ENGINEDRIVER – *ELECTRIC TICKET* EXAMINATION
TYPICAL QUESTIONS & ANSWERS

1. What precautions must be taken before changing any High- or Low-Volt fuse?

Only authorised persons may work on electrical equipment after taking the following necessary precautions:

High-Volt:

- Lower all pantographs
- Check visually that they are fully down and that no foreign material is caught between pantographs and the overhead
- Check the Main Isolation Switch (MIS) is OPEN
- Check that all auxiliary machines are stopped.

Low-Volt:

- The Motor Generator must be stopped (by opening the auxiliary circuit breaker on locomotives or by lowering the pantograph on an EMU). A switch in the circuit may be turned OFF where provided
- Use only tested fuses.

2. What action should the driver take if a fire or arcing occurs on an electric locomotive or EMU?

- Master controller to OFF
- Lower all pantographs
- Stop and secure the train (compressors not running)
- Use fire extinguisher on any fire
- If arcing from the overhead occurs and all pantographs are down with the locomotive stationary, contact the TCO immediately to have the overhead made dead.

3. What precautions must be taken before entering a depot or shed with an electric locomotive or EMU?

- Stop
- Check indicator shows "alive"
- Check that barrier is up and the road is clear
- Sound the horn
- Speed not to exceed 8 km/h.

4. What precautions must be taken before an electric locomotive or EMU leaves the depot or shed?

- Ensure all persons are clear
- Ensure all barriers are raised
- Release all handbrakes
- Test air brakes and check air pressures
- Sound the horn
- Speed not to exceed 8 km/h.

5. Precautions before touching any High- or Low-Volt equipment.

- Check the equipment is isolated
- Check the pantographs are lowered (visual)
- Ensure that no foreign material is attached between a pantograph and the overhead (visual)
- Check MIS is open
- Covers and shields must not be removed from high-voltage (HV) equipment while it is alive, and must be replaced before the equipment is made alive again
- If HV equipment is to be observed operating with covers or shields removed, there must be two people present
- Low-voltage (LV) equipment must not be touched until the Motor Generator is isolated and has completely run down or until the switch (where provided) in the circuit has been opened.

6. Precautions to isolate the overhead before climbing on the roof of a locomotive, and precautions before allowing the overhead to become alive again.

No employee may mount the roof of an electric locomotive unless the vehicle is standing under a dead section of overhead that has been isolated, and the key controlling the overhead is in his possession. While the key remains in his possession he is held responsible for the safety of the workers under his control. He must take the following precautions:

- Check all pantographs are lowered
- Open the overhead isolator (after ensuring that it pertains to the correct road), and lock it in the EARTH position
- Observe that the isolator blade moves to the EARTH position. Do not place absolute reliance on the handle position
- Lower the barrier arm
- Check the DEAD light is illuminated.

Before making the overhead live again:

- Check that no one is working on the locomotive or EMU and that all persons are clear of the roof and understand that the overhead is about to be made live again
- Check that all pantographs are still lowered
- Unlock the overhead isolator and return the handle to ALIVE position. Check that the ALIVE light is illuminated. Don't lock the handle in this position. Only the employee who isolated and blocked the overhead DEAD may open and liven it again
- Return the key to its proper position and raise the barrier.

7. Procedure to carry out a control test on an ED locomotive.

- Raise the pantograph and start all auxiliary machines
- When air pressure is sufficient, apply Independent brake
- Open Main isolation Switch (MIS)
- Leave the Auxiliary Isolation Switch (AIS) closed
- Control switch ON.
- Weigh down the dead-man's pedal
- Place the controller in Notch 1
- Check that LS1 and 2, S1 and 2, and F1 and 2 are closed
- A control test can only be carried out with two authorised persons present.

8. If no contactors are closed on an ED locomotive but the Position Relay (PR) was closed, state possible causes.

This is a control air fault.

- The Control Reservoir (CR) could have low pressure
- The CR cut-out cock could be closed
- The CR reducing valve could be faulty.

9. If an ED locomotive would not move in Notch 1 and the control test proved the Low Voltage circuit was correct, state the possible faults and how to rectify.

- Series fuse blown. After taking safety precautions, renew with a tested fuse
- Resistance grid broken. Block PR and advance the controller to Notch 5
- Check that MIS is closed.

10. Procedure to prepare an electric locomotive for service.

i. Before raising the pantograph:
   - Check that all necessary repairs have been booked off the trouble card
   - Ensure all auxiliary machines and heaters are isolated
   - Ensure all persons are clear
   - Raise the pantograph carefully to avoid bounce.

ii. After raising the pantograph:
   - Start all auxiliary machines
   - Check all switches are correct
   - Charge the pantograph Emergency Reservoir and seal it
   - Check the Control Circuit Governor (CCG) bypass switches are sealed
   - Check the warning horn at both ends
   - Check head- and tail-lights both ends
   - Check dead-man's device at both ends
   - Check the sand supply and operation
   - Check locomotive air pressure and release the handbrake
   - Make a full brake test and check piston travel. Lubricate as necessary.

iii. Additional for EMU's:
   - Check jumpers and hoses
   - Make a preparation brake test
   - Check all interlock magnet-valve isolating cocks are open
   - Test door operation and see that DOOR light illuminates.

11. Drivers duties when stabling an electric locomotive, and precautions before lowering the pantograph.

- Check the locomotive is clear of all fouling points
- Apply the handbrake at No. 1 end
- Close brake valve isolating cocks
- Check the pantograph Emergency Reservoir is fully charged and sealed
- Turn off all electric switches
- Isolate all auxiliary machines and heaters
- Lower the pantograph carefully and make a visual check
- Check the sand supply
- Hang the master controller key in the correct place
- Check emergency lights are not illuminated

- Book any repairs and report serious ones
- Close and lock all driving compartment windows and doors.

12. Describe the procedure to raise a pantograph (see p20)

- Check the Emergency Reservoir is fully charged
- Check that all auxiliary machines, heaters, and switches are turned off
- Check the following cocks are correctly positioned:
  - Both pantograph 'emergency lower' cocks
  - Both Selector cocks (one open, one closed)
  - 3-way charge cock (ED locomotive)
  - Ladder door interlock cock (ED locomotive)
  - Hand pump isolating cock (EW locomotive)
- Ensure all persons are clear
- Open the pantograph interlock cock with the Master Control key
- Slowly open the shutdown valve on the pantograph Emergency Reservoir to prevent the pantograph bouncing
- Turn ON all auxiliary machines and necessary switches.

13. Procedure if a pantograph fails to raise.

- Check pantograph Emergency Reservoir air pressure. If low, use the hand pump. If correct, check the following:
  - 3-way charge cock to Emergency Reservoir (ED)
  - Ladder door interlock cock (ED)
  - Hand pump isolating cock (EW)
  - Both emergency pantograph lower cocks
  - Selector cocks
  - Pantograph interlock cock
- If all appears normal, raise the other pantograph by opening its selector cock. Close the selector cock to the defective pantograph and book the defect.

14. How are the compressors on an electric locomotive controlled (a) automatically, and (b) manually?

(a) They are controlled automatically by the compressor governor, which is operated by Main reservoir (MR) and spring pressure. When MR pressure is low the compressor government contacts are held closed by spring pressure, completing the LV circuit to the compressor contactor coil, which contacts will close to connect the overhead HV supply to the compressor motors which will run to charge the MR to 750 kPa. When this pressure is attained, the compressor governor contacts are opened to de-energise the compressor contactor's coil and allow the contacts to open, disconnecting the overhead supply from the compressor motors, which will stop. When MR pressure drops to 700 kPa, spring pressure again closes the compressor governor contracts and the sequence is repeated (Note: EMU - 700 to 600 kPa).

(b) Compressors are controlled manually or use of the bypass switch. When depressed, it completes the circuit to the compressor contactor coil, bypassing the compressor governor and governor switch and fuse. By watching the MR gauge, the correct pressure can be maintained by operating the bypass switch.

15. Procedure if compressors run continuously.

- Check the isolating cock to the compressor governor is open
- Check the governor bypass is not stuck down in one of the driving cabs
- Check the compressor governor contacts are not stuck closed. If so, open the governor isolating switch and use the bypass switch
- Check the compressor contractor is not stuck closed. If it is, continue operation but have the set removed from service at the first opportunity
- Book the defect.

16. Procedure if both compressors fail on an electric locomotive.

Use the bypass switch and if the compressors run, control the air pressure by use of this switch and at the earliest opportunity check the following:

- The compressor governor contacts and the compressor governor wiring
- The compressor governor isolating switch and fuse

If the compressors do not run when the bypass is used, stop and secure the train, and check the following:

- The supply switch and fuse
- The compressor contactor and wiring
- The compressor HV fuses

If only one compressor is stopped, check the HV fuse for that compressor. On EWs, also check the Main Control Switch (MCS) is closed (note: there is no compressor governor fuse). On DM units, also check that the Isolator Selector Switch (ISS) is closed (only one HV fuse).

17. Describe the Low Volt circuit to the compressor contactor coil (see p21).

ED: current flows from the Motor Generator (MG) via the MLT fuse, supply fuse and switch, and the compressor governor to N. When the bypass switch is used, current flows from the MG via the MLT fuse and the supply fuse and switch to the compressor contactor coil, and then via the bypass switch (depressed) to N, thus bypassing the governor fuse and switch and the compressor governor itself.
EW: MCS between the MLT fuse and the supply fuse, and there is no fuse with the compressor governor switch.
DM: ISS between MLT fuse and compressor supply fuse.

18. Purpose of the CCG and procedure if defective.

It is to prevent control circuits from being energised while BP pressure is low, by its contacts being held open until BP pressure reaches approximately 450 kPa (provided the trip valve isolating cock is open). It is operated by pressure from an extension of the BP and will open again when BP pressure falls to about 325 kPa. BP air could be lost by operation of the leading trip valve, or dead-man's pedal or handle, which would cause CCG to open. If defective, break the seal on the CCG bypass switch, and reverse the switch position. Book the details. The defect must be reported and rectified at the earliest opportunity.

19. Procedure if a trip valve becomes defective in service (see p22).

- Secure the train
- Close the leading trip valve isolating cock
- Break the seal on the CCG bypass and reverse the switch position
- Report the closing of the trip valve isolating cock to the TCO at the nearest phone
- Test the dead-man's device before moving the train. If it is defective, the guard or other competent member must travel in the driving compartment until the vehicle with the

defective trip valve is taken out of service, which must be at the earliest opportunity. Book the defects and the broken seal.

20. Describe the operation of the dead-man's device.

It consists of a pilot valve, an emergency valve, and a foot-operated pedal (also, a dead-man's handle on an EMU). The system is charged with BP air via the emergency valve and dead-man's pedal to the pilot valve. The pilot valve is operated by the MC key/Reverse lever. With the lever in FOR or REV, the pilot valve is open to atmosphere and the dead-man's pedal must be depressed to stop the exhaust of air from the pilot valve. When in Neutral, the pilot valve is closed from exhaust and the dead-man's pedal (or handle) may be released. The emergency valve is held on its seat by having equal pressure on both sides of its piston plus spring tension on one side. With the Reverser moved from Neutral and the dead-man's pedal released, air from above the emergency valve vents to atmosphere via the pilot valve. Greater pressure below the emergency valve will cause it to lift and open its exhaust port to vent BP air direct to atmosphere, causing an Emergency brake application and CCG to open and deaden the controls.

21. State the purpose of traction motor blowers and describe the indications a driver would get, and the action taken, if a TM blower failed.

TM blowers are provided to blow air through the motor for cooling and excluding dust. If a blower fails, this results in a total loss of traction power. Line Switches 1 and 2 will drop out and break the TM circuit. Use the blower bypass switch to clear the main line. Lower the pantograph and open MIS. Check the blower fuse and replace if required. If still unable to rectify, proceed but coast as much is possible and do not use Field Tap notches. Do not attempt to ascend any grade. Keep driving amperage low and do not operate above Series. Book the defect.

22. Purpose of resistance banks and precautions to prevent them overheating.

They are provided so that a smooth start can be made, by reducing starting current to a safe limit. They convert power not required by the TMs into waste heat, thus reducing TM voltage. Do not remain in Resistance notches too long. Do not conduct excessive shunting. If in Resistance for 10 minutes, shut off and allow 10 minutes for cooling down before again notching up. On DM cars, stay in First Point for a maximum of two seconds only.

23. State the purpose of OLR and describe its operation.

The overload relay is a safety device to prevent excessive current from flowing in and damaging the TM circuits. It is an electro-magnetic contactor with an HV coil in the TM circuit which—when operated by a surge of current—opens LV contacts in the circuit to the coils of the Line switches (LS). These being de-energised, open their contacts to break the HV TM circuit. When OLR trips out it is held open by a latch and is reset by returning the controller to OFF and operating the reset switch (or if this fails, by resetting manually after taking safety precautions).

24. State the purpose of the No Volt Relay (NVR) and describe its operation (see p 23).

NVR is a safety device to protect the TMs from a power surge when power is restored suddenly after a power failure. It has an HV coil in the TM circuit which—when the TM circuit is de-energised (overhead power failure)—allows spring pressure to open the NVR low volt contacts in the LV circuit to the LS coils, and break the TM HV circuit (via LS contacts). This ensures that the HV circuit is broken should power suddenly be restored. NVR is effective from Notch 2 upwards and will reset itself. However the controller must be returned to N1 to regain the power circuit, via the Position relay (PR).

25. Procedure if OLR will not reset with the reset switch.

- Stop and secure the train
- Check OLR reset fuse
- Try the reset switch in the other driving cab
- If necessary, lower the pantograph (make visual check), remove the covers from OLR and reset by hand
- Replace the covers, raise the pantograph and proceed
- Book the defective reset switch.

26. Indication if TM is defective and the procedure to locate the defective TM set.

OLR will trip each time the controller is placed in a power notch. LS1 and 2 will open and de-energise the TM circuit.

- Stop and secure the train
- Take necessary safety precautions before entering the HV compartment
- Isolate one group of TMs and reset overloads
- Restore power, try the controller, and if OLR does not trip, then proceed
- If OLR does trip, repeat the procedure and isolate the other group of TMs
- Cut IN the previous set, reset OLR, restore power, and notch up
- With one TM group isolated, watch for wheelslip when notching up and don't operate above Series. Reduced load if necessary.
- Book the defect

(EMU: Again, don't operate above Series unless there is more than one DM car in the consist, in which case Parallel can be used)

27. Procedure to correct excessive wheelslip (a) on a locomotive, and (b) on an EMU.

(a) Reduce power, apply sand and notch up carefully. Where rail conditions are known to be bad, apply sand before wheelslip occurs.

(b) Notch off, depress the Reduced Acceleration button, and open the controller again. Hold the button IN until train speed has reached 50 km/h. Use this button when rail conditions are known to be bad.

28. Procedure if a locomotive or EMU runs off the overhead.

- Stop immediately and secure the train
- Before lowering any pantographs, ensure the sliding shoe will not foul on the overhead
- Lower pantographs and isolate controls
- Take necessary precautions to prevent electric shock
- Check overhead for damage
- If the overhead is damaged or a pantograph cannot be lowered, advise the TCO immediately to have the overhead made dead
- Wait for an unauthorised person to clear the damage, then isolate the defective pantograph
- If any part of a damaged pantograph is touching the locomotive, do not raise any other coupled pantographs until the damaged pantograph is isolated by an authorised person
- The train must not be moved until the authorised person gives permission.

29. Procedure if locomotive is derailed and the pantograph cannot be lowered.

All pantographs that can be lowered must be lowered and isolated. The TCO must be advised immediately and until the overhead has been made dead the following precautions must be taken to guard against electric shock:

- Do not touch the locomotive or coach while standing on the ground

- Do not uncouple drawgear behind the derailed vehicle
- Keep everyone clear of the derailed vehicle and any hanging equipment
- Secure and protect the train.

30. Procedure if overhead is damaged through an accident.

The train must be stopped if possible before reaching the damaged section of overhead. Pantographs must be lowered and isolated.

- Advise the TCO
- Take measures to ensure passenger safety. Passengers must not be allowed to leave the train until it is safe to do so
- When removing passengers other than at a station, the emergency wooden ladder must be used. Detrain away from adjoining lines
- Once on the ground, do not allow passengers to touch or re-enter the train until traction staff have made it safe for them to do so
- Take measures to stop or reduce the speed of other trains as may be necessary.

31. Procedure if overhead power fails.

- Stop and secure train at the nearest phone
- Lower all pantographs
- Contact the TCO. If the TCO is not aware of the failure or cannot be contacted, the driver must check his locomotive to see that it is not causing the defect. If it is, he must rectify and report to the TCO before proceeding
- If the driver finds that the locomotive is not likely to have caused the power failure he may wait 5 minutes and raise one pantograph. If power has not yet been restored he must lower it again and await instructions
- The train must be secured and protected if necessary.

32. Procedure if locomotive or EMU loses traction motor power but the overhead is still alive (question assumes we are running and still have some power).

- Place the controller to OFF and operate the OLR reset
- If this has no effect and the pantograph is definitely touching the overhead (e.g. lights, compressors, and blowers are working), coast to the next station if possible
- If compressors are not running, stop immediately and secure the train
- In either case attempt to locate the fault
- If unable to do so in a reasonable time, advise the TCO
- Book the fault(s).

33. State what occurs at each position of the Electro-Pneumatic (EP) brake valve (see p24).

No.1 Position - RELEASE (Electric and Pneumatic): MR air flows via the Brake Valve Isolating Cock Switch (BVICS), feed valve, and rotary valve and seat to charge the BP and Equalising reservoir (ER) to 500 kPa. BP air flows via the triple valve to the Auxiliary Reservoir (AR).
LV circuit - current from the Motor Generator (MG) flows via MLT fuse, ISS switch, EP fuse, and Reverser drum FOR or REV to the leading BVICS (cut IN), where it divides into two feeds. One feed goes to 'A' finger of the brake drum, which is energised in all positions. 'A' finger feeds 'C' finger, which energises the Interlock Magnet-valve (IMV). The other feed from BVICS (cut IN) goes to the rear-most air-operated switch (PI), which is closed, then the rear most BVICS (cut OUT) to one finger of the rear-most Holding Magnet-valve (HMV) interlock, where it stops. There is no blow of air from the interlock in this position.

No. 2 Position - HOLDING (Electric): The BP is charged via BVICS, feed valve, IMV, and the rotary valve to the BP. The ER remains on charge.
LV circuit – 'A' finger feeds 'C' and 'D' fingers. 'C' finger energises IMV. 'D' finger energises all HMVs throughout the train, thus blocking off triple valve exhausts and closing HMV interlocks. These interlock contacts complete the safety circuit as follows;

- from the leading BVICS (cut IN) to the rear-most PI (closed) via all trailing BVICS (cut OUT) and all HMV interlocks throughout the train (closed) back to the leading BVICS (cut IN) to a holding resistance and to the coil of IMV to N. An EP blow can occur in this position. IMV is energised from two sources.

No. 3 Position - Application (Electric): The BP remains on charge via IMV. The ER is not on charge.
LV circuit – 'A' finger feeds 'B' finger, which feeds all Application Magnet-Valves (AMVs) throughout the train. Each AMV supplies MR air to the brake cylinders via a reducing valve. HMVs prevent the escape of brake cylinder air. The safety circuit (wire 12) is completed. An EP blow can occur in this position.
No. 4 Position - LAP (Pneumatic): All ports and passages in the rotary valve are closed.
LV circuit – 'A' feeds 'D', this energising all HMVs. The safety circuit is complete (as in Position 2). No EP blow can occur.
No. 5 Position - SERVICE (Pneumatic): Pressure from above the equalising piston and ER flows to atmosphere. BP pressure moves the equalising piston up to open the secondary exhaust port and allow BP air to exhaust to atmosphere. When the brake valve Laps, it seats and closes its exhaust.
LV circuit - Same as for LAP position.
No. 6 Position - EMERGENCY (Electric and Pneumatic): BP and ER air escape via the rotary valve and seat rapidly to atmosphere causing a full-force brake application.
LV circuit – 'A' feeds 'B' as in the No. 3 position. AMVs supply MR air to the brake cylinders in case the AR has been depleted for any reason.

34. When would the IMV isolating cock be closed and how would you proceed when it is closed?

When a fault occurs in the EP brake, which causes an EP blow that cannot be rectified. Close the cock and proceed, using the Automatic brake valve in the following positions; 1, 4, 5, 6.

35. What is the function of BVICS in both positions?

Cut IN: The air valve of BVICS allows MR air to flow to the brake valve. The contacts of BVICS supply current to the brake valve drum 'A' finger, break safety circuit (12 wire), the door signalling circuit, and the controller for Reverser operation.
Cut OUT: The air valve of BVICS isolates the MR from the brake valve. Its contacts complete the break safety circuit (12 wire).

36. What are the component parts of the EP brake unit and what is the purpose of each part?

i. The Holding Magnet-valve (HMV): When energised, it blanks off the triple valve exhaust port. When de-energised, it allows brake cylinder air to escape as long as the triple valve is in RELEASE position.
ii. HMV interlock contacts: When closed (HMV energised), these contacts complete the safety circuit on the 12 wire.
iii. Application Magnet-Valve (AMV): When energised it allows MR to air to flow to the brake cylinders.
iv. Reducing valve: This reduces MR air to 350 kPa for use in the brake cylinders.
v. Safety valve: Prevents more than 375 kPa pressure in the brake cylinders.
vi. Isolating cock: When closed, it cuts off the air supply to AMV.

37. What is the purpose of PI on an EMU and what circuits do they apply to?

PI is provided to return the safety circuit for the EP brake when closed at the rear of the train. If the rearmost PI is positioned correctly, no EP blow occurs in the No. 3 brake position. PI must be closed at the front and rear of the train to complete the door signal light circuit when the Reverser is in FOR or REV.

38. What is an interlock blow (EP blow) and what will cause it (a) in No. 2 and 3 positions, and (b) in No. 3 position only?

It is a discharge of BP air from the IMV exhaust. Anything that causes a blow in No. 2 position will cause a blow in No. 3 position also.

(a) No. 2 and 3 positions:

- Master Controller (MC) not in direction of travel
- BVICS not cut IN normally
- EP fuse blown
- White jumper cable out or loose (driving from Trailer)
- ISS open
- Any LV failure that affects the MG output (including the MG HV fuse or MLT fuse, in which case try the cab lights).

(b) No. 3 position only:

- Rearmost PI closed
- Any BVICS cut IN to the rear of the driving compartment being used
- A blue or yellow jumper out or loose
- An HMV is defective or its interlock contacts are faulty.

39. When should a Service brake test be carried out?

- When a train is to run as a first service after being prepared
- When coaches have been added or detached
- When a train has been standing in the yard or siding between services
- When a train has had any coupling hoses uncoupled for any reason.

40. What is the procedure to carry out a Preparation brake test on an EMU?

- Open BVICS in the Trailing drivers cab and charge the BP to 500 kPa
- Close BVICS and reduce the BP to zero, then return the brake valve handle to the No. 1 position
- Walk along one side of the train and checked all pistons are in the Applied position, coupling hoses are correct, cocks are open, and other equipment
- At the leading cab, check the BP is still at zero before cutting in BVICS
- Cut in BVICS and check the BP charges to 500 kPa, and that the brake cylinder gauge goes to zero
- Now carry out an EP brake test as follows;
  - MC key in FOR or REV
  - Brake valve handle in No. 3 position for 5 seconds, then to No. 2 position
  - Check that the brakes fully apply and hold a steady pressure. If there is no EP blow, the electric brakes are okay
  - Release and ensure the brake cylinder gauge goes to zero.

41. What is the procedure to carry out a Service brake test on an EMU?

- Cut in BVICS
- MC key to N
- When BP and MR are fully charged, apply the brakes (when the train examiner signals to do so) in the No. 6 position and exhaust all air from the BP
- The train examiner (or authorised member making the test) must check the gauge in the trailing cab is showing zero before signalling for Release
- The driver may release on receipt of the signal if the BP is completely exhausted
- The train examiner must check that the gauge in the trailing cab restores to 500 kPa
- If, during the test, any defect is detected, it must be rectified and another test carried out
- The train examiner shall be responsible for making sure the brakes function correctly and that the train is safe to run. He must inform the driver that the brakes are correct.
- The driver must then carry out an EP test.

42. What would cause OLR to trip on an EMU? Describe the indication that is received and state the procedure for when this occurs.

Causes: Any TM or resistance grid defect which would cause an Earth fault, wheelslip, or dragging brakes causing overload of TMs.
Indication: A white light displayed in every driving cab and a *local* white light on the defective DM.
Procedure: Notch off, reset OLR, and notch up. If OLR trips again, check for flooring material caught between resistance grids and ground. If there is only one DM in the train-set, carry out a TM cut-out test. Leave the defective set cut OUT. If there is more than one DM in the train-set, open the CCO of the defective set. Proceed, with running limitations.

43. If a 3-car EMU set will not move and the controller is alive, state the possible causes for this and the procedure to adopt.

- CCO may be cut OUT. Cut IN
- Reverser not throwing correctly. Operate by hand
- IR is defective. Block NVR
- OLR has tripped. Reset and test the controller
- TL contactor fuse blown. Renew
- TM isolator switch open. Close the switch
- Resistance grid broken. Block NVR and advance the controller to Series
- Check control air pressure is correct and the control air cock is open
- The yellow jumper is out or loose or is defective. Replace or change the jumper

44. State the possible causes and procedure to follow if a 3-car EMU set will not move and the controller is dead.

- MG failed. Renew MG HV fuse
- MLT fuse blown. Renew
- LSS open. Close
- Control fuse blown. Renew
- Control switch open. Close
- CCG open or defective. Check the trip valve is set and the trip valve isolating cock is open and BP pressure is correct
- If CCG is defective, reverse the CCG bypass switch and book the details
- BVICS is not correctly cut in. Cut IN
- Master Controller and Reverser drum contacts are not correct

- Jumper cable(s) defective. Change jumpers

Take safety precautions before changing any fuses.

45. What would be affected on a 3-car EMU set if the Motor Generator failed or an MLT fuse blew? State the indication and procedure to be adopted.

The following would all fail:

1. TM and control circuits
2. Door operation and signalling
3. Heaters
4. EP braking
5. Compressors
6. Lighting (except emergency lights)

The indication would be a red light on the panel and an EP blow in both No. 1 and 2 positions.
The procedure is as follows;

- If the MG Is running, change the MLT fuse
- If the MG is not running, change the MG HV fuse

Take safety precautions and use tested fuses.

46. Describe the procedure to ascertain if a roof fuse of a DM has blown (2-car set).

1. Check the pantograph contact wire
2. Contact the TCO to ascertain if the overhead is dead
3. If not, check that the MG is running. If so, drop the pantograph and change the MLT fuse. If not, change the MG HV fuse
4. If the DM is still dead, the main roof fuse has blown. Call for assistance.

47. Describe when emergency fuse links should be used and the procedure to insert them.

They are used when there is more than one DM coach in the set, and any one of the following fail on any DM: MG, main roof fuse, VR, the pantograph.
Take necessary safety precautions and proceed as follows;
On the defective set: Remove the MLT fuse and leave it out. This prevents a back feed to the MG via emergency fuse links. Open ISS, insert a tested 30 A fuse and close ISS. If the MG races, remove the MG HV fuse.
On the good set: Open ISS, insert a tested 30 A fuse, close ISS. In daylight, turn off all saloon lights. At nighttime, remove ONE saloon light fuse from each coach on the train to reduce saloon lighting by half.
Operate within running limitations.

48. Describe the purpose of CLRs on a DM coach and state how they operate.

CLRs control the closing of the resistance contactor, so that each resistance bank is cut out at the correct amperage, thus preventing overloading of TMs. CLR coils are used in the TM circuit to operate LV contacts on the actuating wire to feed resistance contact coils. When starting off, amps are high and CLR contacts are open. As speed increases and amps reduce, CLR contacts close and the actuating wire supplies current to the coil of R1. R1 closes to cut out some resistance and amps again increase, opening CLR contacts. R1 is held energised from a retaining wire whose contacts are closed when the R1 coil is originally energised. As speed again increases, and amps reduce, CLR contacts again close and complete a feed to the R2 coil. The same sequence it is now repeated until all resistance is cut out.

There is both a fast-acting and a slow-acting CLR coil for each set of TMs. Fast-acting coils operate normally at 235 A, and slow-acting coils are operated by the Reduced Acceleration button at 155 A.

49(1) What is the duration of the required pause in Notch 1 on a DM? (2) What are the likely results if the pause is too short in duration? (3) What is the procedure to reduce damage to traction motors in unfavourable conditions?

1. 2 seconds.
2. If the controller is moved too quickly into Series when there is more than one DM in the set, LS may not close on all trailing DM's. The result will be that the whole train will be powered by one DM only, causing possible wheelslip and TM overload.
3. Use the Reduced Acceleration button when starting until speed reaches 50 km/h. If wheelslip occurs while running, shut the controller off and depress the Reduced Acceleration button. Notch up and hold the button until 50 km/h. is attained

50. What procedure is to be adopted if a fuse blows after being changed?

Leave the fuse out of the rack for rewiring or replacement. Book which fuse has blown and state where you have placed it.

51. Describe the procedure to be followed with the following door faults on an EMU.

1. <u>One or a pair of doors are not operating</u>: The T-valve or the isolating cocks to the large or small door-operating cylinders may be positioned incorrectly.
2. <u>All doors on one side of a coach are inoperative</u>: The key-operated door isolator is open.
3. <u>All doors on one coach are inoperative</u>: The door reservoir is empty or the door reservoir cocks are closed.
4. <u>All doors behind a certain point are inoperative</u>: Blue jumper out or loose.
5. <u>None of the doors on the train are operating</u>: Look for any LV failure. The white jumper is out or loose (driving from a Trailer). The door valve (DV) fuse is blown (when the guard is operating from a coach where the fuse is blown). 2 door keys are in operation or 2 door operating box switches are closed (this will cause a DV fuse to blow).

52. Name the air cocks in the door operating system and state what occurs when they are altered from their normal position on an EMU.

1. <u>Isolating cock to large door engine cylinder</u>: When closed, this will exhaust air from and cut off supply to the large cylinder. The door will not open.
2. <u>Isolating cock to small door engine cylinder</u>: When closed, this will exhaust air from and cut off supply to the small cylinder. The door will not close, or may be pushed open if already closed.
3. <u>T-valve outside the coach</u>: When reversed, this valve opens the pair of doors to which it relates by supplying air to the large door cylinder, bypassing the door valve. It will prevent these doors from closing.
4. <u>Door reservoir isolating cock</u>: When closed, this cuts off MR supply to the door reservoir. No doors on that coach can operate.

53. Describe the electro-pneumatic operation of EMU doors, and component parts (see p25).

<u>Each EMU coach is fitted with</u>:

- Two door isolators.
- Four guard's control boxes. When a guard's ET key is inserted and turned the pushbutton in the door circuit is energised.
- Four EP door valves (2 on old stock). They control the door engines on the side of the coach to which they relate.

- Eight door engines consisting of one large and one small piston connected to a common rod, which, in turn, is linked to the doors. The small cylinder is under constant pressure from the door reservoir to hold the doors closed. The door valve supplies air pressure to-and-from the large cylinder to open the doors.

Low volt circuit - OPEN position: Current flows from the MG via the MLT fuse, ISS, door valve fuse, guard's control box with key inserted, Door Open button depressed, and the door isolator to the Open-Door valve operating coil, thence to N. When its coil is energised, the operating valve moves to allow air to flow via the Close-Door valve to the chamber beneath the operating valve to hold it in its OPEN position, and to the large cylinders of the door engines, which move across, overcoming pressure in the small cylinder to mechanically open the doors.

CLOSE position: When the Close button is pressed, current flows from the guard's control box via the door valve isolator to the Close valve coil and to N. The Close valve operates to allow air from under the operating valve to exhaust to atmosphere. The operating valve can now move down and cut off the supply of air to the large cylinder and allow air already there to exhaust to atmosphere. When the Close button is released, the Close valve assists this exhaust. The small cylinder can now move across and mechanically close the doors.

54. What are the possible causes if passenger doors operate correctly but no door light illuminates on the driver's panel?

1. The Reverser is not in direction of travel
2. The EP fuse is blown
3. BVICS is not cut in correctly
4. The blue or white jumper is out or loose
5. The door signal fuse has blown anywhere on the train
6. A door is stuck open
7. A door interlock is faulty
8. PI at the front or rear unit is not conditioned correctly
9. A door signal relay is open or defective.

If the fault cannot be rectified, the guard—after checking all doors are closed at each station—may give Right Away verbally or from the luggage compartment. Book the defect in the 54T.

55. Describe the procedure to open EMU doors in an emergency and state the precautions to be taken.

- Use the T-valve on the outside of the coach if safe to do so, or close the isolating cork to the small cylinder of the door engine and open the doors by hand
- Take necessary precautions against electric shock
- Use the wooden ladder to disembark passengers away from running lines, and warn them not to touch anything
- Stop or reduce the speed of other trains as necessary
- Lower and isolate pantographs
- If pantographs cannot be lowered, advise the TCO to make necessary safety arrangements
- Don't uncouple any coaches.

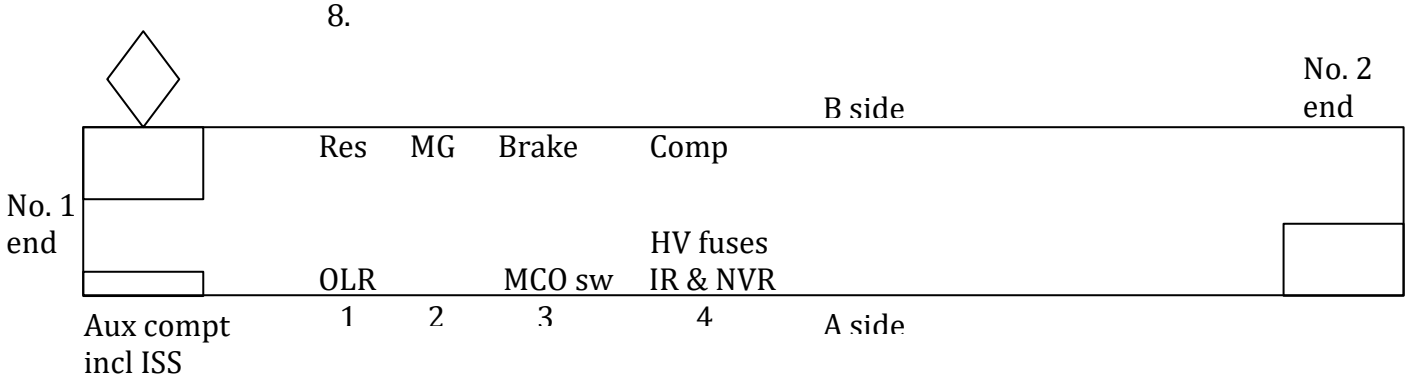
56. Describe the compressor contactor LV circuit on a DM.

Via the governor: Current flows from the MG via the MLT fuse, ISS, compressor supply fuse and switch, compressor contactor coil, governor isolating fuse and switch, and compressor governor contacts, to N.

Via the bypass: Same as above, except that from the compressor contactor coil, current flows to N via the compressor bypass switch contacts when the switch is depressed (thus bypassing the compressor governor fuse and switch) and the compressor governor.

57. When the Pantograph Lower switch has been used, how is the pantograph again raised?
- Stop and secure the train
- Proceed to the DM and place the pantograph control cock (in the luggage compartment) in its Lower position, and isolate all auxiliary machines and heaters
- Exhaust the Raise magnet-valve by pressing the button on top of the magnet-valve
- Carefully turn the pantograph cock to RAISE position to prevent the pantograph from bouncing
- Start all auxiliary machines, and proceed.

58. Describe the position of the following equipment on a DM coach.
1. MCO switches: Behind the No. 3 panel on the A-side
2. OLR: Behind the No. 1 panel on the A-side
3. Cut-out cocks to AMV's and triple valves: Behind the No. 3 panel on the B-side
4. Passenger door valves: Under seats adjacent to doors
5. ISS: In the auxiliary cabinet in the luggage compartment
6. Control Reservoir cut-out cocks: Under the coach, No. 1 end, A-side
7. Interlock and NVR: Behind the No. 4 panel on the A-side
8.



59. Describe the jumpers between the D and a DM coach.
There are five jumpers:
1. YELLOW: Trainline and EP brake
2. BLUE: Trainline for door signals, door operation, and EP brake
3. WHITE: Control line P and N
4. RED (large): HV heater
5. RED (small): LV heater interlock

Their purpose is to complete circuits between coaches to facilitate multiple unit control.

60. Describe the indication to the driver in a D coach if a blue jumper falls out.
1. There will be an EP blow at the No. 3 position
2. The driver's Door signal light will be extinguished
3. The passenger doors behind where the jumper is out will not work
4. TM control will be okay
5. Lighting will be okay

61. Describe the indication to the driver in a D coach if a yellow jumper falls out.

1. There will be an EP blow at the No. 3 position
2. The driver's Door signal light will be illuminated
3. Door operation will be okay
4. TM control will be lost
5. Lighting will be lost

62. What are the likely causes of air pressure not reaching its correct level on an EMU set although the compressors are operating?

1. End coupling cocks are open
2. Burst hose
3. Any reservoir drain cock open
4. Trip valve tripped
5. Passenger's emergency cock in coach is open
6. Driver's brake valve handle in a trailing cab is wrongly positioned.

63. State the location of the following fuses on an EMU.

1. Door Valve fuse: Auxiliary cabinet on the DM
2. Door Signal fuse: Driving cab of Trailer
3. EP brake fuse: All driving cabs
4. Main LV fuse: All driving cabs
5. Main HV fuse: Auxiliary cabinet on the DM
6. Auxiliary HV fuse: Luggage compartment on the DM
7. Trainline contactor: Driving cab on the DM
8. Spares: LV in all driving cabs and auxiliary cabinets. HV in DM cabs only.

64. Describe how power can be shut off and what occurs if the controller handle is jammed in a running notch.

1. Turn the control switch off. This cuts off the LV supply to MC. LS opens and disconnects the HV supply.
2. Release the dead-man's pedal or place the brake valve handle in EMERGENCY position. This opens CCG and cuts off the LV supply to MC. LS contacts open as above.
3. Operate the Emergency Pantograph Lower switch. This energises the Pantograph Lower magnet-valves.

65. Describe the purpose of X and Y grouping switches and state when they operate.

These switches divide the TMs from the Series arrangement into two groups of three for Series Parallel, and then into three groups of two for Parallel. Moving the controller from Notch 15 in Series to Notch 16 in Series Parallel, the X grouping switch sets up the traction motors for Series Parallel working (2 groups of 3). When the controller is moved from Notch 24 Series Parallel to Notch 25 Parallel, the Y grouping switch sets the TMs into 3 groups of 2 for Parallel working. When notching back, the process is reversed.
(The X group switch operates in Notch 15 and the Y group switch in Notch 24)

66. If an EW locomotive is completely dead and the overhead is alive, what are the possible causes and the procedure to adopt?

1. The pantograph is not against the wire. Check visually. Use of the other pantograph if necessary.
2. The pantograph isolation link is open. De-energise the overhead and close the link.
3. The main HV fuses have blown. Lower the pantograph, take necessary precautions, and exchange with a tested fuse.

4. Check MIS is closed (lower the pantograph before closing).
5. Auxiliary CB has tripped. Reset after returning the controller to OFF.

67. If an EW locomotive won't move and the controller is dead, what are the possible causes and the procedure to adopt?

1. MG light on the panel is illuminated, indicating the MG has stopped. Try the lights. If they and the compressor are not working but the blowers are running, come to a stand, take necessary precautions, and replace the MG HV fuse.
2. The MLT fuse has blown. The MG is still running but otherwise the same as above. After taking precautions, replace the MLT fuse.
3. CCG is defective. Check the trip valve isolating cock is not open. Use the CCG bypass switch and book the switch and broken seal.
4. The main control switch in the auxiliary cabinet is open. The compressors will not run. Close the switch and wait for air pressure to be restored.
5. The main control fuse in the auxiliary cabinet is blown. Take precautions and replace.
6. The driver's control key is not inserted correctly or the contact it operates is not closed and clean. Check that the body of the control key has not become unscrewed. Check the contacts in the master controller and Reverser drum.

68. If the line switches on an EW locomotive won't close and the controller is alive, where would the faults be and what is the procedure to adopt?

Before leaving the cab: Check the control air pressure at the No. 1 end and ensure the air cocks are open. Return the controller to OFF and reset OLR. Test the controller. Use the blower bypass switch and test the controller. Renew the blower HV fuse at the earliest opportunity.
Engine room: Check both J and K reversers have thrown correctly, and the LV contacts are closed. If not, operate manually. Check that IR is not defective. If so, block IR closed (remember, there will be no NVR safety feature). Check X and Y grouping switches are in their correct positions and X1 and Y1 a closed. If necessary, operate manually. Check R7 and R12 contacts are not stuck closed and that their interlocks are closed and clean. If necessary, force them open.

69. What are the possible causes and the procedure to adopt if line switches on an EW locomotive were closed but the locomotive would not move in Notch 1?

1. A resistance grid is broken. Block IR and notch up to approximately N6 (remember, there will be no NVR).
2. Check that both MCO switches are correct and that motor contactors are closed.
3. Check that Field Tap switches are correct by seeing that E1 and D1 contacts are closed. If not, operate the magnet-valve by hand.
4. Check a TM isolator is not open.
5. Check the control air gauge and isolating cocks at the No. 2 end. Open if necessary.
6. Check that R17 is closed. If not, check HR.
7. Book the defect.

70. Describe the indication and how many items would be affected if an MG or MLT fuse failed on an EW locomotive.

1. Red alarm light illuminated on driver's panel
2. TM power lost as controller is dead
3. The compressors will stop
4. Only emergency lighting will be illuminated
5. Heaters will be inoperative

Note: blowers will still run.

71. State the cause of the various indicating lights being displayed on the driver's panel of an EW locomotive and describe the appropriate procedures.

1. *Green* - Low MR pressure: Stop and check the compressors. Do not move until full MR pressure has been restored. Rectify the problem.
2. *Red* - Motor Generator failure: Check the MG HV fuses and MLT fuse. Lower the pantograph and use tested fuses. Check ACR and the battery fuse. Repair at the end of the journey, if necessary.
3. *White* - OLR tripped: Place the controller to OFF and reset. If the fault is not rectified, reset by hand. Take necessary precautions.
4. *Dim White* - Low MR pressure in other cab: Put the low MR pressure switch flag down at the earliest opportunity.

72. Name the equipment in the auxiliary cabinet on an EW locomotive.

1. Automatic cut-out relay, resistance, and fuse
2. Battery, battery charging resistance, and fuse
3. Blower relay bypass switch
4. Compressor control switch and fuse
5. Compressor governor and isolating switch
6. Fuse testing contacts and lamp
7. Heater fuse
8. Main Control Switch and fuse
9. MLT fuse
10. Main lighting switch and fuse
11. Spare fuse
12. Shed supply socket and fuse
13. Voltage Regulator

73. State the location of the following items of equipment on an EW locomotive.

1. Auxiliary HV fuses: No. 1 power panel, No. 1 equipment frame, B-side. Main fuses are on the wall above the compressor, B-side, No. 1 end.
2. Overload Relays: OLR 1 and 2, lower panel, No. 1 equipment frame, A-side. OLR 3 and 4, No. 3 top panel, No. 2 equipment frame, B-side.
3. No Volt Relay: No.3 panel, No. 2 equipment frame, A-side.
4. Interlock Relay: No. 2 top panel, No. 2 equipment frame, A-side.
5. Motor Cut-out Switches: No. 2 top panel, No. 2 equipment frame, B-side.
6. K Reverser: No. 2 lower panel, No. 1 equipment frame, A-side.
7. J Reverser: No. 1 lower panel, No. 2 equipment frame, B-side.
8. Control Air cut-out cocks: Under the passenger seat in each case. No. 2 lower panel, No. 1 equipment frame, A-side. No. 1 lower panel, No. 2 equipment frame, B-side.

74. Name the running notches on the master controller of ED and EW locomotives, and a DM coach.

ED: Series Full-Field (SFF), Series Intermediate Field (SIF), Series Weak Field (SWF). Parallel Full-Field (PFF), Parallel Intermediate Field (PIF), Parallel Weak Field (PWF).

EW: S, SP, PFF, PIF, PWF. Series and Series Parallel Field tap notches are obtained by movement of the Reverser key.

DM: S, P, WF.

They are called 'running notches' because all resistance has been bypassed from the TM circuit, and the controller may be left in them indefinitely. The controller must not be left in indefinitely in 'resistance notches'.

75. Describe the indication to the driver and the procedure to adopt if OLR tripped on an EW locomotive.

1. White light on the panel. TM power lost.
2. Return controller to OFF. Reset OLR and notch up slowly.
3. OLR could trip by notching up too fast, dragging brakes, excess load, or excessive slipping causing overloading of the TMs. A defective pair of TMs could cause OLR to trip.
   If OLR trips each time the controller is notched up after reset, carry out a TM cut-out test to identify the faulty group. Do not operate above Series. Book the defect.

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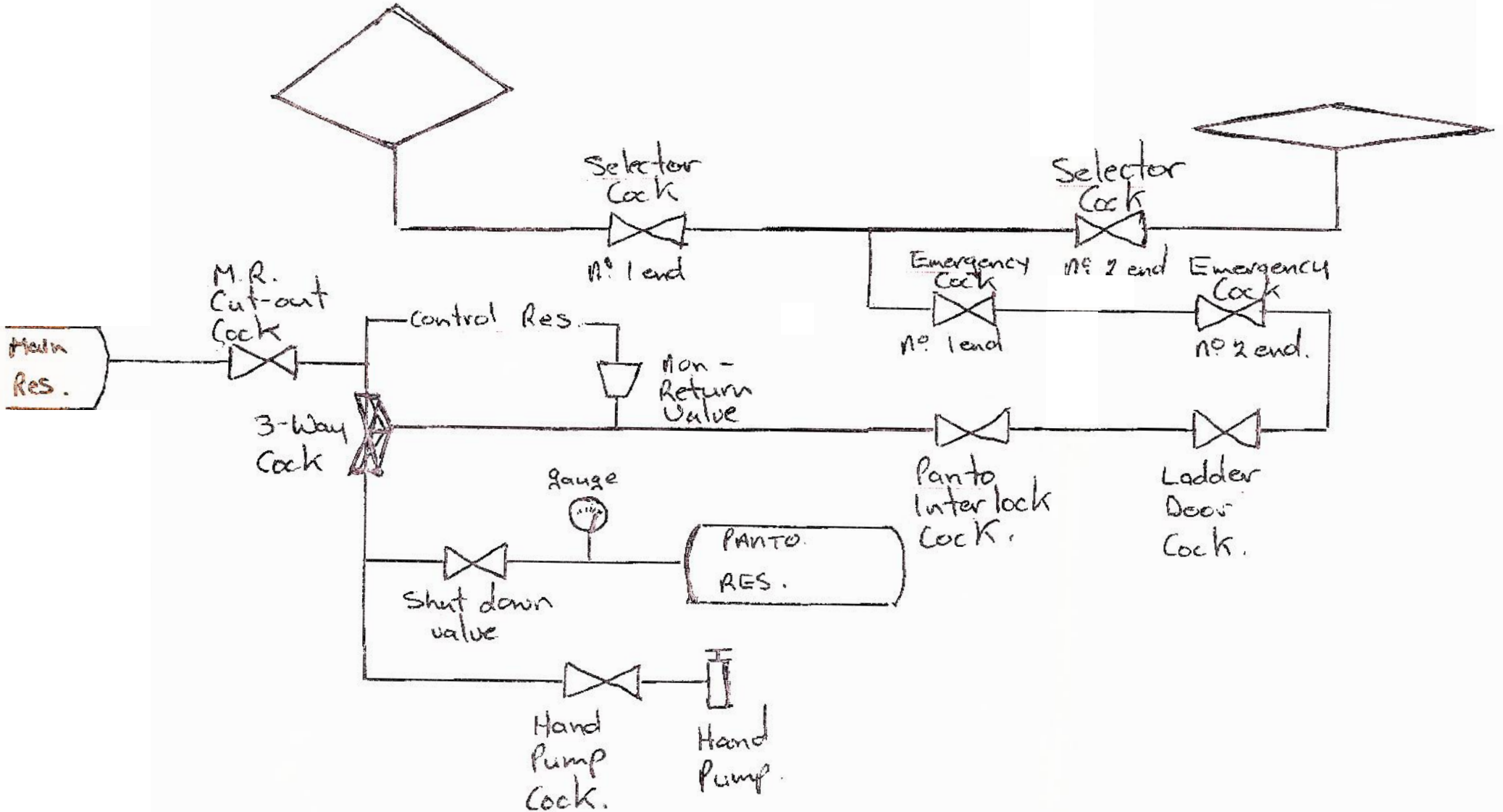
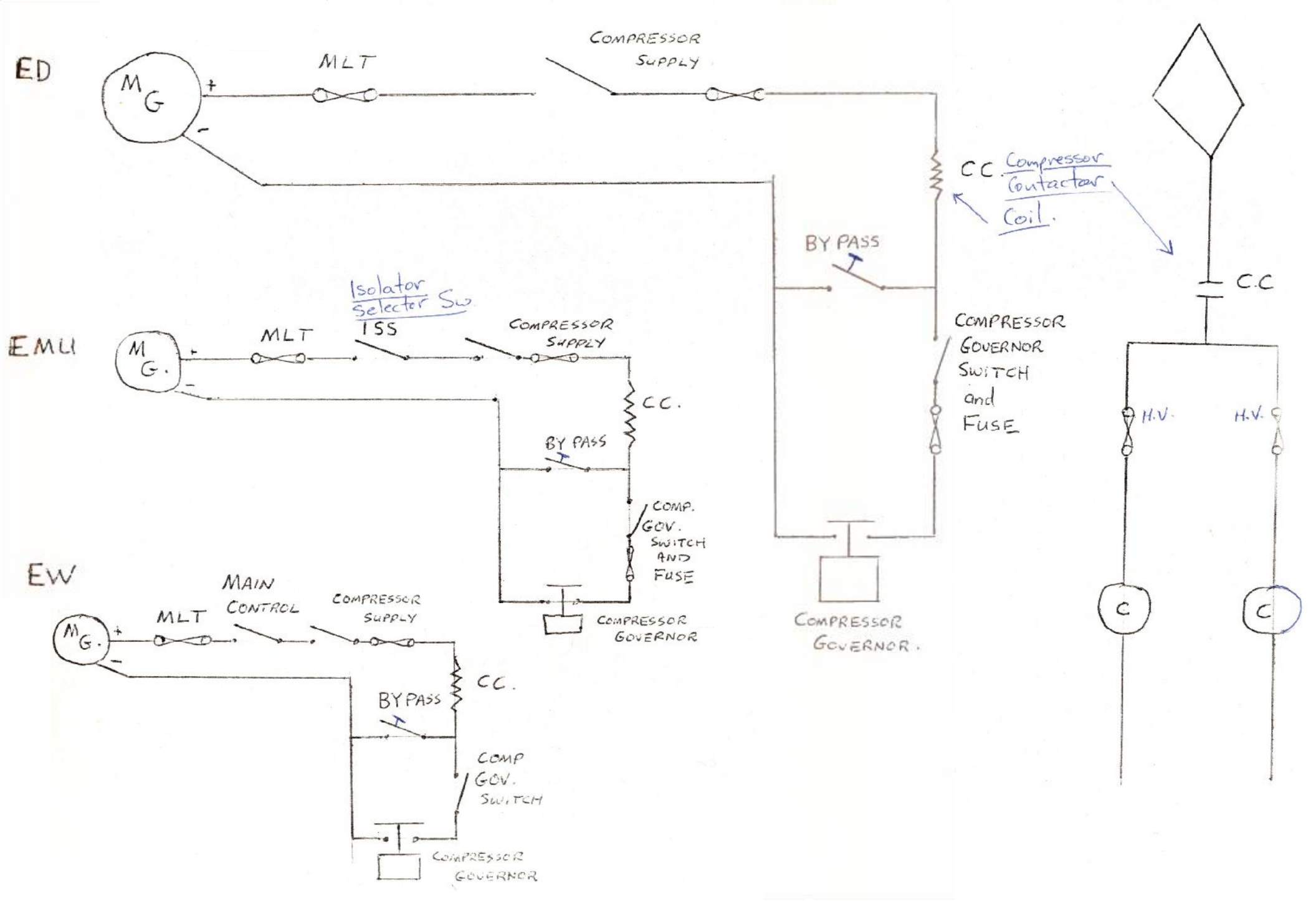
SUMMARY: EMU JUMPERS

Blue:
- Brake application magnet-valve
- HMV
- HMV Int
- DSR
- Door light (2 wires)
- Door Open/Close (2 wires)
- Buzzer
- Spare

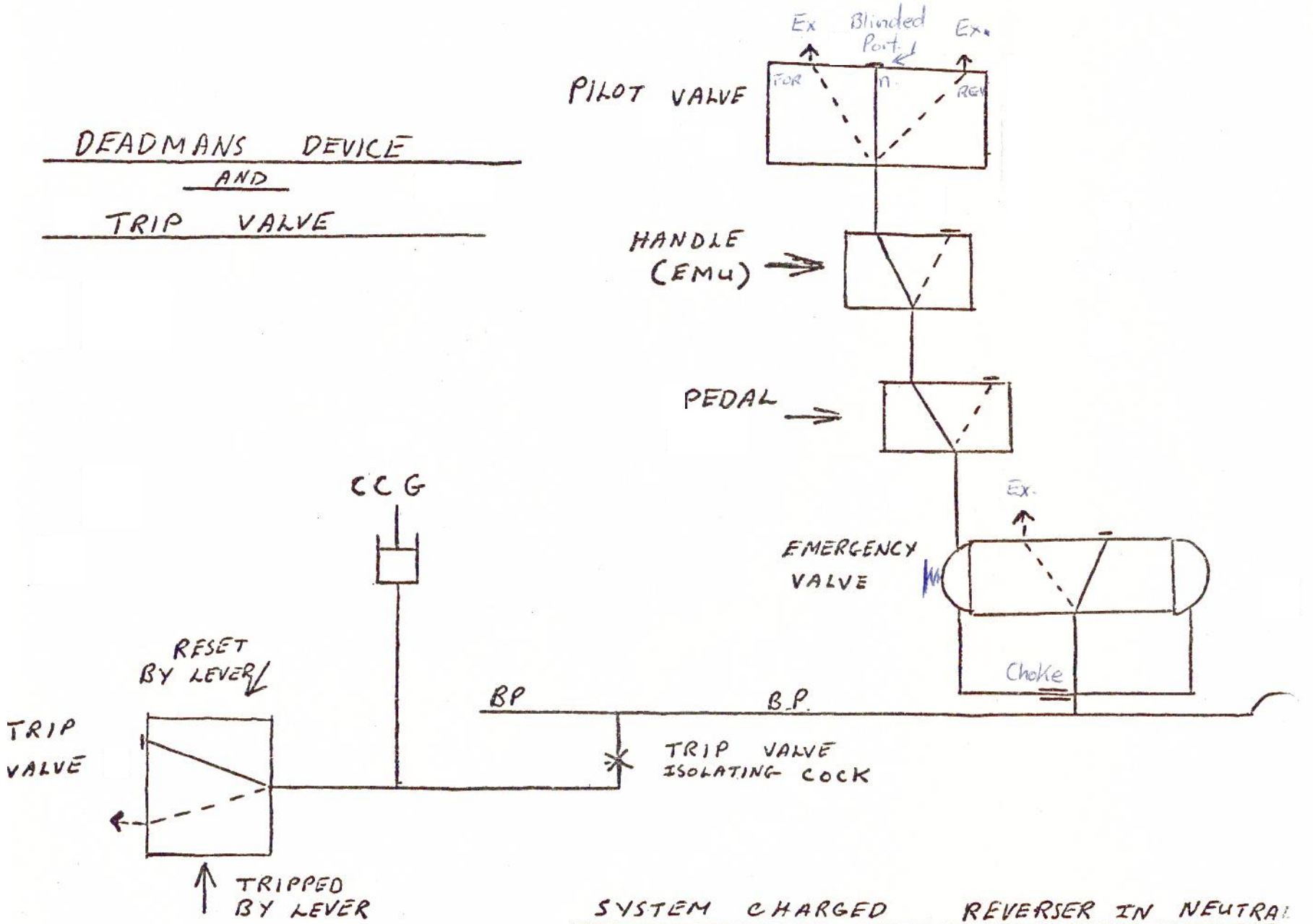
Yellow:
- Trainlines For/Rev
- Series Parallel
- WF IR
- OLR reset Reduced Accel
- AMV
- HMV
- Panto Up/Dn
- Saloon lights

White:
- Emergency links
- CCG and Control (2 wires)
- Saloon lights On/Off
- NEG
- Spare
- OLR
- Compressor governor synch wire
- Battery and Emerg lights


Selector Cock
No 1 end
Selector Cock
No 2 end
Emergency Cock
No 1 end
Emergency Cock
No 2 end.
M.R. Cut-out Cock
Main Res.
Control Res.
Non-Return Valve
3-Way Cock
Gauge
Panto Interlock Cock.
Ladder Door Cock.
PANTO. RES.
Shut down valve
Hand Pump Cock.
Hand Pump.

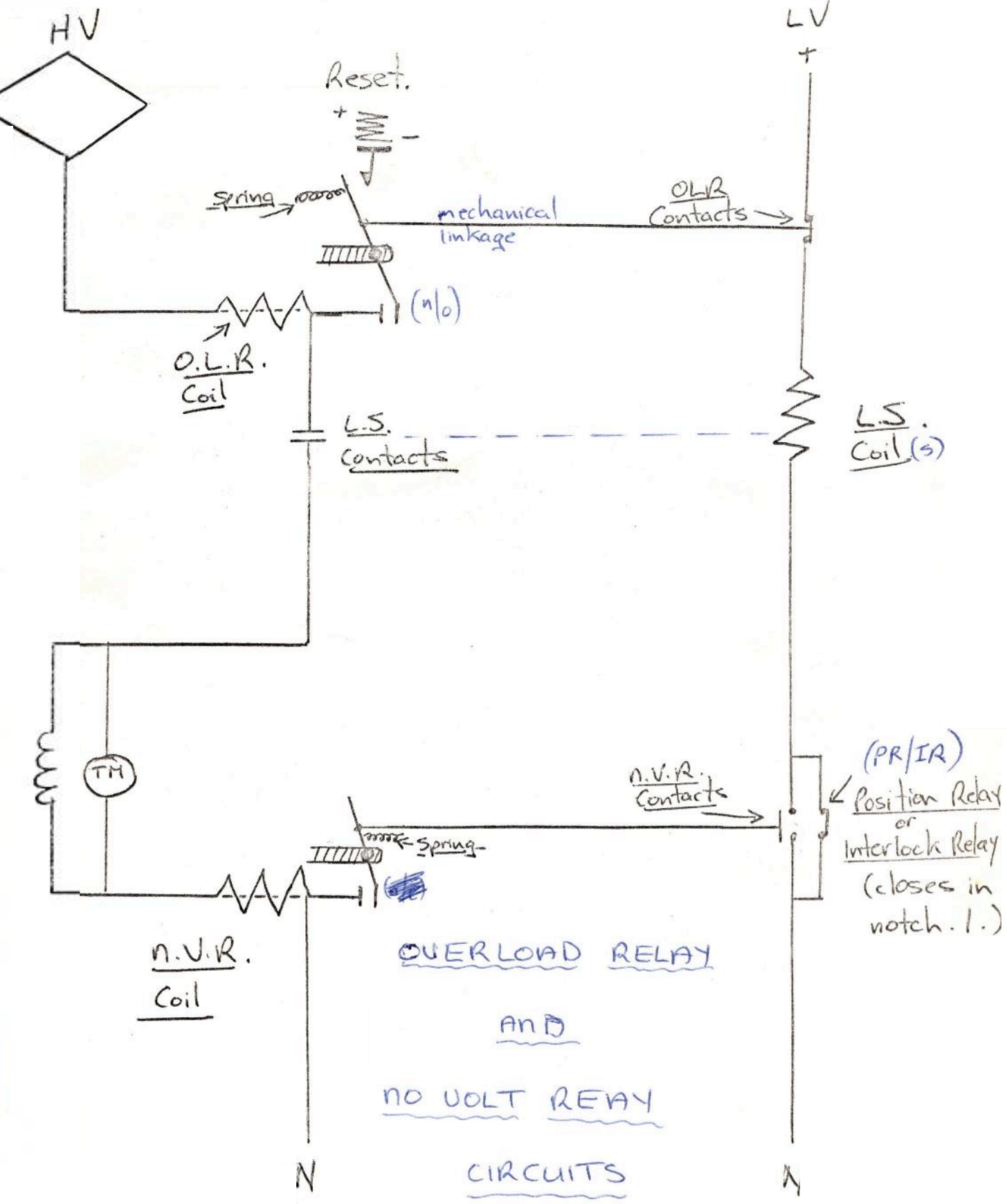

ED
M G
+
-
MLT
COMPRESSOR SUPPLY
CC. Compressor Contactor Coil.
BY PASS
C.C
COMPRESSOR GOVERNOR SWITCH and FUSE
H.V.
H.V.
C
C
COMPRESSOR GOVERNOR.
EMU
M G.
MLT
Isolator Selector Sw.
ISS
COMPRESSOR SUPPLY
CC.
BY PASS
COMP. GOV. SWITCH AND FUSE
COMPRESSOR GOVERNOR
EW
M G.
MLT
MAIN CONTROL
COMPRESSOR SUPPLY
CC.
BY PASS
COMP GOV. SWITCH
COMPRESSOR GOVERNOR

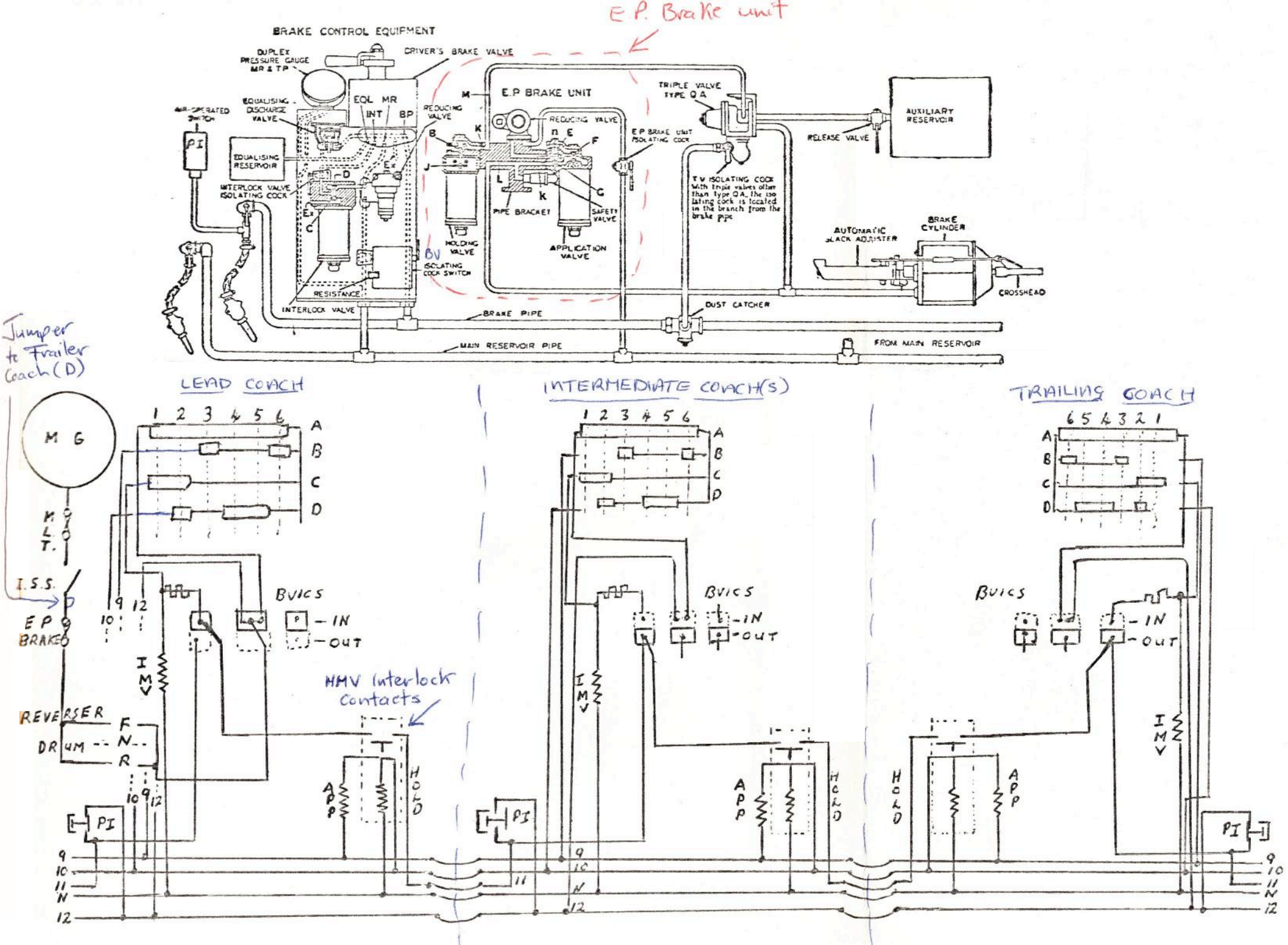
DEADMANS DEVICE AND TRIP VALVE



SYSTEM CHARGED REVERSER IN NEUTRAL

TRIP VALVE SET


HV
LV
+
Reset.
+
−
Spring
mechanical linkage
O.L.R. Contacts
(n/o)
O.L.R. Coil
L.S. Contacts
L.S. Coil (s)
TH
N.V.R. Contacts
(PR/IR)
Position Relay or Interlock Relay (closes in notch. 1.)
Spring
N.V.R. Coil
OVERLOAD RELAY
AND
NO VOLT REAY
CIRCUITS
N
N


E.P. Brake unit
BRAKE CONTROL EQUIPMENT
DUPLEX PRESSURE GAUGE MR & TP
DRIVER'S BRAKE VALVE
EQUALISING DISCHARGE VALVE
EQL MR INT BP
REDUCING VALVE
E.P BRAKE UNIT
TRIPLE VALVE TYPE Q A
AUXILIARY RESERVOIR
RELEASE VALVE
EQUALISING RESERVOIR
INTERLOCK VALVE ISOLATING COCK
E.P BRAKE UNIT ISOLATING COCK
T.V ISOLATING COCK With triple valves other than type Q A, the isolating cock is located in the branch from the brake pipe
PIPE BRACKET
SAFETY VALVE
APPLICATION VALVE
HOLDING VALVE
BV ISOLATING COCK SWITCH
AUTOMATIC SLACK ADJUSTER
BRAKE CYLINDER
CROSSHEAD
RESISTANCE
INTERLOCK VALVE
DUST CATCHER
BRAKE PIPE
MAIN RESERVOIR PIPE
FROM MAIN RESERVOIR
Jumper to Trailer Coach (D)
LEAD COACH
INTERMEDIATE COACH(S)
TRAILING COACH
M G
M L T.
I.S.S.
EP BRAKE
REVERSER DRUM
F N R
IMV
BVICS
IN
OUT
HMV Interlock contacts
APP
HOLD
PI

EMU DOOR OPERATION (one side of coach only.)