¹	Tag axle
K15 ¹	RECU (retarder control unit)
K16 ¹	RECU (retarder control unit)
K17	Ignition relay (+15)

¹ Dependent on variant

ESSENTIAL SPARES FOR MARK-3 VOLVO VEHICLES

Sl. No.	Group	Part No.	Description	Remarks
1	SERVICE AND MAINTENANCE	OL 67-18003	ENGINE OIL	
2		OL 1161278	ENGINE OIL	FOR RETARDER
3		OL 1161279	DIFFERENTIAL OIL	
4		OL 1161280	GEAR OIL	
5		OL 1161941	STEERING OIL	
6		VO 1089238	COOLANT	
7		VO 1161967	BRAKE FLUID	
8		VO 20998807	OIL FILTER KIT	Oil Filter
9		VO 349619	FILTER	Steering Filter
10		VO 8149064	FILTER INSERT	Air Filter
11		VO 20998805	FUEL FILTER KIT	Fuel Filter
12		VO 20853583	FUEL FILTER	Water Seperator
13		VO 20773824	FILTER CARTRIDGE	Air Drier Cartrige (Part No. Changed from 20546795)
14	ENGINE BELT DRIVE	VO 20581953	V-BELT	Fan Belt
15		VO 20860507	V-RIBBED BELT	Alternator Belt
16		VO 20759364	IDLER ROLLER	
17		VO 20795659	IDLER ROLLER	
18		VO 3183643	BELT TENSIONER	
19	ENGINE AND ACCESSORIES	VO 21085150	TURBO CHARGER	
20		VO 20997647	COOLANT PUMP	
21		VO 20708905	RADIATOR	
22		VO 20499474	RUBBER CUSHION	Engine Bedding - Rear
23		VO 20502976	RUBBER CUSHION	Engine Bedding - Front
24		VO 20936050	CHARGE AIR COOLER	
25	ELECTRICAL	VO 20898062	ALTERNATOR	
26		VO 20918011	VOLTAGE REGULATOR	
27		VO 20997663	STARTER MOTOR	
28		VO 20795890	RELAY	For Starter Motor
29		IN2 3171257	BATTERY (PRESTOLITE-165Ah)	
30	TRANSMISSION AND CLUTCH	VO 20569139	CLUTCH	Pressure Plate with release Brg
31		VO 20366370	CLUTCH DISC	
32		VO 8171722	CLUTCH SERVO	Common For Mark 2
33		VO 1190131	BALL JOINT	Gear Cable Ball Joint
34		VO 1190132	BALL JOINT	Gear Cable Ball Joint
35		VO 85110086	BEARING	For Inertia Mass (Gearbox)
36		VO 85110083	SEAL	
37		VO 85108767	LOCK RING	
38	COMPRESSED AIR & BRAKES	VO 20928544	SENSOR	Wheel Speed Sensor
39		VO 21024702	BRAKE PAD KIT	
40		VO 21101027	AIR COMPRESSOR	
41	WHEELS AND STEERING	VO 20751021	KINGPIN KIT	
42		IN2 75-6028	WHEEL DISC	
43	SUSPENSION	VO 9959538	ANTI-ROLL BAR	Front
44		VO 9516524	RUBBER BUSHING	For Front Anti-roll Bar
45		VO 9521922	LINK	Front Anti-roll Bar Link
46		VO 10371200	ANTI-ROLL BAR	Rear
47		VO 20994420	STAY	Rear Anti-roll Bar Link
48		VO 70371206	RUBBER BUSHING	For Rear Anti-roll Bar
49		VO 20485166	SHOCK ABSORBER	Front
50		VO 20512274	SHOCK ABSORBER	Rear
51		VO 1137888	AIR BELLOW	Front
52		VO 20540789	BELLOWS	Rear- Rear
53		VO 20540792	BELLOWS	Rear -Front
54		VO 70371217	BUSHING	For Reaction Rod