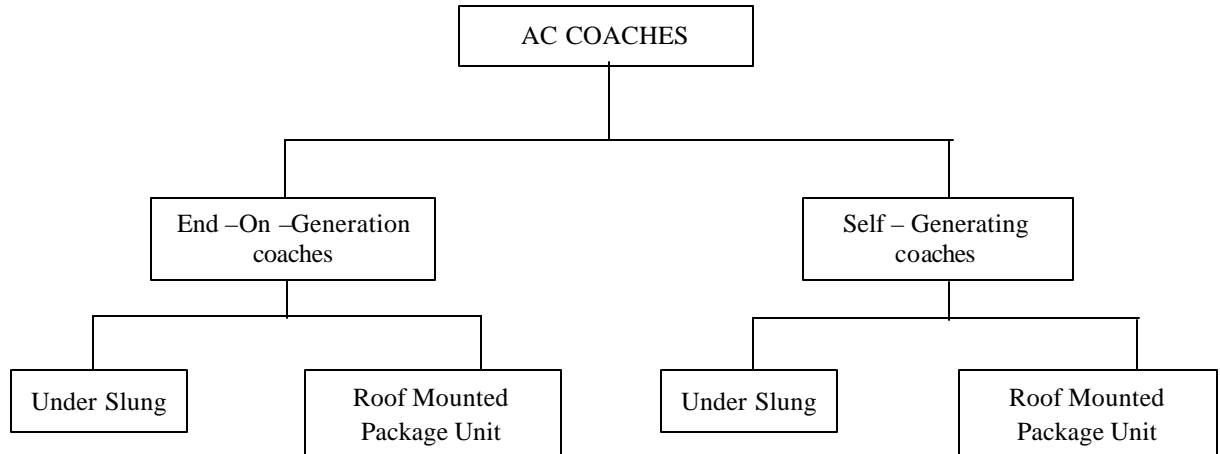


CHAPTER 8

AIR CONDITIONED COACHES

801 INTRODUCTION

Types of AC coaches on Railways can be classified broadly as under :



801a Power Supply System: As far as power supply system is concerned, the coaches are of the following two types :

- (i) End-On-Generation (EOG) : In this system two types of Power cars are used
 - a. Coaches mounted with 50 KVA, 750 V/415V, 3 ϕ transformer.
 - b. Coaches with out stepdown transformer suitable only for old low capacity power cars.
- (ii) Self Generating (SG) : Based on AC equipment, there are two types of Self Generating coaches.
 - a. 110 V DC with under slung type AC equipment working from 110 V DC.
 - b. 110 V DC with Roof Mounted AC Package Units working from 415 V, 3 ϕ , obtained with the help of 25 KVA inverters mounted on underslung as well as onboard.

801b MAJOR EQUIPMENTS USED IN AC UNIT ARE :

1. Compressor (open type for under slung, sealed type for Roof Mounted Package Unit (RMPU))
2. Condenser including liquid receiver and dehydrator.
3. Expansion Valve
4. Evaporator with heater element.
5. Motors for compressor, condenser, evaporator .
6. Other protective devices and control panels.
7. Thermostat, Filters etc.

802 MAINTENANCE SCHEDULES FOR SELF GENERATING AIR CONDITIONED COACHES FITTED WITH UNDER SLUNG EQUIPMENT: (Ref: RDSO's maintenance schedule No EL/TL-AC/Maint.Sched./Rev.1)

802a TRIP SCHEDULE (PRIMARY AND SECONDARY MAINTENANCE)**i Axle Pulley**

- Examine the indicating white mark on the pulley axle and ensure that the pulley has not shifted . If pulley has shifted , pulley to be removed and re-tightened after replacing rubber pads. Indicating white marks to be provided. Also check distance between wheel axle and axle pulley with gauge.
- Tap with hammer and judge the tightness by sound.
- Check the lock nuts and split pins for availability and tightness.
- Check profile of 'V' groove for worn out pulleys, replace pulley if worn out.

ii Belts

- Check condition of belt for fraying of edges and replace it on condition basis.
- Check the belts for overturn and correct it, if necessary.
- Check the number of belts. The belts should be 12 (6 on either side) for each alternator in primary depot and 10 (5 on either side) in secondary depot.
- Tension should be felt by hand by striking it slightly. Belt in correct tension will respond `alive' . Pull the belt and check the spring action.

iii. Alternators

- Check the condition of outgoing cables and its cleating arrangement. Replace the grommet, if necessary. Ensure that flexible pipe carrying the cables is connected properly to the grommet to prevent damage to insulation.
- Check the suspension pin, bush and securing nuts and bolts.
- Check the pulley fixing, concentrating on lock nut and locking collar pin. If lock nut is damaged, replace it.
- Carry out visual inspection of terminal box for signs of overheating and presence of fumes. Blow off dust if required.
- Check the terminal box for presence of water and drain out if necessary.
- Check the connections for looseness or cracks, if required re-crimping/ tightening should be done.
- Check main suspension lugs of alternators for signs of crack.
- Clean the regulator box externally and remove all the dust particularly from heat sinks.
- Check safety chains and chain fixing nuts, bolts and split pins.
- Check tension rod fixing pin of alternator with washer and split pin.
- Check the log book for abnormal /unequal load sharing . Corrective action should be taken to ensure that the difference is within the range of 30 %.

iv. Battery & Battery Box

- Check the level of electrolyte in all the cells and top up with distilled water, if necessary.
- Check the specific gravity and voltage of 4 pilot cells.
- Check inter-cell connection for looseness. Check for crack in containers leading to leakage. If needed replace the defective cell with healthy cell of similar capacity and lug date.
- Check for heating signs on the positive and negative terminals and discolouring of the cells container/top lid.
- If required, individual cells in the battery bank or complete battery bank may be subject to charging so that the Specific Gravity (SPG) may rise to min. 1.240.
- Check the top of cells and keep it clean and dry. Plugs should be tight.
- In case of Valve Regulated Lead Acid (VRLA) batteries, check for abnormal bulging of cell lids, cracks on positive and negative terminals. Replace defective cells..
- In case of sulphation of terminals remove the connectors, clean, put back and apply petroleum jelly.
- Check suspension/cradle of battery box for availability of all suspension bolts, signs of any crack, corrosion, rusting and take corrective action, if necessary.
- Check for proper fitment of battery cells in battery box or module fitment in case of VRLA batteries, if required proper packing may be provided.

- Ensure that spare batteries, particularly VRLA cells are properly kept at places not exposed to direct sunlight, rain, dust etc. The batteries should be stored indoor preferably between 20 to 35°C in clean and dry location.
- VRLA Batteries : SMI no.RDSO/PE/TI/SMI/0001-98 (Rev.0) dt. 01.06.98 to be followed.

v. Compressor and Condenser Motor

- In case of compressor motor, examine the tyre coupling for any indication of looseness or slip and rectify defects.
- Open inspection cover and examine the condition of commutator. Clean with sand paper or pumice stone, if necessary. Do not remove the dark tan film unnecessarily. Clean all carbon dust with dry compressed air.
- Check condition of carbon brushes. If worn out, replace with carbon brushes of approved grade.
- Check condition of pigtails. If necessary, replace as per the manufacturer's recommendation.
- Check the starting resistance connectors for tightness.
- Check suspension of compressor motor unit for any signs of crack, corrosion and rusting. Take remedial action if required.
- Carry out visual inspection for signs of overheating and presence of fumes. Blow off dust if required.

- Check the direction of rotation for correctness if the same has been attended.
- Check the fan blades for tightness in case of condenser motor.

vi. Evaporator Motor

- Open the inspection cover and examine the condition of commutator. Clean with 00 sand paper or pumice stone, if necessary. Do not remove the dark tan film unnecessarily. Clean all carbon dust with dry compressed air.
- Check condition of carbon brushes and pigtails. Replace if necessary as per the manufacturer's recommendation.
- Check the bearing for noise.
- Check the blower fixing for tightness.
- Carry out visual inspection for signs of overheating and presence of fumes. Blow off dust if required.

vii. Compressor

- Check the proper lubrication of compressor level of oil when operating should be upto half of the bull eye glass.
- Lubricate the compressor as per RDSO SMI No. RDSO/AC/SMI/6
- Examine the reading of HP, LP and OP gauges recorded during the journey for abnormality and take necessary action.

- Examine flexible type coupling and replace, if found defective.
- Clean the compressor externally with compressed air.
- Check for signs of leakage at joints & shaft seal and take remedial measure wherever necessary.
- Examine the fixing arrangement, check the condition of the anti vibration mountings for tightness of the fixing bolt.

viii. Condenser

- Check and ensure that the protection plates and grills are provided on the three sides of the frame.
- Examine the fins for external damage due to flying ballast and take corrective action if necessary.
- Check suspension of the condenser for signs of cracks, corrosion or rusting and take remedial action. Tighten bolts, etc., if necessary.

ix. Dehydrator And Liquid Receiver

- Check the sight glass for leakage, rectify if necessary.
- After 10 minutes of starting the compressor, check the level of liquid refrigerant should be at the bottom of the lower glass of the liquid receiver.
- After 15 minutes of starting the plant, feel the outlet and inlet to dehydrator by hand for temperature difference. The outlet should not be colder than inlet.

- x Filters**
- Remove fresh air and return air filters and replace it by spare clean units.
 - Check and ensure that fresh air dampers are in proper order.
- xi Thermostats**
- If the report of the attendant indicates that thermostate do not work, examine the thermostats for break in mercury, break in stem, etc. Replace the thermostats, if necessary. Follow RDSO SMI No RDSO/SMI/AC/15.
 - Clean thermostat bulb with cotton.
 - Ensure working of plants in auto mode for all temperature setting.
- xii. Panel Board**
- Clean the panel and remove dust.
 - Check the working of indication lamps, replace it if necessary.
 - Check the availability of spare fuses in the place provided for the same and provide if necessary.
 - Check the availability of arc chute and provide if necessary.
 - Check and clean the contacts of contactors 12, 13 and 13A.
 - Check the operation of cooling pilot relay (by short circuiting terminals C.T.). Remove short after the completion of check.
- xiii. Lights And Fan Wiring**
- Check for earth leakage in the wiring with a double test lamp. Rectify if any defect noticed.
 - Check for any loose connection & tighten if necessary.
- xiv. Lights And Fans**
- Check all the lights and fans for proper working. Rectify or replace if necessary.
 - Clean the fan and light fitting externally.
 - Check all switches, fan regulators, call bells and push buttons for proper working. Replace if necessary.
- xv. Pre-Cooling Unit**
- Clean rectifier unit externally with dry compressed air.
 - Check the presence of water in terminal box, drain out if necessary.
 - Load the pre-cooling unit to its maximum capacity and check for any overheating.
 - Check suspension of battery charger for sign of any crack, corrosion or rusting and take action if required.
 - Check the pre-cooling socket pins and its fixing arrangements.
- xvi. General**
- Check log- sheet of last trip and attend all the faults recorded in the log sheet.

- Run the plant for half an hour. Check system operation, specially the following:
 1. Suction pressure gauge reading should be 2-3 Kg/cm².
 2. Delivery pressure gauge reading should be 10 – 14 Kg/cm².
 3. Oil pressure should be minimum 3kg/cm² above suction pressure.
 4. Suction should be cold and sweaty. Delivery should be very hot and liquid line should be warm.
 5. Feel the expansion valve by hand. It should be cold.
- Note the battery voltage on LOAD and NO LOAD.

802b MONTHLY SCHEDULE

In addition to the trip schedule items, following are also to be attended.

i. Axle Pulley

- Ensure that the gap between the two halves of the pulley is 3 mm. Check tightness of the axle pulley bolts by 30 kg-m torque wrench.
- Check distance between wheel hub and axle pulley with gauge plate.

ii. Belts

- Check tension of belts. For the exact measurement of static tension, apply force 'P' with a Spring balance at the Centre of span in direction perpendicular to the span until the belt is deflected from the normal to the extent of 16 mm per metre of span. The force 'P' should be between 31.4 to 47.0 kg. If the belts are loose, replace them.

iii. Rectifier Cum Regulator Box

- Clean all dust with dry compressed air externally.
- Open the cover and check sealing rubber gasket for signs of fraying. Drain out water if any.
- Clean all dust with dry compressed air, preferably a hand blower from inside to remove all dust particularly from heat sink of electronic components and terminal board.
- Check that the voltage and current setting. Ensure that they have not been disturbed and are in locked position.
- Check the field fuses and phase fuse and ensure that only specific HRC fuses have been used.
- Check all the electrical connections for tightness.

iv. Alternators

- Lubricate the threads of the tension rod and adjusting nut.
- Check the profile of 'V' grooves and replace worn-out pulleys.

v. Battery Chargers

- Ensure that the coarse and fine control switch is in position No.1.
- Check and clean all connections and contacts.

vi. Battery

Conventional Lead Acid Batteries

- Check specific gravity and voltage of all cells.

- Remove inter-cell connection, take out the cells, clean thoroughly the cells, intercell and end cell connectors and fit back in the coach. Use petroleum jelly.
- Examine condition of battery boxes. Paint if necessary.
- Check vent plugs. Tighten if necessary. Replace if missing.
- Check the condition of cells by cell tester. Replace defective cells.

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. 09.12.98 to be followed.

vii. Compressor Motor

- Check tightness of the coupling and mounting bolts by 30 kg-m torque wrench and tighten, if necessary.
- Check the terminal connections in the terminal box and tighten, if necessary.
- Examine the incoming leads for proper connections and tightness. Check the flexible conduit for proper anchoring at both ends.
- Measure the spring tension of brush holder. If less than the value recommended by manufacturer, replace the spring.
- Check the carbon brushes; if necessary, replace with approved grade of carbon brushes.
- Check the alignment of the compressor and motor.

viii. Condenser & Condenser Motor

- Clean the condenser fins thoroughly with high pressure water jet so that air passes through the fins uniformly .
- Clean fins with liquid solution and high force water jet.
- Ensure minimum air flow of 4 meters per second through condenser.
- Check the incoming leads for proper connection and tightness. Ensure that the grommet is in position and the flexible hose pipe is connected properly at both ends.
- Check the spring tension as recommended by the manufacturers.
- Check the carbon brushes; replace with approved grade of carbon brushes if necessary.

ix. Evaporator Motor

- Check the blower drum for looseness.
- Check the spring tension as recommended by the manufacturers.
- Flush the drip tray. Check drain pipe of drip tray for clogging by passing water through the drip tray and clean, if found clogged.

x. Compressor

- Check tightness of bolts of anti-vibration mounting with 30 kg- m torque and tighten if necessary.

- Check the tightness of nuts and bolts of compressor head and its cover.
- Check oil and liquid levels and note any signs of leakage which will be indicated by presence of the oil at the point of leakage.
- Clean the oil strainer with petrol or CTC (Carbon Tetrachloride).

xi. Evaporator & Drip Water Drain

- Clean evaporator coil.
- Replace return and fresh air filters.
- Pour water on evaporator coil and ensure the water drains out easily..

xii. Panel Board

- Clean contactor tips of all contactors; replace where necessary.
- Check all the electrical connections for tightness and tighten if necessary.
- Check the relays and contactors for their proper functioning.
- Check the PCB in the thermostat circuits.
- Check the diodes provided on the panel board.
- Check the rotary switch for fluorescent lights. The polarity change connections should be in order.

xiii. Light and Fan

- Open the inspection-cover of each coach fan and examine the condition of commutator. Clean with 0-0 sand paper. if necessary.

- Do not remove dark tan film unnecessarily. If necessary, replace the carbon brushes with carbon brushes of approved grade.
- Remove the cover of tube light, night light and clean the bulb, tube and cover from inside.

802c QUARTERLY SCHEDULE

In addition to Trip and Monthly Schedule items, following are also to be attended.

i. Axle Pulley

- Check grooves for wear and take necessary action.

ii. Alternator

- Disconnect the regulator and measure the insulation by 500 V megger; if less than 2 Meg ohm, remove winding of alternator and heat in the oven at 80 degrees C for 1 hour.

iii. Compressor, Condensor And Evaporator Motors

- Disconnect the motors, measure the insulation by 500 V megger; if less than 2 Meg ohms, remove and heat in air oven at 80° C for 1 hour.
- Check for the positive locking of rockers.
- Lubricate the bearings of all motors with recommended grease.

iv. Condenser

- Clean the compressor fins and copper tubes as per RDSO SMI No. RDSO/SMI/AC/16
- Check the condition of body frame and replace the condenser, if necessary.

<p>v. Dehydrator and Liquid Receiver</p>	<ul style="list-style-type: none"> ■ Clean the strainer in the dehydrator-cum-filter unit. 	<p>with pre-cleaned/new-filter and close access doors properly.</p>
<p>vi. Evaporator And Expansion Valve</p>	<ul style="list-style-type: none"> ■ Clean the strainer used before expansion valve. ■ Clean the assembly of evaporator coil and surroundings with vacuum cleaner. ■ Clean the drip tray and drain-pipe thoroughly and check for water leakages. 	<p>v. Check the log sheet maintained for each AC coach and attend the defects noticed during run as reported by escorting staff.</p>
<p>vii. General</p>	<ul style="list-style-type: none"> ■ Adjust the air distribution by measuring the temperature of each compartment. 	<p>vi. Check for working of Roof Mounted Package Unit (RMPU) and Control panel as following:.</p>
<p>803</p>	<p>MAINTENANCE SCHEDULE FOR ROOF MOUNTED AC PACKAGE UNITS AND ITS CONTROL PANEL</p>	<ul style="list-style-type: none"> ■ Switch `ON` RSW-I and check that all the three pilot indication lamps (Red, yellow and blue) for R.Y.B. phases and power `ON` indication LED (Green) are glowing.
<p>803a</p>	<p>TRIP SCHEDULE (PRIMARY AND SECONDARY MAINTENANCE)</p>	<ul style="list-style-type: none"> ■ Put RSW-2 in ``ON` position and keep RSW-3 in `VENT` position and check that:
	<ul style="list-style-type: none"> i. Clean all dust from panel by dry compressor air from the panel. ii. Check that all the safety and protection devices are in working condition and not in the by passed condition. iii. Replace defective/by passed components including indication LEDs and lamps, if any. iv. Remove fresh air and return air filters by opening the access doors provided under the bottom of unit. Clean these filters with pressurised air and jet of water and place them in their place or replace them 	<ul style="list-style-type: none"> □ Indication LED (green colour) for Blower `ON` is glowing and □ Blower fan is working
		<ul style="list-style-type: none"> ■ Check for satisfactory operation of vane relay by moving the flap by hand gently.
		<ul style="list-style-type: none"> ■ Check for satisfactory operation of the package unit by moving RSW-3, in AUTO, MANUAL HEATING & MANUAL COOLING modes. This can also be verified from indication LEDs (green colour).
		<ul style="list-style-type: none"> ■ Check that cooling system is working even if only one condenser fan out of the two is working. This can be done by simply switching off MCB 2 or MCB 3/taking out fuses of condenser motor 1 or condenser motor 2.

- Check that cooling and heating thermostats works properly, i.e. A/C system “cut-off” and “cut-in” in auto-mode.

- Check that compressor by pass switch RSW-5 works satisfactorily

- **HP1 & HP2 Cut-outs**

Switch ‘ON’ the compressor with condenser fan ‘OFF’. Take out fuses /switch-off MCB-1 and MCB-3 of the condenser fan motors and keep the package in manual cooling mode. Compressor should trip within 10 minutes. HP cut outs should be reset after each tripping.

- **LP-1 & LP-2 Cut outs**

Switch ‘ON’ the compressor with condenser. Take out fuses/switch-off MCB-1 provided in the power circuit of blower motor and short terminals of vane relay. Keep the package in manual cooling mode. Compressor should trip with 10 minutes.

- **OHP1 and OHP2**

Switch ‘ON’ the heaters with blower off, take out blower motor fuses or put off MCB-I and short the terminals of contactors AC-I or vane Relay. In old control panels where AC-I is not provided, keep the package in manual heating mode. The heaters should trip with 10 minutes.

- **CONTROL PCB**

Keep the AC package unit in Auto Mode. Run the blower short terminals of cooling thermostat on PCB. The compressor LED indication should come ‘ON’. Open the terminals of heating thermostat on PCB Heater LED should come ‘ON’.

803b MONTHLY SCHEDULE

In addition to trip schedule following items should also to be attended to:-

- i. Run the plant for half an hour and check the current drawn by various equipment with the help of clamp tester.

Normal currents for various equipment and mode of operation shall be as under:-

- Package in cooling mode : 20-23 Amp.

- Package in heating mode : 11-13 Amp.

- Compressor motors : 7-10 Amp.

- Condenser motors : 1.5-2 Amp.

- Blower Motor : 1.5-2.5 Amp.

- Check working of both Roof Mounted Package Unit (RMPUs) with either of the inverter on the Self Generating (SG) AC coaches provided with two package units.

- ii. Check and tighten all terminals in the control panel.
- iii. Check and clean contacts of contactors and replace pitted contacts if required.
- iv. Check visually condenser fan blades and ensure there is no crack on the blades or the hubs.
- v. Check and tighten mountings of blower and condenser motors and ensure that these are in good conditions.
- vi. Check that all legend plates inside the control are intact.
- vii. Check all connections on switch gears, terminal blocks are tight.
- viii. Check that glass cover over indication PCB is intact.
- ix. Check for proper tightening of cover provided over evaporators compartments.

- x. Create single phasing in compressor circuits by taking out one fuse/removing one phase wire from incoming terminals of MCB-4/MCB-5. Compressors should trip and CP1/CP2 over load trip indication should come ``ON`.
- xi. Check for proper operation of time delay relays provided in compressor circuit. As soon as power supply is switched `ON` first compressor should come in circuit immediately and the second one after 2.5 minutes.

xii. Inverter

Caution: Inverter must be switched off preferably at power panel itself before attempting to do any maintenance operation.

- Cleaning of cubuicle : Dust deposit inside the converter should be carefully removed at regular basis. Unit should be cleaned with brush and vacuum cleaner or with dry compressor (Max. 1bar) – inaccessible parts.
- Cleaning of PCBs : Using a soft brush, remove the dust collected on PCBs gently.

803c QUARTERLY SCHEDULE

In addition to trip and monthly schedules following items should also be attended.

i. Inverter

Caution: inverter must be switched off preferably at power panel itself before attempting to do any maintenance operation.

- **Cleaning of cubicle** : Dust deposit inside the converter should be carefully removed at regular basis. Unit should be cleaned with brush and vacuum cleaner or with dry compressor (Max. 1 bar) – inaccessible parts.
- **Cleaning of PCBs** : Using a soft brush, remove the dust collected on PCBs gently.

- Terminal Connections/Fixing :
- **Electrical** - Normally loose connections leading to wire burning/sparking are observed at connection terminals.
- Usage of spring washer mostly avoids this problem.
- Gently shake the wire (especially power cables) near the joints and on observation of loose joints, tighten the same and also observe cable insulation for any deformation/brittleness. If so replace them with same size of the cable only.
- **Mechanical** - Inverter should be fixed at the bottom as well as top, tighten the bolts and nuts used for fixing the inverter and ensure that it does not vibrate in run. Also tighten the sub-assemblies if found loosened. In case of under-slung inverter these shall also be regularly checked and tightened.
- Protection circuit/ Induction circuit :
 - Check the indication/ protection circuits ensure that all the protection and indication are working properly.
 - Uses of fuse of power rating in the inverter, don,t use wire fuses.
 - Remove both inverter and battery fuses in power panel before attempting some fitting or wiring in the inverter.
 - **Capacitor** - On observing leakage of any capacitor inside the inverter remove the respective capacitor and replace with new one of the same value and make.

- Cooling Fan – Check the cooling fan for operation. If damaged/burnt replace with new one of the same rating. Life of fan is about 3 years, replace, if due.
 - Instrument cooling fans- Check if the instrument fan provided between inverter and chopper modules is working when the inverter is “ON”. If not working replace the fan, by taking out chopper and inverter modules. (in on-board type inverter).
 - PCB Terminal – Gently tap the wires at PCB terminals and check for any loose connection. Tighten the screw or solder the terminals if found blackened, informed the inverter supplier.
 - Colour change in PCBs – Check for any colour change in PCBs. Replace the PCB, if found blackened and inform the inverter supplier.
 - MCCB – When MCCB is switched “ON” MCCB is tripping and fuse is blowing instantaneously, it is due to IGBT problems. They have to be checked and replaced, if they are found defective.
- ii. Drip Tray**
- Check the normal flow of water in drip tray by running the AC plant continuously for 2 to 3 hours.
 - Pour water into drip tray and ensure that the poured water is drained through the outlet pipe.
 - Some sort of cleaning agent should be used for cleaning the sludge inside the pipe walls.
- iii. Others**
- Check all the motors for abnormal sound use shock pulse meter and replace the bearing of condenser and blower motor, if necessary.
 - Check anti-vibration mountings of compressor, condenser and blower motors and replace if necessary.
 - Charge refrigerant (R-22) if less cooling is noticed.(refer RDSO SMI No. RDSO/AC/SMI/7
 - Check that locking arrangement of control panel works properly.
 - Check insulation resistance of all the motor by 1000 V megger. Attend motors with poor insulated less than 2 Mega-ohm.
- iv. **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 key way, groove angle etc. shall be monitored during POH. Proper gauges shall be used for checking “V” groove of the pulley.
- 804 SIX MONTHLY SCHEDULE**
- 804a V-belts:**
- The existing “V” belts shall be replaced with the new “V” belt (6+6) nos., having same grade/make. The old “V” belts removed from service to be destroyed.
- 805 POH SCHEDULES OF UNDER SLUNG Self Generating (SG) TYPE AIR CONDITIONED COACHES (Ref : RDSO doc. No. EL/AC/POH Schedule/002, Nov.,93)**

805a. SEQUENCE OF WORK TO BE DONE DURING POH

On arrival into shop place the coach on pit line and inspect electrical and A/C equipment. Note down the defects and deficiencies. Disengage the 'V' belt tensioning gear on both the bogies. Disconnect the alternator connection, and remove the belt-tensioning device.

i. Lifting

Remove the alternator cables and carry out visual inspection on conduit and refrigeration pipes. Remove the alternators from bogies. Replace alternator, regulator and tensioning gears with over hauled alternator, regulator and tensioning gear. During this activity carry out repairs, if required, to equipment suspension arrangement on under carriage. Send the alternators and regulators to shop for overhauling.

ii. Stripping

During this activity, the following air-conditioning and electrical equipment will be removed:

- Fresh air and return air filter
- Compressors and their motors
- Condenser including liquid receiver cum dehydrator and condenser motors
- Evaporator unit and its motor
- Water raising apparatus
- Battery and battery box for repairs.
- Battery charger-cum-pre-cooling transformer
- Thermostats
- Control panel
- Expansion valve
- Gauges and cutouts
- Carriage fans
- Berth light fittings
- Ammeters and voltmeters of power panel

iii. Dusting

With the help of compressed air remove the dust of air ducts.

iv. Cleaning and overhauling

Before overhauling, measure the insulation resistance of all the electrical equipment such as alternator, motor and wiring to know the condition of equipment. Check and clean all the under frame suspension arrangements, lugs and terminals. After POH, test the wiring for insulation and fit the pre-cooling plugs.

v. Simulation testing

Check the alternator output on different load conditions. Check both the alternators for load sharing with the help of variable speed motors.

vi. Equipping

In this activity fit all the refrigeration and electrical equipment to their respective positions. Connect all the wiring and flanges in the refrigeration system wherever necessary. Charge the gas into the system.

vii. Static testing

Run the plant through pre-cooling terminal and check for proper functioning of electrical and AC equipment.

viii. Alternator Connection and Tensioning

Join the connections of alternators and fit the belt-tensioning device. Provide the new 6+6 'V' belts for alternators.

805b OVERHAULING ACTIVITIES OF MAJOR AC EQUIPMENTS DURING POH

i. Compressors

- The given activities are only for under slung type AC system installed with open type compressors. Remove driving flange and provide 'V' groove pulley. Test the compressor to ascertain its condition. Record the oil pressure during run. For Carrier and ACCEL compressors, oil pressure developed should be 3.2 to 3.9 Kg/Sq. cm and 4.2 to 4.9 Kg/Sq.cm respectively.
- Dismantle the compressor completely.
- Inspect and check the dimensions of the wearing components. Replace the worn out components.
- Replace following components 100% irrespective of their condition.
 - Piston rings
 - Scrapper ring
 - Suction and discharge valve
 - Shaft seal assembly/O rings
 - Gasket packing
 - Half section bearing
 - Self locking nuts
 - Lubricating oil of correct grade.
- Replace other components on condition basis. The sealed control valve shall be replaced after ascertaining its performance.
- Assemble the compressor with replaced components and charge it with lubricating oil. Change the lube oil and refrigerant suction strainers.

- In case of carrier 5F 30 compressor match the colour to ensure proper matching between tapered shaft and corresponding flexible coupling.
- In case of ACCEL compressor check the end play of crank shaft and replace the thrust plate, if necessary.
- Check the anti vibration mounting and replace, if necessary on condition basis.
- Use suitable grade of oil for Lubricating the compressor as per RDSO SMI No.RDSO/AC/SMI/6.

ii. Tests on Overhauled Compressor

Following tests should be conducted on overhauled compressor

- Temperature rise test
- Volumetric efficiency test
- Leak back test
- Vacuum test
- Sub merge test

Temperature rise test

This test shall be conducted with compressor running in free air with both suction and discharge valve open. Run the compressor till the temperature gets stabilized. The temperature will be recorded on the casing cover. Maximum temperature rise at shaft seal shall not be more than 45° C.

Volumetric efficiency test

The compressor shall be run with air at nominal speed of 1500 rev/min and time taken to attain a pressure of 7 Kg./Sq.cm shall be recorded when the discharge line is connected to a reservoir of 100 liters capacity.

The time taken to attain a pressure of 7 Kg./sq cm in the reservoir should not be more than 53 seconds for ACCEL compressor and 73 seconds for Carrier, KPC, Elgi and Alfa Laval compressors. Time to attain above specified pressures in the reservoir shall vary according to working speed of the compressor and atmospheric pressure also.

Leak back test

This test is in continuation of volumetric efficiency test. In this test immediately after attaining pressure of 7 Kg/sq.cm. in the reservoir, the compressor shall be stopped and pressure drop due to leakage shall be noted. Pressure shall be recorded at the end of 5 minutes and the drop in pressure shall not exceed 1.25 Kg/sq.cm.

Vacuum test

The compressor shall be run with suction valve closed and delivery valve open to atmosphere till a vacuum of 100 mm of Hg. below atmospheric pressure is created. The drop in vacuum level shall be recorded, after switching off the compressor.

Sub-merge test

The compressor shall be charged with dry air at 21 Kg/sq.cm pressure and submerged in water. Then check shall be conducted for any leakage; the same shall be attended and test repeated. No leakage through casing shall be permitted.

iii. Condenser Unit (Including liquid receiver cum dehydrator)

- Dismantle the MS Frame, condenser coil, liquid receiver-cum-dehydrator. Cover the inlet and outlet flanges of cooling coil with a strip of cover plate and gasket so that water may not enter in to cooling coil. Clean thoroughly the condenser coil, MS frame by dry air to remove the loose suspended particles in and around cooling fins.
- Immerse the heat exchanger in water tank for 24 hours. Wash the coils and fins thoroughly with compressed water jet at 12 Kg/sq.cm pressure. Remove all the suspended material from the fins. Clean the water-spraying pipe and open the holes.
- The cleaning process shall be supplemented by scrubbing with brush and use of compressed water jet.
- After cleaning the cooling coil pressurize with air at 300 psi (21kg./sq.cm.) and immerse in water tank duly connecting a pressure gauge for 24 hours to detect any leakage by air bubble method. Also see if the pressure drops. Leaks in pipe shall be detected and brazed.
- After cleaning check the air flow of unit with anemometer.
- Deflange the liquid receiver by removing the outer cover and gasket packing. Clean thoroughly the inner walls of receiver to remove any oil/impurity. Clean the sight glass. Assemble the cleaned liquid receiver parts by providing suitable gasket and flanging the outer cover.
- Pressurize the liquid receiver at 300 psi (21 kg./sq.cm) and test it for leakage by immersing in water tank and notice for any air bubble in case of leakage.
- Replace the filter and drier after leak testing of the liquid receiver. Clean the condenser housing thoroughly and paint it before assembly of other equipment.
- Change the dehydrator-cum-filter element. Also clean the conical filter thoroughly.

iv. Evaporator Unit

- Dis-mantle the housing assembly and take out the cooling coil. Attend the heating element in position by conducting continuity test. Also check the insulation value between the positive terminal and negative terminals shorted and the earth. If the value is less than 2 meg ohms, replace the complete unit. IR value shall be measured with 500 V megger.
- Clean the cooling coil by blowing compressed air. Cover the inlet and outlet flanges of cooling coil with strip of cover plate and gasket so that water may not enter into cooling coil. Immerse in water tank for 24 hours and wash with compressed water jet at 12kg./cm. sq. pressure. Remove all suspended material on fins and clean the cooling coil. (as per RDSO SMI No. RDSO/AC/SMI/8)
- The cleaning process shall be supplemented by scrubbing with brush and use of compressed water jet.
- After cleaning the cooling coil pressurize with compressed air at 300 psi (21kg./sq.cm) and immerse in water tank duly connecting a pressure gauge to detect any leakage by air bubble method. Also see if the pressure drops. Leaks in pipe shall be detected and brazed.
- Clean the Evaporator housing and paint it. Assemble the cleaned unit.
- Take out main and auxiliary drip trays from the bottom of the evaporator unit, disconnecting the drain pipe connection. Check for free flow of water through drip drainpipe by admitting water on the drip tray. Replace the hose pipes and hose clips by new ones.

v. Motors for Condenser, Compressor & Evaporator

- Dismantle the motor.
- Test the insulation resistance of armature with 500 V megger. It should be more than 1 mega ohm.
- Check armature winding by a voltage drop test method for open circuit & short circuit fault.
- If the armature is burnt, over heated or short circuited, rewind it as per manufacturer's instructions.
- If armature is in good condition apply a coat of air drying varnish on the winding.
- Check the commutator surface. If the surface is found improper, skim the commutator surface.
- Check the under cut between segments. If it is found shallow under cut the mica to the required depth. Chamfer the edges of the segments.
- Check the bearing with the help of shock pulse meter. In case of compressor and condenser motors, replace by new ones on condition basis, otherwise after cleaning and greasing re-use it. In case of evaporator motor 100%, bearings shall be changed.
- Check the field winding by resistance measurement method for open circuit and short circuit.
- Check the insulation of field coil with the help of 500 Volt megger. It shall be more than 1 mega ohm. Replace the field coil, if defective. If field winding is in good condition apply a coat of air drying varnish on the windings.

- Check the brush boxes and studs for rigidity, clean the rocker assembly.
- Replace the carbon brushes and clean the brushes using sand paper of size 400 grade or by using brush seating stone until the faces of brushes make perfect contact on commutator surface. Blow out the carbon dust using dry air jet.
- After assembly conduct the load test and insulation test. Current taken by motor should not be more than the rated current. Conduct insulation test with 500v megger. It should be more than 1 meg ohm.
- After the compressor/condenser motor is completely assembled connect a milli-voltmeter across brushes of opposite polarity. Connect the shunt field to 110V mains through a switch. Switch on the mains and note the kick in the voltmeter. Rock the brush gear to the left or right and repeat the test as before. Clamp the rocker arm in a particular position at which the kick is zero or minimum. Before this test, care should be taken to make sure that the brushes are bedded properly. If brushes are at neutral axis, the speed in both the directions of rotation will be same.
- After the evaporator is completely assembled the neutral axis can be selected by running the motor in both the directions on no load at approximately 25% of the rated voltage and measure the speed in both the directions. If brushes are at neutral axis, the speed in both the directions of rotation will be same.

vi. Control Panel

- Completely isolate the panel from the power supply and its loads, Contacts of the contactors (12, 13, 13A, 29 and 17) shall be removed and cleaned by means of clean rag soaked in petrol. Any contacts, which are burnt, should be replaced, after which they should be lightly covered with vaseline.
- Similarly, dismantle the contacts of the relays and clean them by means of clean rag soaked in petrol. Any contacts which are burnt should be replaced.
- Check the flexible braided connections. If found damaged, replace the same.
- The pin holding the pull off spring on the armature framework of the contactor should be pulled out of its slot and the armature hinge pin removed. This should be examined for wear and if necessary, replaced by a new pin lightly covered with vaseline.
- Measure the insulation resistance of each relay and contactor. If the insulation value is less than 2 mega ohms, replace the coil of the respective unit.
- Check whether all connections are tight. If found loose, tighten the same.
- Replace all the fuse links.

vii. Gauge and Cut outs

- Clean the contacts with CTC/Petrol and test for correct operation of settings. Calibrate with the standard gauge.
- Check the performance of the gauges. Calibrate with the standard gauge. Replace defective gauges.

viii. Refrigerator Piping

- Whenever the AC equipment are removed from the refrigeration system for the purpose of overhauling the pipe outlets should be closed immediately to prevent entry of any foreign material into the piping system.
- After reconnecting all the AC equipment, pressure test and vacuum test shall be performed before charging the refrigerant.

ix. Pre-Cooling Transformer & Rectifier Unit

- Open the cover and clean externally with compressed air.
- Dismantle the unit as per manufacturer's instructions.
- Remove and clean the contacts by means of a clean rag soaked in petrol. Contacts, which are burnt shall be replaced and covered with petroleum jelly.
- Clean the transformer, rectifier and rotary switch (RSW). Check for operation and, if defective, change it. Checking shall be done as per following activities:
 - Check proper functioning of indication lamp.
 - Check all protective circuit and fuses etc.
 - Ensure that earthing of housing is intact at two points.
 - Check for any crack/aging in PVC cable. Replace if required.
 - Check the voltage generation at RSW position 1-1 and 4-4.

- Check IR value of the transformer with 500V megger. It shall be minimum one mega ohms.
- Check the gasket for sealing the front cover provided for proofing.
- Check the diodes and adhesion with heat sink. Clean the base and heat sink and tightened diode as per manufacturers guide line.

x. 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. Skim or polish the commutator as 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 circulating oven.

- Clean the ball bearing, check for noise, replace if necessary or grease it with recommended grade.

- **Testing**

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

xi. Wiring

- **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/STD 7-6-001.

- **Coach insulation**

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

- **Cable termination joint**

- All cable joints shall be checked. Loose joints and cables having damaged insulation shall be replaced/repared. All cable ends shall be properly screwed with crimping type copper sockets.

- Surface of copper 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 retardant PVC grommets to BS-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 rigid steel conduit.
- All inspection covers shall be opened to check the distribution boards and condition of wiring.

xii. Air Filter

- For cleaning the ferrule type fresh air and return air filters remove them from frames and after brushing or shaking off all loose dirt immerse them in a solution of hot water and soda (sodium carbonate) approximately 6 grams to one litre of water. When thoroughly cleaned, the filter units should be rinsed in clean hot water and allowed to dry. When properly dry, they should be completely kept immersed in the oil (compressor lubricating oil) until air bubbles cease to rise. Then remove and allow to drain for at least 8 hrs. before being placed in service again.
- Replace the filter with new one in case of synthetic type filters.

xiii. Cooling Tests

- Cooling capacity test should be carried out by providing electrical compensating loads for worst ambient conditions and full occupancy of the coach. The duration of pre cooling of the coach should be between 3 to 4 hrs.

After the stabilization of the temperature of each berth (20 mm from window and back rest and 100 mm above the berth) should be recorded. The variation in temperature on different berths should not exceed 1 deg. C.

- The cycling duty of the plant shall be determined by recording ON and OFF time of the compressor. It should be between 10 to 15 cycles per hour.

xiv. Additional Items for End-On-Generation (EOG) Coaches

- Overhaul the DG set as per the manufacturer's instructions.
- **Inter-vehicle coupler, ratchet assembly, junction box and connections:** inspect, clean and check for over heating, solder run out, replace if defective. Tighten connections as needed.
- Measure insulation resistance value of the circuit with 500 V megger. It should not be less than 2 mega ohms.
- Check the proper functioning of WRA.

xv. Final Testing of AC Coach, after POH

- Visual inspection of each equipment for their proper fitment.
- Ensure that refrigerant pipes are properly clamped.
- Ensure all the modifications are complied with.
- Check safety chain and tension rod of alternator for proper fitness.
- Under frame cables leading to alternator should be properly cleaned.

- Check earth leakage by two lamp method.
- Check refrigeration system for any leakage before charging the gas.
- Conduct vacuum test. (For 12 hrs.)
- Conduct pressure test (by charging Freon 12 or CO₂ gas)
- Vacuum test for 15 minutes for dehydration of refrigeration system.
- Check control panel and ensure that proper fuses are provided.
- Check contactors, relay and switches for correct sequential operation.
- Ensure that time delay in operation of contactor No. 12, 13, 13A is 2.5 sec.
- Check heaters for correct operation.
- Check hooter for proper operation.
- Start the plant and check condenser motor, compressor motor, blower motor for any abnormality.
- Check leakage air from doors.
- Check oil level in compressor, the level when operating should be 1/2 bull's eye.
- Check the proper working of capacity control solenoid valve.
- Run the plant for four hours. An equivalent heat load (convector heater) should be kept for performance test of plant.
- If new expansion valve is provided during POH, it should be set properly.
- Ensure that batteries are in fully charged condition.
- Run the plants with dynodrive motors for 8 hrs. at different speeds.
- Ensure that both the alternators are sharing load equally during run. If not set both the alternator panels.

	<p>xvi. General Checks</p> <ul style="list-style-type: none"> ■ Suction pressure gauge reading should be 37-40 PSI (2.6-2.8 Kg/sq.cm.) ■ Delivery pressure gauge reading should be 150-170 PSI (10.6-12 Kg/sq.cm.) ■ Oil pressure should be minimum 3 Kg/sq. cm. above suction pressure. ■ Feel temperature. Suction should be cold and sweaty. Delivery should be very hot and liquid line should be warm. ■ The coach shall be jointly inspected with division's staff and the performance of electrical and refrigeration equipment shall be recorded. Any attention to the given equipment shall be given before dispatch of the coach from workshop. 	<p>ii. Lifting</p> <p>Remove the alternator cable and carry out visual inspection on conduit. Remove the alternator from bogies, replace alternator, regulator and tensioning gear with overhauled alternator, regulator and tensioning gear. Suspension arrangement on under carriage frame. Send the alternators regulators to shop for overhauling.</p> <p>Lift the roof-mounted unit with the help of 1 ton lifting arrangement as per procedure given below and place it on the wheeled trolley to take it to the shop for overhauling.</p>
806	<p>POH SCHEDULE FOR SELF GENERATING (SG) TYPE AC COACHES FITTED WITH ROOF MOUNTED AC PACKAGE UNIT (Ref. : RDSO maintenance schedule No. ELPS/SCH/AC/01)</p>	<p>iii. Precaution / Procedure for Removal of AC Package Unit from the Roof</p> <ul style="list-style-type: none"> ■ Remove lock to access the evaporator unit from bottom, in the doorway ceiling. ■ Disconnect condensed drainpipe connection. ■ Disconnect all electrical connections to package unit. ■ Dismantle the first piece of main duct. Disconnect the supply duct and return air duct bellows. ■ Remove Top cover provided above the package unit. Remove rubber package also provided to prevent water leakage. ■ Unscrew the 8 Nos. of mounting bolts of AC package unit. ■ Do not use forklift. ■ Lift the package unit carefully using suitable crane of 1 ton capacity. Arrangement as per RCF drawing No.XZ003801 for lifting ring may be used. ■ Do not drop the package unit on the ground while handling.
806a	<p>SEQUENCE OF WORK TO BE TACKLED DURING POH</p> <p>i. Pre-Inspection</p> <p>On arrival to shop, place the coach on the pit line and inspect the electrical and air-conditioning equipment. Conduct the cooling test. If the cooling time is less than the specified values, any further attention to refrigeration circuit is not necessary, except cleaning. Check operation of all protections and note down the defects and deficiencies. In case of self-generating type of coaches, disconnect the cable connection from alternator terminals and remove belt tensioning device.</p>	

iv. Stripping

During this activity, the following air-conditioning and electrical equipment will be removed:

- Fresh and return air filters.
- Water raising apparatus
- Battery and battery box
- Battery charger
- A/C Control panel & power panel
- Inverter units
- Carriage fans

v. Dusting

With the help of compressed air, remove the dust of the conditioned air duct.

vi. Cleaning and Overhauling

Before overhauling, measure the insulation resistance of all the electrical equipment such as alternator, motor and wiring to know the condition of equipment. Check and clean all the under frame suspension arrangements, lugs and terminals. After POH, test the wiring for insulation and fit the pre cooling plugs.

vii. Equipping

In this activity fit all the refrigeration and electrical equipment to its respective positions. Connect all the wiring and flanges in the refrigeration system wherever necessary.

806b SPECIAL ITEMS TO BE INSPECTED DURING POH**i. Check for corrosion in trough**

It is necessary to check steel trough, which is provided below AC package unit during every POH of AC coach. If any corrosion is observed, then it should be patched up with 2 mm. thick sheet of stainless steel.

ii. Check for corrosion of welded joints of AC package unit structure

The welded joints of AC package unit structure should be examined carefully for presence of corrosion and such corroded members shall be replaced/rectified.

iii. Check for accumulation of water in condensed drain pipe and trough outlet

Clean the condensed drain pipe and trough outlet pipe with help of compressed air. It is also desirable to blow compressed air into the pipe from below, every two months to avoid any choking of pipe due to accumulation of dust, etc.

iv. Deterioration of rubber lining

If there is any deterioration or cracks in rubber lining provided on AC package unit, it should be replaced.

806c PROCEDURE FOR LOWERING AC PACKAGE UNIT

- Before lowering package unit, check roof opening and stainless steel trough for corrosion. Jig to drawing No.XD000201 may be used for ensuring the squareness of the opening.
- Package unit is mounted on strengthening frame with the help of 8 Nos. of mounting pads (Resistoflex, STB-0069 Type-70). Mounting pad should preferably be replaced.
- While lowering the package unit, care should be taken that it does not touch/interfere with the coach at any place. The unit should sit properly on mounting pads.
- Lower the AC unit on the coach and secure it with 8 nos. of bolts as per drg. No.CC44162.

- Provide rubber sheet seal on the strengthening frame as shown in the drg. No.CC44162.
- Connect transition duct and return air duct bellows with the unit with D-panel.
- Make electrical connection as per circuit diagram issued for a particular type of coach and package unit.
- Connect condense drain pipe of package unit with the gradient of drain pipe to avoid filling of condense tray.
- Place roof top cover above the unit, after the unit is sealed by means of rubber sheet in evaporator area.
- Test the unit for water leakage. For stopping any leakage, suitable sized of rubber sheet may be used.

i. Static Testing

Run the plant through pre-cooling terminals and check for proper functioning of electrical and air conditioning equipment, including all the protections.

ii. Simulating Testing

For self-generating type of coaches, check the alternator and inverter output on different load conditions. Check both the alternators for load sharing.

iii. Alternator Connection and Tensioning

In this activity join the connection of alternator and fit the belt-tensioning device. Provide 6+6 'V' belts for alternator.

806d OVERHAULING ACTIVITIES OF MAJOR AC EQUIPMENTS

i. Compressor

There is no need to open the refrigeration system of the ac package units, since it is completely sealed at factory. Conduct the cooling test. If the time required to cool the coach is more than the recommended value and it does not decrease even after cleaning of condenser and evaporator, the compressor will have to be changed.

ii. Procedure for replacement of compressor

- Braze a 1/4" (6mm) OD copper tube fitted with shut off valve at one of the ends. Connect the shut off valve through a charging line to an empty refrigerant cylinder and keep in a cold iced water container until all gas is extracted. Weigh the cylinder before and after. Ensure that weight gain is minimum 2600 grams. A gas compressor can also be used to extract the gas and forcing it into the empty cylinder.
- De-solder the suction and discharge lines and disconnect the electrical wiring from the compressor.
- Remove the compressor and clean the system using carbon tetrachloride (CTC) with the help of circulating pump. It is advised that CTC flushing should not be done with compressor of AC coach in circuit but a separate compressor should be used.
- Install a new compressor, and re-solder the suction and discharge lines. Make the electrical connections. Use high quality silver based copper solder with minimum 40% silver.

- Test for leakage under 30 Kg/sq.cm. pressure using nitrogen/carbon dioxide gas cylinder fitted with a two stage pressure regulator.
- Create a vacuum of 50 micron for 15 minutes with the help of two stage rotary vacuum pump to extract the moisture from the refrigeration system.
- Charge the required quantity of refrigerant gas (R22) as per recommendation of the manufacturer. Charging stub-tube on the compressor should be 1/4" OD and of heavy gauge. Pinch off charging tube nearest to the compressor body so that it remains as short as possible. Longer stub tube can break due to vibrations. Place slight amount of solder at the pinch point for strengthening.

iii. **Condenser and Evaporator**

Clean the condenser coil and cooling coil with steam of 10 kg/sq.cm. to clean thoroughly and to remove all dirt and mud thoroughly. This can be done without removing the coils from their places.

iv. **Motor for Condenser and Evaporator**

- Check for abnormal noise, vibrations, burning smell.
- Check foundation bolts for looseness and tight, if necessary.
- Check the terminals after opening terminal box cover and see for tightness.
- Check the condition of terminal lugs.
- Check the earth connection of the motor body.

- Clean the motor by blowing compressed air.
- Lubricate the motor bearing by approved lubricant use lubricating gun for greasing.
- Check the alignment and re-align the driving and driven shafts.
- Check the coupling for looseness and tighten if necessary.
- Check the duct for crack and for loose/missing fixing bolts.
- Measure the insulation resistance of winding with a 500 V megger. If the insulation resistance is less than 10 M ohm, run the motor for half an hour for drying. If insulation level does not improve re-varnish the armature.
- To avoid brinelling, the armature must be rotated periodically by quarter to half of the revolution.
- It has been observed that bearing greases deteriorate when in the use and ceases to be effective as a lubricant with the lapse of time. The deterioration might show in the form of dry cakes/ flakes in sodium base grease while in the lithium base grease starts thinning and its oil content separates out of the rest of the grease. Deteriorated grease should be changed.

v. **A/C Control Panel And Power Panel**

- Completely isolate the panel from the power supply and its loads. Contacts of the contactors shall be removed and cleaned by means of clean rag soaked in petrol. Contacts, which are burnt, should be replaced, after which they should be lightly covered with silican gel/petroleum jelly.
- Similarly, dismantle the contacts of the relays and clean them by means of clean rag soaked in petrol. Contacts which are burnt should be replaced.

- Check the flexible braided connections. If found damaged, replace the same.
 - The pin holding the pull off spring on the armature framework of the contactor should be pulled out of its slot and the armature hinge pin removed. This should be examined for wear and if necessary, replaced it with a new pin lightly covered with silican gel/petroleum jelly.
 - Measure the insulation resistance of each relay and contactor. If the insulation value is less than 2 mega ohms, replace the coil having Insulation Resistance less than 2 mega ohm, also check the following:
 - Leakage may be through tracking/dust accumulation.
 - Clearance and creepage distance may be checked.
 - Cracks in the housing of switch gear may be checked.
 - Check whether all connections are tight. If found loose, tighten the same.
 - Replace all the fuse links.
 - Check rotary switch for proper working by ensuring following:
 - Ensure that all the poles are functioning.
 - Check that knob shaft is not having any play.
 - Check, clean and tighten all connections.
 - Check for defective ammeters and voltmeters, and replace the defective ones.
 - Check for operation of heating/cooling relay and PCB for ensuring automatic functioning of AC units.
 - Check for continuity and sequence list of AC equipment.
 - Check for cracks/edging, deterioration of wiring. HV test shall be performed with 2.5 KV for 1 minute. IR shall be min. 10 M ohm.
 - Check that all mounting screws are intact and tight.
 - Check all terminals, terminal marking and ensure that legend plates are intact.
 - Check all indicating LEDs are functioning.
- vi. Cut Outs**
- Clean the cover with CTC/Petrol and test for correct operation of settings.
 - Calibrate with the standard gauges.
- vii. Pre-Cooling Transformer Rectifier Unit**
- Open the cover and clean externally with compressed air.
 - Dismantle the unit as per manufacturer's instructions.
 - Remove and clean the contacts by means of a clean rag soaked in petrol. Contacts, which are burnt, should be replaced and covered with Vaseline.
 - Clean the transformer, rectifier and rotary switch. Check for operation; if defective, change it.
- viii. Inverter Unit**
- Open the front panel door and clean with compressed dry air. In case the compressed air pressure is too high, cover the nozzle with thin cloth to reduce the pressure.
 - Clean the semi-conductor device's heat sink with compressed air. In case the dust is not removed completely from fins use hard hairbrush and again blow with compressed air for cleaning the heat sink.
 - Check that all connections to PCB are tight and no insulation

on cables, boards and insulator is damaged.

- Check for normal routine performance test as per manufacturer's instructions.

ix. Fans and Lights

- 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 coils, repair/ replace, if necessary.
- Check the commutator for grooving, pitting marks, ovule, blackness etc. Skim or polish the commutator as 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 circulating oven.
- Clean the ball bearing, check for noise, replace if necessary or grease it with recommended grade.
- Check the rubber packing at fan base. Replace if found cut/damaged.

x. Testing

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

xi. Wiring

■ Light Fittings

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

■ Coach Insulation

Insulation resistance of the coach shall be measured with 500 V megger. The same should be minimum 2 mega ohms in fair weather conditions but it should not be less than 1 mega ohm under highly humid/wet weather.

■ Cable Joints

- It shall be checked. Loose joints and cables having damaged insulation shall be replaced/repared. All cable ends shall be properly socketed with crimping type copper sockets.
- Surface of copper 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 retardant PVC grommets to BS: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 rigid steel conduct.
- All inspection covers shall be opened to check the distribution boards and condition of wiring.

xii. Air Filter

- Replace the filter with new one in case of synthetic type filters.
- In case of wire mesh type filters, wash the filter in hot water first, then with non-subzing detergent and again with hot and cold water. Dry the filter and replace them in the unit.
- The manufacturer's instructions for any other specified type of filter, shall be followed.

xiii. Testing

■ Air delivery test

After checking the air leakage, air delivery test is conducted. The total air delivery for any coach is calculated from the fundamental requirement of the 'FRESH AIR REQUIRED PER PERSON' depending upon the type of the coach (i.e. smoking allowed in I class AC and no smoking allowed in II class AC coach). Minimum fresh air required per person for smoking coach is 0.7 m³/min. for non-smoking coach is 0.35 m³/min. respectively. Fresh, return and exhaust air velocities are measured with the help of anemometer using suitable hoods (for fresh air only) to avoid turbulence of air. The volume of air is computed by multiplying the velocity with face area. For ideal condition, the exhaust air should be equal to fresh air or it can be less by 10 % but for

no reason it should be not more than fresh air.

Condition for airflow tests are-

- Voltage set at 130 volts \pm 1 volts.
- Both side blower motors are working.
- Compartment fans are 'OFF'.
- Readings are taken after half an hour stabilization.
- Coach inside the shop.
- Return air filter should be suitably regulated to achieve the fresh air flow nearer to the required quantity.
- Compartment door exhaust air grill blocked partially to make the exhaust air equal to fresh air or 10 % less.
- Fresh air dampers regulator permanently locked, with paint mark after setting the required fresh air on both sides.

■ Cooling test

Cooling test should be carried out by providing electrical compensating heat loads for worst ambient conditions and full occupancy of the coach. After the stabilization, the temperature of each berth (20 mm from window and back rest panel and 100 mm above the berth) should be recorded. The variation in temperature on different berths should not exceed 1^o C.

xiv. Additional Item for End-On-Generation (EOG) Coaches:

- Check Inter vehicle coupler, ratchet assembly, junction box and electrical connections.
- Inspect cleat for over heating, solder run out and replace if defective.

Tighten connections as needed.

- Measure insulation resistance value of the circuit with 500 V megger. It should not be less than 2 mega ohms.
- Overhaul the DG set as per manufacturer's instructions.
- Check the proper functioning of WRA.

xv. Final Testing of AC Coach after POH

- Visual inspection of coach for proper fitment of equipment.
- Ensure that refrigerant pipes are properly clamped.
- Suction pipe for proper lagging.
- Check safety chain and tension rod of alternators for proper fitness.
- Under frame cables leading to alternator are properly cleated.
- Check earth leakage by two lamp method.
- Check control panel and ensure that proper MCB/fuses are provided.
- Check contactors, relay and switches for correct sequential operation.
- Check heaters for correct operation.
- Check hooter for proper operation.
- Start the plant and check condenser motor,

compressor, blower motor for any abnormality.

- Check leakage air from doors.
- Check that batteries are in fully charged condition.
- Run the plants with dynodrive motor for 8 hrs. at different speeds.
- Ensure that both the alternators are sharing load equally during run. If not set both the alternator panels.

xvi. Final Inspection

- The coach shall be jointly inspected with division staff and the performance of electrical and refrigeration equipment shall be recorded. A list of equipment changed with their serial nos. will also be handed over along with the coach. Any attention, if required to the equipment shall be given before dispatch of the coach from workshop to division
