

CHAPTER 7

TRAIN LIGHTING AND MAINTENANCE SCHEDULES OF NON AC COACHES

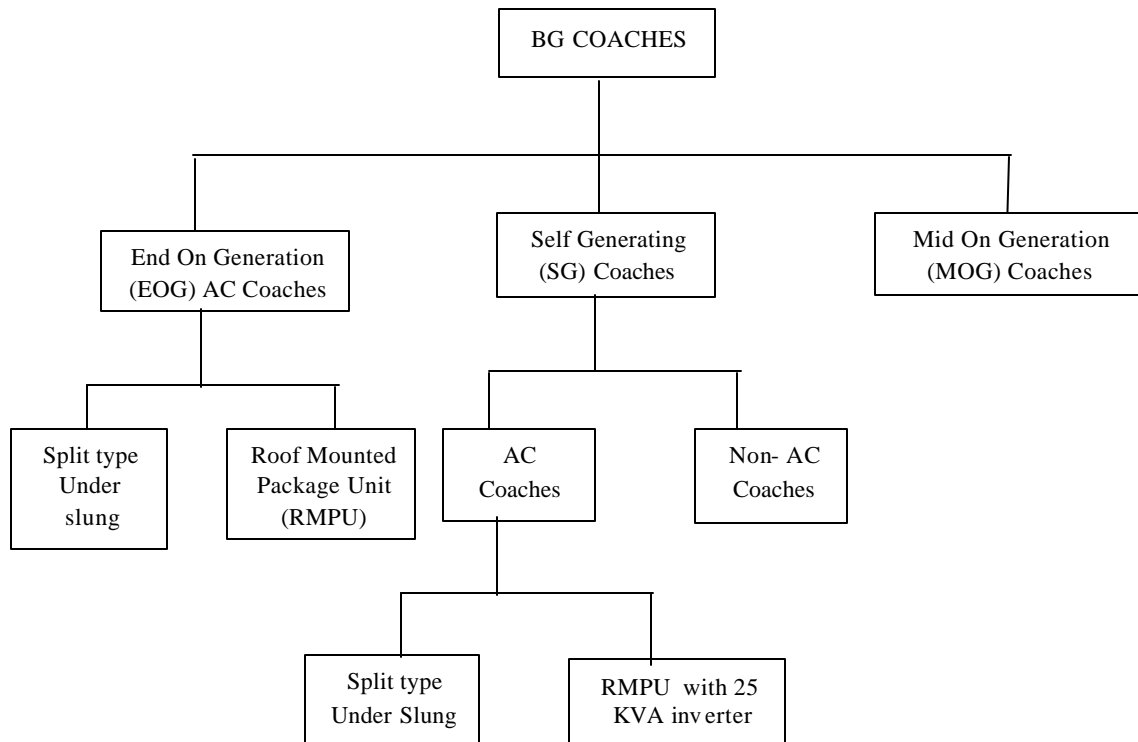
701 INTRODUCTION

The following systems of Train Lighting are in use on Indian Railways BG coaching stock:

1. End On Generation (EOG)
2. Self Generation (SG)
3. Mid On Generation (MOG)

Depending upon the train lighting systems, the coaches are of following types.

In this chapter the train lighting system of Non AC and AC SG coaches will be discussed.



702 GENERAL DESCRIPTION OF MAJOR EQUIPMENT**702a BRUSH LESS ALTERNATORS**

Brushless alternators are axle driven, with 'V' belt drive, mounted on the bogies of the AC & TL coaches. These alternators are of various ratings and make as per requirement for different type of coaches. They are being procured as per following RDSO's specifications: -

Specification No.	Ratings
EL/TL/47 Rev 'C' with amdt no.1,2,3	4.5 kW, 37.5A, 120 V DC used on non AC coaches.
EL/TL/54 Rev 'A' with amdt no.1,2,3	18 kW, 138.5A, 130 V DC used on SG AC coaches. (Split type underslung)
ELPS/SPEC/TL/01, Dec. 1993 with amdt no. 1 & 2	Optimized 22.75 kW/25kW, 175A/ 193A, 130V DC, used on AC coaches of SG type

4.5 kW Brush less alternators are used on Non AC BG Coaches. It consists of a three-phase hetro polar inductor type Alternator and a static Rectifier-Cum-Regulator Unit (RRU).

Earlier AC coaches provided with under slung split type AC units were fitted with two nos. of 18 kW brush less alternators. After the development of roof mounted AC units (RMPU) and 25 KVA inverters, 22.75 kW (Optimized) brush less alternator was developed within the same frame size of 18 kW alternator. Subsequently 25 KW alternator with new design was developed for 2 tier and 3 tier AC sleeper coaches with RMPU and 25 kVA inverters and for AC 1st class one 25 kW alternator with 25 kVA inverter provided.

The brushless Alternator with the help of static rectifier cum regulator unit is capable of developing voltage at the set value to meet the coach load

during journey from minimum speed for full output (MFO) to maximum speed. The alternator is used for:

- i. Charging the coach batteries.
- ii. To meet electrical load i.e. fans, lights, air conditioning, water-raising apparatus (WRA) etc. in the coach.

4.5 kW brush-less alternator are driven by 4 Nos. of C122 matched sets of 'V'belt coupled between the axle and the alternator pulley. The axle pulley is of 572.6 mm PCD (pitch circle dia.) and alternator pulley is of 200 mm PCD. Belts are kept under tension by a spring-loaded belt-tensioning device.

18kW/ 22.75kW/ 25kW alternators are fitted with 12 Nos. of deep V-grooved pulleys of 200 mm PCD with six grooves on each side of the shaft, which is driven by V-belt in conjunction with an axle pulley.

702b RECTIFIER-CUM-REGULATOR UNIT (RRU)

The rectifier cum regulator unit has mainly following functions:

- i To rectify the 3 phase AC output of the alternator through DC full wave bridge rectifier.
- ii Regulating the voltage generated by the alternator at the set value.
- iii Regulating the output current.

Recently electronic rectifier cum regulator (ERRU) conforming to RDSO specification No.RDSO/PE/SPEC/D/AC/0013 (Rev.0), developed, which has been fitted on a very few coaches on trial.

702c BATTERIES

The following types of batteries are provided on under-frame of AC & non AC Self Generating type and End On Generation type coaches.

- i. 6V/120 Ah flooded type (Mono block cells) on Non AC BG SG coaches.

- ii. 2V/120 Ah , VRLA cells on Non AC BG SG (Self Generating) coaches.
- iii. 2V,1100 Ah 56 cells VRLA 110 V SG AC coaches fitted with RMPUs and 25 kVA Inverter
- iv. 2 V, 800 Ah flooded type cells on under-slung mounted split type AC equipment .
- v. 90/120 Ah, 24V on EOG (End-On-Generation) type AC coaches (Emergency batteries for lighting)

The 2V,120 Ah TL batteries are used in conjunction with brushless alternator with suitable Rectifier-cum Regulator of 4.5 kW capacity for train lighting system of TL BG SG type coaches. The 2V, 56 cells 800 Ah / 2V, 56 cells 1100 Ah VRLA batteries are used in conjunction with brushless alternator with Rectifier-cum Regulator unit of 18/22.75/25 kW capacity for AC coaches. 1100 Ah batteries are used on AC coaches equipped with the Roof Mounted Package type AC plants. 1100 Ah capacity battery are of the valve regulated lead acid (VRLA) type which has its inherent advantages like :

- Topping up with water is not required.
- Periodical checking of specific gravity is not required.
- Regular maintenance to avoid sulphation of terminals and connections not required.

The VRLA batteries are also known as Sealed Maintenance Free (SMF) batteries.

702d BATTERY BOX

ICF type design battery box for AC coaches is a fabricated framework made of mild steel confirming to drg. No. WGFAC-7-1-026. Whereas RCF design is of closed type confirming to drg. No. CC71448 (PP side) & CC71451 (NPP side), It is suspended on coach in the under frame and is provided with front opening doors for paying attention to batteries. FRP trays are provided to prevent corrosion. The interior of the

battery box is painted with anti-corrosive paint.

While mounting the battery box in underframe of the coaches, special care is taken to provide locking nuts and split pins to avoid any accidental falling of batteries while running.

Recently both the Production Units have been instructed to provide battery boxes as per RDSO drg. No. RDSO/SK/K/0037, which is suitable for both makes of VRLA batteries i.e. M/S Exide and M/S Amar Raja. The battery box is having improved safety factor coupled with flexibility to accommodate both makes of VRLA batteries.

702e BCT (Battery Charging Terminals)

BCT is provided at the both sides of the coaches for external charging of the batteries at stations of maintenance lines .

702f RJB (Rotary Junction Box)

Rotary Junction Box is provided inside the coach. It is used to arrange and control the power supply to various circuit of the coach (e.g. light, fan) with the help of rotary switches and HRC fuses.

702g EFT (Emergency Feed Terminals)

It is provided at the both ends of the coach to feed the additional supply to the adjacent coach in case of emergency. Supply from the healthy coach may be extended to him/dark coach by connecting supply to the positive and negative terminals of the EFT.

702h TL Lamps

25 and 40 Watt lamps are provided in the non AC coaches. The power supply is at 110 Volt DC. 25 Watt lamps are used in corridor, light lamp, wash-basin, toilet. 40 W lamps are used for lights in the coach.

702i FTL (Fluorescent Tube Light)

It is a 2 feet long, 20 watt fluorescent tube light provided in the coach for the light. It works at 110 V DC supply. It gives better illumination and is being provided in the coaches in place of TL lamps.

702j Carriage Fans

On non AC BG coaches 400 mm sweep carriage fans are used where system voltage is 110 DC. These fans are fixed type and confirm to IS : 6680-92 with latest annexure 'H' for deviation to IS 6680-92.

703 TRIP SCHEDULE (PRIMARY & SECONDARY MAINTENANCE)**703a ATTENTION ON MAINTENANCE LINES**

As soon as the rake is berthed in the maintenance lines and before commencing the work, a caution board shall be clamped to the rail on either side of the rake by TXR or his representative. Rail locks shall be used on either side of the rake for the safety of maintenance staff attending under gear equipment. TXR should ensure clearance from electrical Chargemen/staff in charge for the maintenance of rack before removing the caution board and rail locks.

To avoid any malfunctioning of the above system, printed forms for permit to work on pit lines issued by the traffic department and after completion of the work, completed / men withdrawn form can be used.

Check the plate-form attention report and concentrate first on attending the defects in these coaches by adapting systematic trouble shooting procedures. Proceed as follows in respect of other equipment.

703b ALTERNATOR

First attend alternators in coaches for generation, which have arrived "cold" and coach dark condition

as per platform report. Proceed as follows:-

- Check field fuse, replace if found blown, with approved makes i.e., S&S or English Electric make.
- Check the continuity of field and phase winding with the help of test lamp/ multi-meter to ensure that windings are not open circuited.
- Check for loss of residual magnetism with the help of voltmeter across the field terminals. In case of loss of magnetism, give 12 V DC flashing to the field terminals for few seconds to regain lost residual magnetism.
- Check that the regulator feedback loop is O.K.
- Check connections for tightness in alternator and rectifier regulator. If this is all right, remove belt from alternator.
- Use testing machine for testing alternator in situation. Couple the portable motor drive with Alternator.
- Check the DC output voltage at the rectifier and regulator terminals. Identify the defects if any and rectify them. The battery should be isolated while doing this test.
- Provide new split pin for pulley castle nut after completion of work.
- Check up the condition of safety chain and availability of split pins in safety chain bolts.
- Check up alternator suspension bracket and tension gear for any damage and replace, if necessary.
- Check up and tighten loose bolts in terminals box covers.
- Check availability of split pin for alternator castle nut.
- Check the belt tension after every round trip of the coach.

- For new V-belt fitted, the belt should be re-tightened after completing the first trip.
- Check the tension indicator pin at suspension point after every round trip for flat belt drive alternator.
- Never energize field from battery in case of failure of field circuit diode in regulator. Apart from non regulation, this may cause permanent damage to field windings.
- If there is no generation, ensure that there is no breakage in the cable termination.

703c AXLE PULLEY

- Examine the indicating white mark on the pulley axle and ensure that the pulley has not slipped. If pulley has slipped, take necessary corrective action.
- Tap the pulley with hammer and judge the tightness or crack by sound. If it gives clean metallic sound the pulley is tight. Dull sound indicates that it is loose. Bolt should be tightened with torque wrench to 30 kgm.
- Check the lock nuts and split pins for availability and tightness.

703d BELTS

- Check condition of belt for fraying of edges, etc.,
- Check the belts for overturn and correct it, if necessary.
- Check the number of belts which should be 4 nos. for 4.5 kW alternator.
- Tension should be felt by hand by striking it slightly. Belt in correct tension will respond 'alive' and 'spring-back'. If required retensioning, the same shall be retensioned to the recommended values as applicable. This can also be checked using a suitable tension

meter as per recommendations of V belt manufacturers.

- Check that all the sets of belts provided should be of same make & grade.

703e RECTIFIER CUM REGULATOR

- Clean regulator externally. Open regulator terminal cover and check for signs of overheating in all the terminals/bus bars/etc. Check up for loose connections and tighten the same. If the terminal board is found affected due to heat, replace terminal board with new one.
- Check for any damage to the phase and field wires /cables inter connecting regulator and alternator and its anchoring arrangement.
- Check and secure properly the terminal cover and regulator cover.
- If the generator is normal, check the cable termination of the regulator visually for any abnormality.
- If the alternator arrived without generation, open the regulator and check for any abnormality and ensure the fuses are intact.
- Check the cable for any abnormality from the alternator to the regulator by using test lamp, if found open/short attend the same.
- Ensure the residual magnetism is available in the alternator.
- If needed change the regulator and ensure the generator by running the alternator with a portable motor.

NOTE : Components : Components of RRU such as MA, ET, CT, OVR etc., and electronic components such as power diode, field diodes, zener diodes, auxiliary diode etc., shall be procured only from OEM.

Maintenance of alternator/RRU has to be done in line with SMIs issued by RDSO as well as Manufacturer's recommendations.

703f BATTERIES/BATTERY BOX

i. Conventional Lead Acid Batteries

- To know the condition of cells during 'Trip Examination' some cells in a battery are treated as 'pilot' cells. On arrival of train in the maintenance line, disconnect all inter vehicle connections. Record the specific gravity of 'pilot' cells in each battery. Different cells should be identified as pilot cells every month. The idea of identifying different cells as pilot cells every month is to ensure that true condition of the battery is reflected.

In case of conventional coaches working on 110 V D.C. system there are two crates with 9 mono block batteries in each battery box. Marking of these cells to indicate pilot cells shall be done as follows.

Table 7.1

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18

Table 7.2

Month	Pilot Cells
1st Month	1, 12, 13
2nd Month	2, 11, 14
3rd Month	3, 10, 15
4th Month	4, 9, 16
5th Month	5, 8, 17
6th Month	6, 7, 18

Repeat cycle further.

Check the floats of each cell and check for correct electrolyte level as indicated in the float stem. Replace missing/defective floats. In case of low level, replenish with distill water. If any cell needs too much water for replenishing, watch for crack in the cells and also check the voltage on load which should not be less than 1.80 V. In case of any defect, remove the cell and replace by a spare one preferably of the same make and lug date or a lug date as close to the one already in the coach.

- Coaches with discharged batteries which shows less than 100 V on load should be put on charge at double the normal rate of charge and the charging reduced to half the rate of charge as soon as the gassing starts and continued till the specific gravity rises to the fully charged value which should be between 1210 and 1220. Use the battery charging terminals provided in coaches for charging purpose. Check up correct polarity and connect the charging cables. Use a clip on D.C. ammeter of 0-25 A range to check up the battery charging current. Note down the rate of charging and the number of hours of charge.
- Check specific gravity of pilot cells and the total voltage of battery on load at the end of charge and record.
- Keep micro porous vent plug tight. Ensure that washer is available in micro porous vent plugs.
- Check all the battery box members for any cracks in the fabricated battery box/cradle and take corrective action.
- Check for proper fitment of mono block in the battery box ensuring wooden packing pieces.
- The person in charge of battery maintenance should record all the readings mentioned above in his diary and this information should be transferred to the register maintained for various trains.
- Check anti-theft rods and provision of nuts both inside and outside the battery box on either side. Provide if found missing. Secure battery box cover finally after all works are completed.
- Ensure that the fitment of the battery box is in order with all the bolts, nuts, lock nuts, split pins etc. are in order.
- Ensure the weldings are proper and the bottom plate of the box is well secured.

- Ensure the cells are properly cleaned.
- Ensure the water level in all the cells/mono block is upto the mark and top up the cells with distilled water wherever required.
- Ensure all micro porous vent plugs and sealed floats guide are properly closed.
- Check the sp. Gravity of the cells if it is less than 1200, the battery shall be connected on charge.
- Measure the load voltage of the cells/mono block if it less than 100 V, identify the low voltage cell and replace if needed.
- Check the terminations in the fuse and the condition of the fuse.
- Check the termination of cable in the under frame link box, for proper condition and attend if needed.

ii. VRLA Batteries :

SMI no.RDSO/PE/TL/SMI/0001-98 (Rev.0) dt. 01.06.98 to be followed.

703g EARTH CHECKING

Before checking the earth in the coach, it should ensure that coach is not connected to the adjacent coach through EFT (Emergency Feed Terminal). After isolating the coach the earth shall be tested by using a double test lamp as explained in the RDSO code of practice of 110 V coaches. If any earth is noticed the required corrective measures should be taken to remove the earth before inducting the coach in the service. No coach shall be allowed for service with +ve earth. However incase of -ve earth this can be allowed for maximum one trip that too with properly marking as -ve earthed.

Record all the attention given in the under frame and roof, the Specific Gravity, the condition of generation, lamps, fans and fuses, availability of belts etc. with coach and other details.

703h FANS

Following scheme is prescribed for all trains during primary or secondary maintenance at a depot:-

- Switch on each fan individually. Check starting of fan when switched on. In upper class coaches, check fan for starting in the lowest position of regulator and also for variation of speed in the other regulator positions. If the fan does not start, short the switch terminals with a small piece of wire temporarily. If the fan starts this will indicate that the controlling tumbler switch/regulator is defective. Replace defective switch/regulator.
- If the fan does not start when the toggle switch terminals are shorted, proceed as follows:
 - ◆ Test for supply at the 2way connector terminals near the fan with the tumbler switch on. If there is no supply, the wiring is defective and has to be attended.
 - ◆ Open dome cover in case of swiveling fans and remove fan body fixing screws in case of fixed fans.
 - ◆ Remove carbon brushes. Check brushes for condemning size, proper bedding, correct spring tension and correct grade of brush.
 - ◆ Check for free movement of brush in the brush holder. Replace defective brushes/springs.
 - ◆ If the commutator is dirty, clean the surface with sand paper of 0/0 size
 - ◆ If the commutator surface is grooved or the segments are found pitted in one or more locations, replace the fan by an overhauled fan. The defective fan can thereafter be rectified by replacing the defective

armature by a good one. If spare armature is not available send defective fan to shop for attention.

- ◆ If the fan is noisy, check for loose blades/fan guards and tighten them. If the noise is due to bearings, replace the fan and send defective fan to shop for replacing.
- Check the fuse for fans and ensure that it is of correct size (35 SWG) tinned copper.
- Clean fan body and its guard.
- In swiveling and bracket fans ensure that the fan dust cover is promptly replaced after attention and also that the nylon cord provided to prevent loss of fan dust cover, is available in position.
- The MCB/fuse controlling the fan circuit shall be checked for correct rating (16A for non AC SG coaches and 6 A for SG AC coaches and proper functioning and replace if found defective.
- Note down the total number of fans in each coach and the number of fans found defective. Defective fans shall include fans, which required push start. The aim is to achieve cent percent working of fans. The records mentioned above will help in working out the extent of the problem in any particular service to take quick remedial action.
- The fans shall be available as per lay out for the coaches. In case it is necessary to remove any fan for attending to major defects and no spare fan is available a 'Deficiency Label' shall be affixed near the fan point. In case no deficiency Label is available. Theft Memo shall be issued to the security branch.
- Deficiency of fans shall be promptly made good when noted by any depot irrespective of whether the train is primarily maintained or not except in case of

repeated large scale deficiencies of foreign Railway's coaches. The Depot/Railway entrusted with primary maintenance shall be advised by message whenever the deficiency is made good or when large scale deficiencies are noted on arrival.

703i LIGHTING

- Switch on each lamp/tube light. If the lamp/tube light does not glow, check lamp/tube light and replace, if fused. If the lamp is all right, check control fuse and replace, if found blown.
- If the fuse is all right, check control switch and replace, if necessary. If the switch is all right, check up lamp holder for stuck up plunger or loose connection and rectify defect. If there is no defect in the lamp holder, check up for supply at the holder terminals and if the wiring is found defective, mark the coach "Sick" and arrange for attention in maintenance lines.
- Note down the coach number, total number of lights in each coach and the number of defective/missing lights on arrival.
- Provide switch covers and fuse covers promptly, if they are missing.
- If any dome cover is open or not secured properly, rectify defect, if any and secure.
- Replace broken glass domes/acrylic covers of tubelights.
- In case of berth lights in first class and AC coaches, check up for free movement of shutters. Replace, if found defective.
- Clean side lamp glasses and red shield inside the lamp in SLRs. Check up for free movement of operating handle and drop same lubricating oil, if necessary. Clean tail lamp glass and the reflecting surface inside.

- In case of fluorescent light check holders, switches, electronic ballast and wiring and rectify defect/replace component.
- Check MCBs/fuses for light circuits in junction box for proper operation and replace defective MCBs. Watch for loose connections between MCB and bus bars and rectify. Ensure that MCBs/fuses are intact for protection of each circuits.
- Check tightness of terminal connections of HRC fuse for negative circuit in junction box and rectify defect, if any.
- Use fuses/fuse wires of recommended sizes in junction box as a stop gap measure in place of MCBs and HRC fuses. Ensure that fuse wire provided in junction box as a temporary measures enroute should be replaced with MCBs & HRC fuses of the correct sizes at the primary maintenance depot.
- Remember that fuses & MCBs are safety switch gears provided for isolating the supply in case of faults. Never by-pass or use incorrect fuses as this may result in serious failures .

703j WIRING AND ACCESSORIES

- Earthing of wiring in the coach shall be checked both on the positive and negative wire separately in each coach by the earth testing device. A coach with negative earth fault in case of 110 V DC system, which could not be attended in time, can be given in service in case of emergency. The coach shall be taken for attention by the primary maintenance station during the next trip.
- Cable insulation on coaches get damaged in various ways resulting in earthing. Damaged insulation whenever noticed shall be promptly taped with PVC tape.
- The chipping of insulation is a dangerous practice this leaves permanent scratch on the cable. The taped conductor will not be quite satisfactory and so chipping should never be done. Testing shall be done only at cable terminations.
- Poor chipping of cable, poor crimping of cable lugs and loose connections in terminals will result in excessive heating and discoloration of lugs, tapes and cables. Watch for this during inspection and take prompt action to locate and rectify the defects. Replace overheated tape and re-tape the overheated portion of cable insulation at terminals using PVC tape after ensuring proper cable connection and cause of overheating.
- Replace blown fuses, incorrect size fuses and discolored fuses by fuses of proper rating. Replace blown or incorrect size of HRC fuses by correct rating. Check all fuses and ensure that they are secured tightly to their terminals. Replace defective MCBs/fuses in junction box by MCBs/fuses of correct rating
- Never replace a blown fuse by a higher gauge fuse. Remember that fuses are provided for protecting circuits in case of faults. Try to find out the cause of fault.
- Loose and exposed/hanging wires should be secured and properly covered. In case wiring is found mechanically damaged or tampered with or needs replacement , the coach should be marked electrically sick. If the work is of a minor nature, this may be done in maintenance lines.
- If the repairs are heavy the coach may be booked to Shops for attention. Coaches which are suspected to have wiring defect either in the underframe or roof shall be subjected to insulation test with 500 V megger.

704 FORTNIGHTLY SCHEDULE**704a BATTERY**

In addition to the instructions contained under "Trip examination" the following works shall be carried out.

- Clean the interior of battery box.
- Clean the cell tops and deposit of sulphate, if any, in inter cell and end cell connections.
- Remove sulphated inter cell connections, clean the connecting surface with a piece of cloth. Use fresh fasteners. Sulphated internal connections and fasteners should be soaked in kerosene oil, cleaned with warm water and kept ready for use. Inter cell connections should be provided with both small and large strips and four fasteners each with one hexagonal nut, one spring washer to IS:3063 and two steel punched washers to IS:2016.
- Remove end cell connectors, clean the connecting surface both in cell and connector thoroughly and provide back. Check for proper crimping of terminal. In case strands of connecting cable are found cut at the crimping end, cut wire at the crimping end and re-crimp with a new inter cell connector. End cell connector confirming to IS:6848 should only be provided. Tinned copper crimping sockets with a single hole, if any, provided as a stop gap measure should be replaced by standard end cell connector. Provide end cell connectors with both the fasteners each with one spring washer to IS: 3063 and one punched steel washer to IS:2016.
- Tap sealed float guides and check for free movement. Look for elongated holes in sealed float guides and replace such guides. Replace deficient floats promptly.
- Check whether vent plugs are of the anti-splash type and replace if required.
- Check the "make of cells and the lug date. Different "makes" of cells mono block if found mixed together should be replaced by a single "make " of cells. If it is not possible to do this during one Fortnightly Examination this should be noted down and attempts made to replace the same during the next Fortnightly Examination.
- Check whether cell/ mono block packing is tight and provide additional packing, if necessary. Use only hard wood coated with acid resistant paint for cell packing. Never use untreated wood or plywood for packing of cells/ mono block. If any cell/ mono block is found cracked, replace it promptly.
- Check for provision of anti-theft rods and provision of nuts, both inside and outside the battery box on either side. Replace deficient rod and nuts.
- Apply petroleum jelly on inter cell connection and end cell connections. Do not use grease.
- Check battery fuses and replace overheated/incorrect size fuses by correct size.
- Check battery box fixing nuts for tightness.
- VRLA Batteries : SMI.No. RDSO/PE/TL/SMI/0001-98 IRev 0) dtd. 01.06.98 to be followed.

705 MONTHLY SCHEDULE

In addition to the works mentioned in Trip & Fortnightly Examination, carry out the following:

705a ALTERNATORS, RECTIFIER AND REGULATORS

- i) Check for tightness of terminal connections of alternators and rectifier regulators.
- ii) Thoroughly clean externally the alternator and regulator.
- iii) Open inspection cover of regulator. Blow dust with a portable blower. Secure covers tightly after inspection.
- iv) Check locking of current setting of regulator, if disturbed it should be reset/locked as prescribed.
- v) Check the alternator pulley for proper fixture and the availability of castle nut and split pin.

705b AXLE PULLEY

- Watch for shifting of axle pulley by observing the white band on either side of pulley. Reset the correct position of pulley, if found shifted and tighten the loose nuts with torque wrench with recommended torque..
- Check tightness of nuts and also availability of chuck nuts and split pins in all fixing bolts.

705c BATTERIES**i. Conventional Lead Acid Batteries**

- Record specific gravity of individual cells/mono block. "Switch on" full load of the coach and record individual voltage of cells and total voltage. "Switch off" load. If the specific gravity is less than that painted on the battery box, charge the cells as specified under "Trip Examination" after topping up with DM water, if required.
- Use battery charging terminals provided on coaches for charging purposes. Charging should be continued till the specific gravity rises to the value of mentioned in battery box, on "Pilot" cells. In

case pilot cells show no appreciable improvement, check specific gravity of adjacent cells. If the specific gravity does not improve in spite of charging, replace the battery by another set and send the defective battery to Depot/Shop for treatment at the earliest. Cells should be handled with due care while unloading and in transit to avoid breakage. Adequate facilities should be created in Depot for treatment of cells which do not pick up charge. Sulphation will be the main cause for this and Sulphated cells should be treated for their recovery as specified.

- On completion of charging, record the specific gravity of individual cells. If there is any wide variation in the specific gravity/ voltage of cells, disconnect and replace those cells showing low specific gravity/voltage by spare ones. In case there are more than 1/3 of total cells with low specific gravity, the entire set should be replaced. Cells showing reverse voltage, zero volts should be withdrawn and replaced by charged cells immediately.
- Record individual voltage of cells and the total voltage on full load of the coach.
- Change the marking of the pilot cell as given in table 7.2.

ii. VRLA Batteries

SMI no. IRCAMTECH/PE /TL/ SMI/ 0001-98- (Rev.0) dtd. 01.06.98 & RDSO/PE/TL/SMI/ 0002-98 (Rev.0) dt. 09.12.98

705d JUNCTION BOX

- Open front door. Check all connections in MCB-cum-fuse panel for tightness any for heating sign, fuses etc. Check availability of terminal lugs for all cables in junction box and replace if necessary by terminal lugs of correct size.

- Check Rotary Switch / MCBs provided for lights, fans circuits for correct condition and Rotary Switch and EFTs for proper operation. Replace/ repair defective MCBs. If MCBs are not readily available provide rewirable fuses of appropriate ratings, purely as a stop gap measure. Check up negative fuse and replace if necessary by different ratings of HRC fuse for AC and non AC coaches. If rotary switches are provided instead of MCBs, Check for proper operation. Check up HRC fuses provided with rotary switches for correct rating and replace, if necessary.
- Close front door and secure properly by the locking key. If found defective, the same may be attended/replaced.

705e WIRING AND ACCESSORIES

In addition to the items listed under trip inspection, the following items shall be inspected:

Superstructure wiring and underframe wiring shall be tested separately for which the main negative fuse in shall be opened and controlling MCBs for all circuits kept off. All other fuses shall remain in circuit. Insulation resistance shall be measured with all fittings and equipment connected both on underframe and superstructure. The underframe wiring shall be tested with battery fuse open. The IR value should be minimum 2 Mega-Ohm in fair weather condition and min. 1 Mega-Ohm under adverse weather condition. Availability of inspection cover of DFBs should ensured.

705f FANS

In addition to the items listed under "trip examination", the following works shall be carried out :

- The fan body, guards and blade shall be thoroughly cleaned with cloth.
- All fans shall be opened and condition of commutator, brushes and brush gear shall be thoroughly checked. Action should be taken where necessary as given under "Trip Attention".

- Studs used for fixing the fan to coach body, shall be checked and tightened, wherever necessary. Availability of all the three fixing studs should be ensured.
- All the switches controlling the fans shall be checked for its smooth operation and correct working and replaced, where necessary.
- Fan regulators in Upper class coaches shall be checked for smooth operation from one position to the other. In case the regulators are not regulating the fan speed, the resistance box shall be checked and replaced, where necessary.
- Fan blades shall be replaced if found bent, or if there is no proper air discharge.

705g CARRIAGE LIGHTING

In addition to the items listed out under "Trip Examination" proceed as follows.

- Open each fitting with the dome key and remove the dust of the fitting both from inside and outside. Ensure free operation of locking mechanism and replace defective fitting. Clean glass domes first with wet cloth and then with a clean dry cloth.
- Replace rusted fittings and fittings with damaged surface.
- Check up wattage of lamps and replace with that of correct wattage.
- Check up whether toggle switches are marked to indicate lighting control "L", night light control 'NL', side lamps in guards compartment as 'SL', tail lamps as 'TL-Rear', 'TL-Front', luggage room as 'LRL'. If not, stencil legends with fluorescent paint.
- Check up all lighting circuit fuses in each coach for correct sizes and replace if necessary. Stencil the size of fuses near the locations, if not already done.

- Mark inspection covers of Distribution fuse boards as `DFB' if not done already.
- Thoroughly clean metal guards for roof light fittings in luggage rooms and paint, if necessary.

705h TUMBLER / TOGGLE SWITCHES

Check each toggle switch of lights and fans for proper fixing and operation. Replace defective toggle switches. Toggle switches should be provided in the locations intended for them and provided with covers with their knobs exposed for operation by passengers.

705i DISTRIBUTION FUSE BOARDS AND FUSE CUT OUTS

Check distribution fuse boards and fuse cut outs of light and fan circuits, for tightness of connections and provisions of correct size of fuses in the fuse terminals. Replace missing distribution fuse board covers.

705j EMERGENCY FEED TERMINALS (EFTs)

- Check up supply and marking of polarity of EFTs.
- Replace missing EFTs and those without wiring nuts.

706 QUARTERLY SCHEDULES**706a BATTERIES**

In addition to the instructions contained under "Monthly Examination" following activities should be done:

i. Conventional Lead Acid Batteries

- `Switch off' load. Charge the cells at 50% of normal rate of charge, i.e., at 1/10th of the rated capacity of cells. Record hourly cell voltage and specific gravity reading of every cell.

- Terminate charging when 3 successive readings are constant. Record specific gravity and no load voltage of each cell 10 minutes after terminating charge. Specific gravity should be between 1.210 and 1.220 for cells upto 120 Ah capacity. The voltage should not be less than 2.1 V.

- If there is a wide variation in the specific gravity and voltage readings, such cells should be replaced and sent to shops for treatment.

- Check the cell voltage on full load. Cells showing reverse and low voltage are to be replaced with healthy cells of the same make/type.

ii. VRLA Batteries :

SMI no.RDSO/PE/TL/SMI-0001-98 (Rev.0) dt.01.06.98 & RDSO/PE/TL/SMI/0002-98 (Rev.0) dt. 09.12.98 to be followed.

707 HALF YEARLY SCHEDULE

Measure insulation values as follows:

707a SUPER STRUCTURE

Short all the outgoing positive terminals from MCB cum fuse panel.

Measure and record the following insulation values:

- Between the bunched outgoing terminals and earth.
- Between the bunched outgoing positive terminal and main negative outgoing terminal.
- Between the main negative outgoing terminals and earth.

707b UNDERFRAME

Short the incoming terminals PM and L+ in MCB cum fuse panel. Measure and record the following insulation values:

- Between the bunched terminals PM & L+ and earth.
- Between the bunched terminals PM & L+ and main negative incoming terminal.
- Between the main incoming negative terminal and earth.

Note: Insulation resistance under fair weather conditions shall be minimum 2 mega ohm. However under adverse (highly humid/wet) weather conditions, the minimum insulation resistance upto 1 M.ohm will be acceptable.

In case the insulation resistance is found less than the values mentioned above, individual sub-circuits at junction box for super structure wiring and different feeders for underframe wiring shall be meggered separately. The sub-circuit having an insulation value lower than that prescribed above shall be taken up for rewiring. If the nature of repairs is heavy, the coach shall be booked to shops for attention. Do not resort to patchwork in wiring with temporary joints.

Proceed further as follows:

- Strands of aluminium wire cannot serve as tinned copper fuses to protect circuits. Never resort to this habit.
 - Use crimped socket of appropriate size in all cable ends to avoid loose connections and consequent overheating.
 - Use corrosion inhibiting conducting grease while crimping cables or while connecting wires to prevent oxidation.
 - Stencil the correct size of fuses near the locations, if not already done.
 - Check all fuses and MCBs for correct rating and MCBs for proper functioning. Replace if necessary.
 - Provide spare fuse wires of correct rating for use in branch circuits on the bobbins located on distribution fuse boards.
- Check voltage drop between battery and the farthest light or fan point with full coach load "on". The voltage drop should not exceed 3.0 V.
 - Provide deficient switch and fuse covers promptly.
 - Coach wiring should be terminated in two way connectors which shall be of tough non-ignitable moulding materials of rigid PVC from which connection to the fitting shall be provided by flexible single core cables for the following :
 - Fans
 - Reading light fittings
 - Side light fittings
 - Tail light fittings
 - Step light fittings.
 - Provide missing connectors.
 - All cable ends shall be properly socketed. Provide crimping type sockets wherever this is not in existence. Use sockets of appropriate size. Corrosion inhibiting conducting grease shall be applied to the conductor as well as inside the socket before crimping. Soldered joints should ordinarily be avoided, where this is absolutely necessary, only approved grade of solder and flux shall be used.
 - Electrical connections provided with bolts and nuts shall be checked and provided with a set of mild steel plain washer and spring washers, protected against corrosion by Zinc or Cadmium plating and passivation. Use correct tools for tightening cable connections.
 - Surface of aluminum sockets and bus bars, whenever removed for attention shall be cleaned to remove the oxide film from the jointing surface before making a bolted joint and shall be coated with corrosion inhibiting conducting grease to prevent re-formation of oxide film.

- V-Belt : The existing V-Belts shall be replaced with the new V-belt. 4 nos. having same make/grade. The old V-belts removed from service to be destroyed.

708 POH SCHEDULE

708a BRUSHLESS ALTERNATOR

The procedure to be followed shall be as per guide lines given below.

i. VISUAL INSPECTION

Carry out visual inspection of the machine and record the following:-

- Serial number and name plate particulars of the machine.
- Check that rotor rotates freely.
- Check the suspension bushes.
- Check insulation resistance
- Check continuity of the field and stator
- Check alternator tension rod
- Check the bearing noise with shockpulse meter

ii. ELECTRICAL CHECKS

Carry out the following electrical checks and record the following: -

- Open the cover of the terminal box and check whether the internal termination and terminal board are intact.
- Tighten all the connections on the terminal board.
- Using a multimeter, check continuity between
 - Field terminal F+&F-
 - Stator terminals U&V, V to W and W to U
- Check the insulation resistance by 500 V megger between
 - Stator terminals and frame of machine
 - Field terminals and frame

- Field terminals and stator terminals

(Note : Minimum insulation resistance should not be less than 1 Mega ohms for 4.5 kW under worst weather conditions and 20 mega ohm for 18/22.75 kW respectively)

iii. OVERHAULING

- The machine received for overhauling should be externally cleaned with wire brush and wiped before dismantling.
- Clean and re-grease the bearing after removing the bearing from the bearing housing. Only Servo Gem (RR-3) grease shall be used.
- Clean the mating surface of the end shield.
- While removing and placing the rotor, care should be taken that the rotor does not rub over the field coils.
- If any grease has crept into the stator surface, clean it before assembling.
- If stator and rotor parts are found rusty, clean. Apply the insulating varnish (air drying) of recommended grade. Impregnation of the varnish shall be done in an air circulated oven.
- Change the alternator suspension nylon bushes 100% and change the suspension pin on condition basis.
- Apply the insulating varnish (air drying) of recommended grade. Impregnation of the varnish shall be done in an air circulated oven.
- After complete fitment and greasing, the bearing noise shall be recorded using shock pulse meter.
- Only bearing of SKF/FAG shall be provided as per recommendation of RDSO.

iv. TESTING OF ALTERNATORS

INSULATION RESISTANCE TEST

Check the insulation resistance

● **Alternator**

**Place of Check Required Value for
Conventional Coaches**

Between stator.
winding and earth Above 1 M Ω

Between field
winding and earth. Above 1 M Ω

Between field
winding and stator. Above 1 M Ω

● **Regulator**

**Place of Check Required Value
Conventional Coaches**

Short all terminal
(live parts) together Above 1 M Ω
and check the insulation
resistance between the
live parts and earth.

Note: The insulation resistance of all
the above should be measured
by 500 V megger.

v. NO LOAD TEST

Connect the alternator
and regulator with a
resistance/battery load. Run
the Alternator at base load (1
A) at various speed from 357
rpm to 2500 rpm.

This voltage should
not exceed ± 5% of set the
voltage. The cut in speed
should also be checked. It
should not be more than 357
rpm at 108 volts at zero load.

vi. LOAD TEST

Connect the alternator
and regulator with
resistance/battery load. Run
the alternator at half load i.e.
19 Amp. and full load 37.5
Amp. respectively at various

speed from 600 rpm to 2400
rpm. Setting shall be done at
1500 rpm and half load 19A
before starting the test.

The voltage should
not exceed ± 5 % of the set
voltage at a speed from 600
rpm to 2400 rpm. The set
voltage can be 120 V, 122 V,
124 V at 19 Amp. 1500 rpm.
Check the MFO (minimum
speed for full output) i.e. 37.5
Amp. for 4.5 kW alternator, it
should not be more than 600
rpm.

vii. TEMPERATURE RISE TEST

For 4.5 kW Alternator

Run the alternator at 600 rpm
and apply the load. The alternator
should be capable of giving 37.5
Amps at 120 Volts. Run the
alternator at 2500 rpm with full
load for five hours with a fan
cooling the body. Check the
temperature at different part of the
alternator and should be as
follows:-

- a) Power diode - Should not exceed
100 °C at ambient
of 50° C.
- b) Alternator terminal - Should
not exceed 100 °C
at ambient of 50° C.
- c) Bearing temperature - Should not
exceed 85 °C at
ambient of 50° C.
- d) Stator and Field - Should not
exceed 90° C at
winding load of
37.5 Amps.

708b RECTIFIER REGULATOR UNIT

The procedure to be followed shall be
as per guidelines given below.

- Check the terminals and inside
wires for heating signs and
looseness. Blow out the dust.

- Replace the damaged wiring/terminals. The wiring of the regulator shall be done systematically,
- Check the PCB circuit with PCB testing kit or multimeter to identify defective components. Replace the defective components.
- Check field transformer for correct voltage. Replace, if found defective.

708c V- BELTS/ TENSIONING GEAR

- The existing V belts shall be replaced with the new V belts 4 Nos. having same grade/make. The old V belts removed from service to be destroyed.
- Tensioning gear shall be removed and its spring shall be checked for proper functioning. If required moving parts of tensioning device including spring shall be replaced.

708d 'V' GROOVED AXLE PULLEY

The procedure to be followed shall be as per guidelines given below:

- Check the axle pulley for slippage, tightness and physical damage to grooves. Ensure availability of locking nuts and split pins in position. Check the alignment of axle pulley with the alternator pulley and adjust. Change the rubber packing.
- Replace the pulley if any groove is damaged/broken/worn-out.
- The pulley shall be replaced after four years period or earlier on condition basis.

708e BATTERY AND BATTERY BOX

The procedure to be followed shall be as per guidelines given below.

- Remove the cells from the battery boxes on arrival of the coach in workshop and bring them in the battery shops for maintenance.

- Record voltage and specific gravity of each cell.
- Clean exterior of the cell/ mono block thoroughly. Wash top of the battery with a 10% solution of soda and a wire brush. During such cleaning, it is necessary to ensure that the micro porous vent plugs are mounted on the cells so that the water does not enter into the cells.
- Battery boxes shall be cleaned/repainted and repainted with anti corrosive epoxy based paint after removing the battery. Check the opening of welds and cracks thoroughly specially on load bearing members, vicinity of mounting bolts etc. Detection of minor hair line crack shall be done with ultrasonic testers.
- Top up cells wherever necessary with distilled water. The level should be corrected as indicated on the float.
- If there is corrosion/sulphation on the inter-cell connectors etc., clean them thoroughly and protect from further corrosion by applying petroleum jelly or Vaseline. Cell connectors and fasteners should be changed on condition basis.
- Replace defective sealed float guide and micro porous vent plugs, if any.
- Clean micro porous vent plugs and sealed float guides and ensure that vent holes are in order.
- Record lug date to determine the life of the battery.
- Charge the battery fully till 3 constant half hourly readings of voltage and specific gravity are obtained. This will indicate that battery is fully charged.
- Discharge the battery at 10 hrs discharge rate. While discharging, record the voltage and specific gravity.
- Record the capacity of the battery during discharge. It should not be less than 80% of the rated capacity.

- In case while discharging, any of the cells fall below 1.8 volts, disconnect the cell from the circuit for treatment with one or two cycles of slow charge and discharge.
- After two cycles of charge and discharge, recharge the cells fully.
- Battery box vertical/horizontal member shall be checked for any minor/hair line cracks, its mounting arrangement ensuring proper securing through nut bolts/washers etc.
- In case of VRLA Batteries, SMI no.RDSO/PE/TL/SMI/0001-98 (Rev.0) dt. 01.06.98 and RDSO/PE/TL/SMI/0002-98 (Rev.0) dt. to be followed.

708f WIRING (After 2 years for new coaches and 1 year for old coaches)

The wiring shall be completely inspected for damage by opening side panels, end wall near EFT's and also near fittings after stripping. The re-wiring shall be done on condition basis or planned on the basis of life of 20 years for cables.

The cables used for re-wiring shall be as per IS:694-1990 (Third Revision) The cables taken up for re-wiring shall be done through PVC conduits in super structure conforming to IS:2509. Bushes/Grommets used shall be of Hard PVC as per BS:1767-1951 or to grade 6 of IS-5831 latest. Flexible conduits used, if any, under water tank shall be as per IS:6946.

i. Coach insulation

Insulation resistance of the coach shall be measured with 500 V megger. IR value should be minimum 2 Mega ohms but it should not be less than 1 Mega ohm under highly humid/wet weather.

ii. Cable termination joint

- All cable joints shall be checked for its looseness or heating signs. Loose joints and cables having damaged insulation shall be replaced/repared. All cable ends shall be properly socketed with crimping type sockets.
- Surface of crimping sockets and bus-bars shall be cleaned to remove the oxide film from the jointing surface before making a bolted joint and shall be coated with corrosion resistant conducting grease of approved make to prevent reformation of oxide film.
- Fire retarding PVC grommets to IS:1767 or grade 6 of IS:5831 shall be provided at all cable entry points in metallic members.
- The under-frame wiring if running loose shall be provided in flexible steel conduit.
- All inspection covers shall be opened to check the distribution boards and condition of wiring.

iii. General Precautions

- Do not peel insulation for testing. If wires are found with peeled insulation replace them with fresh wires. If peeling is of short length apply proper PVC adhesive tape.
- Do not use twisted joints of aluminum cables to avoid oxidation and improper contacts and over heating/earth fault due to loose strands.
- Remove earth fault by isolation method instead of hit and trials and short circuiting of opposite polarity of earth.

- Use proper rating of fuses both in branch circuits, rotary panels and regulator boxes for field and main fuse.
- Use HRC fuse to the extent possible except for branch which may be done with rewirable tinned copper fuse. In the absence of HRC fuse use correct size equivalent rewirable fuse. Do not use under rated or over rated rewirable fuse to avoid faulty tripping of defective circuits.
- Use connectors for lights & fans.
- Ensure extra length of cables near termination's for future maintenance and replacement, if found inadequate at the earliest opportunity.
- Check for earth fault on every maintenance and rectify those detected.
- Do not tamper with regulator potentiometer setting unless tested in a proper alternator drive having variable speeds.

708g SWITCHES, LIGHT FITTINGS, ETC

i. Light fittings

The light fittings, reflectors, clear acrylic sheet cover, glass globe, holders, etc., shall be checked and cleaned. Any defective part shall be replaced. Anti-theft arrangement for fluorescent light fittings shall be checked as per ICF Drg. No. ICF/SK-7-6-079.

ii. Rotary Switch Cum Junction Box

Strip the housing from the coach and clean thoroughly and remove oxidation from terminal points and check the function of rotary switches. Fit back the same and do the connections using corrosion inhibiting compound for better conductivity and to avoid oxidation of all contacts.

708h FANS

- Dismantle the lower guard, upper guard, blade and fan motor.
- Check the guard assembly, repair/replace if necessary.
- Check the blade angle with a measuring gauge. Correct the same, if necessary.
- Check the insulation resistance of the fan motor. The IR value should not be less than 2 Mega ohms as specified in IS: 6680-1992.
- Check the fan leads and change it if necessary.
- Check the armature winding and field coil, repair/replace, if necessary.
- Check the commutator for grooving, pitting marks, ovality, blackness etc. Polish the commutator if required.
- Check the carbon brush and brush spring. Replace by correct grade of carbon brush as recommended by RDSO. The fan spring should meet the requirements given in IS:6680. Replace the same if necessary.
- Apply air drying insulating varnish if IR value of the armature and field coils is low, give impregnation treatment in an air circulated oven.
- Clean the ball bearing, check for noise, replace if necessary or grease it with recommended grade grease.

Testing

- i) Check the load current at rated voltage. The wattage of the fan should not exceed the value specified in IS: 6680.

- ii) Check the air delivery of one or two fans from a batch to ascertain the correctness of the blade angle. The value of the air delivery shall not be less than that specified in IS:6680.

NOTE :

- SKF/FAG (imported) make bearings for alternator procured directly from manufacturers as specified in the RDSO specification shall be used. Use of other makes of bearing is not permitted.
- Shock pulse meter shall be procured by Railways and workshops to monitor condition of the bearing regularly during maintenance service and after replacement of defective bearings.
- Induction heater/oil bath shall be used for heating the bearing to the required recommended temperature.
- The pulley condition such as wear on V group, pulley key way, shaft way, groove angle etc. shall be monitored during POH. Proper gauges shall be used for checking "V" groove of the pulley.

709 DO'S AND DON'TS FOR MAJOR EQUIPMENT

709a ALTERNATOR

i. DO'S

- Do ensure the correct polarity of field winding i.e. positive connected to F + while measuring the continuity of the field winding, otherwise the alternator will not self excite.
- Do check the proper compression force on the tensioning spring with indicator plate by tightening the special nut.

- Do keep the terminal box tightly closed.
- Do open the terminal box once in a week and clean the accumulated dust, if any.
- Do check tightness of the connection regularly, at least once in a week.
- Do use the cable grommets or cable gland of correct size for reducing the vibration of terminal connections. It is preferable to anchor the cables externally to avoid shocks and vibrations on the terminals.

ii. DON'TS

- Don't use improper tools to handle the alternator, it may damage parts of the alternator.
- Don't re-grease the bearing frequently. Re-greasing should be done after thoroughly cleaning the bearing with white spirit. It is preferable to re-grease the bearing only during POH.
- Don't over-grease the bearing.
- Don't keep the belts in over tension as this may reduce life of the belt.

709b REGULATOR

i. DO'S

- Do check the regulator terminal box once in a month for loose connections and for cleaning the dust.
- Do short all seven terminals of the terminal box before measuring the insulation resistance.

- Do ensure that DC '+' and DC '-' are connected to battery positive and battery negative respectively. Wrong connection will damage main diodes.

ii. DON'TS

- Don't disturb the settings of the regulator shunt and potentiometer.
- In any circumstances the burden resistance setting should not be disturbed.
- Don't open the regulator box unless there is a defect.
- Don't use a megger to test the components . Use multimeter.
- Don't reverse the field terminals on regulator and alternator.
- Never use a fuse wire for field fuse. Always use HRC fuse of specified value.

709c 'V' BELTS

i. DO'S

- Use belt of the same length for a set.
- Belts should be stocked in lots as per date of receipt and use in the principle of first in first out basis. The belts shall be stored in a well ventilated room free from direct sunlight and moisture.
- Ensure correct belt tension i.e. 330 Kg for 18 kW, 22.75 kW and 25 kW alternators and 105 kg for 4,5 kW alternators. The tolerance of tension shall be ± 5 kg in both cases.
- Re-tension newly fitted belts after first trip.
- Maintain a gap of approx. 75 mm between supporting plate and fixing nut on the free end of tension rod or

upto the split pin for the 18 kW, 22.75 kW, 25 kW Alternators and 55 mm for 4.5 kW alternators.

- Maintain proper alignment between axle pulley and alternator pulley.
- Replace pulley with burn out grooves i.e. 0.8 mm depression on sides and bottom of grooves with uniformly shining surface.
- Form grades of the belts received from the stores/suppliers after checking on belt measurement gadgets. The grading of belts should be between 48 and 52 only of matched sets.

ii. DON'TS

- Do not allow loose belts.
- Do not disturb the nut and check-nut on free end of tension rod if proper gap is available between supporting plate and fixing nut i.e. 75 mm for AC coach alternators and 55 mm for TL alternator.
- Do not use repaired pulleys.
- Do not use old and new mixed belts in sets.
- Belt should not have any oil or grease traces ,if persist clean it by soap and water.
- The matched set should have belts of one manufacturer only. Do not use belt of same grade of different manufacturer in a set.

709d VRLA Batteries : Do's and Don'ts from SMI no. RDSO/PE/TL/ SMI/ 0001 - 98 (Rev.0) dt. 01.06.98 to be followed.