

ILLINOIS CENTRAL SYSTEM

QUESTIONS AND ANSWERS

Pertaining to

**SUBURBAN CAR MULTIPLE
UNIT OPERATION**

CHICAGO TERMINAL

QUESTIONS AND ANSWERS
PERTAINING TO MULTIPLE
UNIT OPERATION

Chapter I

Q-1. What is a Multiple Unit?

A. A multiple unit and tender coupled together.

Q-2. What is the name of power?

Every employee whose duties are in any way connected with the operation and maintenance of the suburban multiple unit cars, is required to be familiar with the apparatus he is called upon to operate and repair in the performance of his duties and will be examined from time to time as to his qualifications for such duties by such persons as are appointed by proper authority.

ENGINEERS are required, in addition to the above, to know in general, the principles of operation of the various pieces of apparatus, the manner in which they should be operated and the method of procedure in case of failure.

Q-3. How are pantographs raised?

A. Pantographs are raised when the train is

Q-4. How are pantographs lowered?

A. Pantographs are lowered by pulling down on the pantograph pin and inserting screw hook if necessary.

QUESTIONS AND ANSWERS PERTAINING TO MULTIPLE UNIT OPERATION

— Chicago Terminal —

- (1) Q. What is a Multiple Unit?
A. A one-motor car and trailer coupled together.
- (2) Q. What is the source of power?
A. 1,500 volts direct current supplied through overhead contact wire.
- (3) Q. How is this source applied to the unit?
A. By pantographs.
- (4) Q. How many pantographs per unit?
A. Two per motor car designated as "A" and "B".
- (5) Q. How are pantographs controlled?
A. Pantographs are controlled by means of push buttons on the auxiliary controllers located in the engineers' cabs, provided the unit is made up for service.
- (6) Q. How are pantographs raised?
A. Pantographs are spring raised after being unlatched either by electro-pneumatic valve or use of long pantograph pole.
- (7) Q. How are pantographs lowered?
A. Pantographs are air lowered or may be pulled down by long pantograph pole and inserting switch hook, if necessary.

- (8) Q. Where is long pantograph pole and switch hook located?
- A. Long pantograph pole is located on east side of trailer car near "B" end. The switch hook is located in trainmen's locker at "B" end of motor car.
- (9) Q. How is "A" and "B" end of unit designated?
- A. "A" ends have the engineer's cab. "B" ends are coupled together.
- (10) Q. What must be done without fail before inspection or repairs can be made to any unit involving 1,500 volt circuit?
- A. Both pantographs must be lowered and grounded.
- (11) Q. How are these pantographs grounded?
- A. Each pantograph is provided with a ground hook which must be placed over a cross member of the pantograph, using switch hook.
- Note: Extreme care must be exercised to keep clear of overhead wires.
- (12) Q. Are both pantographs alive?
- A. BOTH PANTOGRAPHS ARE ALWAYS ALIVE WHEN EITHER PANTOGRAPH IS UP.
- (13) Q. Which pantograph should be used under normal operation?
- A. Pantograph designated by special instructions.
- (14) Q. How is 1,500 volts applied to motors?
- A. From pantograph through main fuse box, to choke coil, main switch and fuse board, line breaker, motor controller, reverser, motor resistors, main motors, and ground.

- (15) Q. What are main fuse boxes for and where are they located?
- A. Main fuse boxes are for protection of the 1,500 volt wiring and are located, one at each pantograph.
- (16) Q. What should be done if this fuse is blown?
- A. Lower pantograph affected and use the other.
- (17) Q. What is the purpose of the choke coil and its location?
- A. To prevent extreme voltage surges. Coil is suspended from center sill of motor car.
- (18) Q. What is location and contents of main switch and fuse board?
- A. Located west side of motor car; contains main motor switch, air compressor switch and fuse, motor generator switch and fuse, heat switch and fuse.
- (19) Q. What precaution must be taken before opening these switches or renewing these fuses?
- A. Before opening switches or renewing of fuses on this main switch and fuse board; pantographs must be lowered, grounded and switch hook used.
- (20) Q. What is function of the line breaker and its location?
- A. Opens and closes main motor circuit—located west side of motor car.
- (21) Q. What does the motor controller contain?
- A. Contains the reverser, air engine and cam shaft for operating contactors (which make the electrical combinations of the motors and regulates the starting resistance in circuit with them), overload relay, accelerating relay, and "motor cutout" switches.

- (22) Q. Where is the location of the motor controller?
A. West side of motor car.
- (23) Q. What is the purpose of the reverser?
A. To reverse the direction of flow of current to the main motors.
- (24) Q. Should reverser handle be moved when unit is in motion?
A. No.
- (25) Q. What is the purpose of overload relay?
A. To protect main motors from excessive current.
- (26) Q. What is purpose of accelerating relay?
A. Provides gradual acceleration.
- (27) Q. What is the purpose of motor cutout switches?
A. To cut out either or both pair of motors.
- (28) Q. What is the purpose of motor resistors and their location?
A. Resistors are used to regulate the flow of current to the motors while the unit is accelerating. Located on east side of motor car.
- (29) Q. How many main motors per unit and how are they numbered?
A. There are four per motor car and are numbered, 4-3-2-1 from "A" end.
- (30) Q. What is "ground"?
A. Car body and rail circuit.
- (31) Q. What other devices are also in main motor circuit and what are their functions?
A. Field control switch, potential relay, and lightning arrestor.

- (31) A. (continued)
- (a) Field control switch is used to cut out part of the main motor fields.
- (b) Potential relay is for protection against low voltage.
- (c) Lightning arrestor is for protection against lightning.
- (32) Q. Where are these devices located?
A. (a) Field control switch is located on west side of motor car.
(b) Potential relay is suspended from the center sill of motor car.
(c) Lightning arrestor is suspended from center sill of motor car.
- (33) Q. How is this various 1,500 volt equipment made to function?
A. By use of 32-volt electrical equipment and 70 lb. control air pressure.
- (34) Q. What should be done in case of fire?
A. Lower pantographs and use pyrene fire extinguisher located in "B" end, west side of each motor car vestibule.
- (35) Q. What provides the 32-volt electrical equipment?
A. 1,500 volt motor direct connected to 32-volt generator, plus 32-volt storage battery.
- (36) Q. How is 70 lb. control air provided?
A. By means of feed valve reducing main reservoir air pressure to 70 lbs.
- (37) Q. Where is storage battery located?
A. Located on west side of trailer car.

- (38) Q. Where is main battery switch and its fuses located?
- A. Located on west side of trailer car next to battery box.
- (39) Q. Trace 32-volt circuit from battery switch to master controller.
- A. By cable from battery switch to control switch in "A" board of motor car; brake pipe cutout; auxiliary controller; and to master controller.
- (40) Q. What other circuits lead off the "A" board?
- A. 32-volt air compressor and governor control—motor generator control—"A" and "B" pantograph control.
- (41) Q. What is the purpose of brake pipe control cutout?
- A. To prevent movement of unit without air pressure.
- (42) Q. What is the purpose of auxiliary controller?
- A. Auxiliary controller is provided with push buttons for operation to raise and lower pantographs; headlight; cab door operation; reset line breaker; cab heater; and couple and uncouple.
- (43) Q. What is the purpose of master controller?
- A. Master controller is used to control the operation of the motor control apparatus.
- (44) Q. How many positions on master controller?
- A. Five. (1) Switching (2) Series (3) Series By Pass (4) Parallel By Pass (5) Parallel
- (45) Q. How many positions on reverser of master controller?
- A. Three. (1) Forward (2) Off (3) Reverse

- (46) Q. Trace 32-volt circuit from master controller to the motor controller.
- A. By cable from master controller to 8 point control cutout panel; to motor controller with taps to potential relay; line breaker and field control switch.
- (47) Q. What is the location of 8 point control cutout panel?
- A. Located back of seat in engineer's cab—motor car.
- (48) Q. How many fuses are on this control cutout panel?
- A. Seven.
- (49) Q. How are these fuses numbered?
- A. 1 to 7, inclusive.
- (50) Q. Describe how a blown fuse on this panel will affect the operation of this unit.
- A. No. 1 Fuse: Motor controller will not step up. Unit will be sluggish and motor resistors will overheat.
- No. 2 Fuse: Unit will not move.
- No. 3 Fuse: Motor controller will not advance past full series position.
- No. 4 Fuse: Unit will not run South.
- No. 5 Fuse: Unit will not run North.
- No. 6 Fuse: Motor controller cannot be "notched up" by hand.
- No. 7 Fuse: Line breaker cannot be reset.
- (51) Q. What does "hand notching" consist of?
- A. Moving master controller handle from "Series By Pass" to "Parallel By Pass" as many times as required for acceleration.

- (52) Q. When should "hand notching" be used?
- A. "Hand notching" should be used when rail conditions require.
- (53) Q. How is air compressor controlled?
- A. By a governor and fused air compressor switch on "A" board, and air compressor governor located under No. 1 long seat on motor car.
- (54) Q. How is air compressor started and stopped?
- A. By closing governor and air compressor switches thereby closing 1,500 volt electric magnetic contactor. Compressor stops when main reservoir pressure reaches setting of governor.
- (55) Q. How is motor generator started?
- A. By closing motor generator fused switch on "A" board thereby closing 1,500 volt electric magnetic contactor.
- (56) Q. What indication is displayed when motor generator is in operation?
- A. Green light on "A" board.
- (57) Q. How are "A" and "B" pantographs selected?
- A. By closing left fused switch for "A"; right fused switch for "B".
- (58) Q. Where is 1,500 volt electric magnetic contactors for air compressor and motor generator located?
- A. In contactor box located near center sill—motor car.
- (59) Q. What other contactors are located in this box?
- A. Five heat contactors.

- (60) Q. How would you prepare a single unit train for service?
- A. Use pantograph pole to unlatch designated pantograph. Close following switches on "A" board: designated pantograph, air compressor governor and air compressor, motor generator and control. Open brake pipe cutout cock. When air pressure builds up to 70 lbs., lower and raise pantograph to assure control of same. After brake system is charged to standard pressure, proper standing test must be made before train is moved. When desiring to move, place reverser handle in forward position on master controller. Hold down master controller handle and move to desired position.
- (61) Q. What should be done when changing to trailer cab?
- A. Apply brakes. Close brake pipe cutout cock. Remove brake valve and reverser handles. Close cab door. At trailer cab close control switch in "G" board. Open brake pipe cutout cock. Lower and raise pantograph to assure control of same. Release brakes.
- (62) Q. How would you add an additional unit?
- A. Move slowly against unit to be coupled into with enough force to bring coupler faces together to lock couplers. Next, depress coupler selector switch and raise operating button until both drum switches have operated correctly. This connects the main reservoir, brake pipe and electrical circuits through the couplers and will produce an emergency application of the brakes due to sudden drop in brake pipe pressure. Close proper switches on "A" board of unit coupled into. Proceed to either end of train, depending on direction of movement. Make up cab. Press down pantograph button for an instant (to

(62) A. (Continued)

cushion pantographs). Press raise pantograph button. Charge and test brake system. Make final inspection to see that pilot lights and air compressors are operating.

(63) Q. How would you uncouple two units?

- A. Make up a cab where cut is desired. Set brakes. Raise coupler selector switch and raise operating button until both drum switches have operated correctly. Release brakes; take slack, if necessary. Make certain separation is made.

(64) Q. How would you tie up a unit at outside points?

- A. Set brakes. Lower pantographs. Close brake pipe cutout cock. Close lower cab door button. Pull out headlight, cab heater buttons and turn off window wipers and classification lights, if in use. Close cab door. Open all switches on "A" board.

Note: Main light switch, doors, heater relay and Nos. 1 & 2 heat switches on "B" and "D" boards must also be opened. This is duty of trainmen.

Open control switch on "G" board. If train consists of more than one unit, proceed as outlined above.

(65) Q. What type of air brake is in use on this equipment?

- A. New York Air Brake Company Type PS Electro-Pneumatic.

(66) Q. Name the principal parts of air brake equipment.

- A. On Motor Car: One H-6 Brake valve with electric control head, one air compressor and governor, two main reservoirs, one supplementary reservoir, one auxiliary reservoir, one equalizing reservoir, one control reservoir, two brake cylinders, one triple valve, one magnet valve bracket

(66) A. (Continued)

complete with service, emergency and release magnet valves, one vent valve, one conductor's valve, two safety valves, one pressure controller or feed valve, one quadruplex air gauge, and necessary piping and cutout cocks.

Note: Trailer Car is not equipped with air compressor or governor, main reservoirs, control reservoir and has only one brake cylinder.

(67) Q. What is the purpose of H-6 brake valve with electric control head?

- A. This provides for electrical connections to the magnet valve brackets.

(68) Q. Can electric feature be cut out?

- A. Yes. By pulling out electric feature plug.

(69) Q. Where is electric feature plug located?

- A. To the left of each brake valve.

(70) Q. How does the electric feature benefit the operation of the brakes?

- A. In electric service, brake pipe air is vented direct to brake cylinder on each car to effect the local brake pipe reduction throughout train, thereby building up brake cylinder pressure before auxiliary reservoir air is vented to brake cylinder through triple. This results in full service application approximately four times faster than pneumatic application. Electric holding provides for holding air in brake cylinder while recharging brake pipe and to graduate air from brake cylinders in any desired graduations simultaneously on all cars.

(71) Q. Can emergency application of brakes be obtained after service application?

- A. Yes.

(72) Q. What two air pipes are continuous throughout train?

A. A one-inch main reservoir and a $1\frac{1}{4}$ inch brake pipe.

(73) Q. Where does main reservoir pressure begin and end?

A. Begins at air compressor discharge valves through discharge pipe to both main reservoirs and main reservoir pipe; to pressure controller, through coupler on "A" end; with branches to drum switch magnet valves, horn and bell, quadruplex gauge, F-2 feed valve at control reservoir, and air compressor governor.

On trailer car: Through couplers "B" end, to pressure controller, through coupler "A" end, branches to drum switch magnet valves, horn and bell, and quadruplex gauge.

(74) Q. Where does brake pipe pressure begin and end?

A. On motor car: Begins at pressure controller, to brake valve with branches to pressure controller governor, quadruplex gauge, dead main control, drum switch, "A" end coupler, PS Electro-Pneumatic valve, conductor's valve, and "B" end coupler.

Note: Same arrangement applied to trailer car.

(75) Q. Where are main reservoir pipe cutout cocks located?

A. At #2 reservoir, ahead of drum switch, drum switch, bell and horn, and "B" end coupler.

Trailer Car: "B" end coupler, ahead of drum switch, drum switch, and bell and horn.

(76) Q. Where are brake pipe cutout cocks located?

A. At brake valve, brake pipe ahead of drum switch, drum switch, brake pipe by-pass located at "A" end of car east side, PS Electro-Pneumatic valve and "B" end coupler.

Trailer Car: "B" end coupler, PS Electro-Pneumatic valve, brake valve, brake pipe ahead of drum switch, drum switch and brake pipe by-pass located "A" end of car west side.

(77) Q. In what position (in regard to pipe) is cutout cock handle when open?

A. Crosswise to pipe.

(78) Q. In what position (in regard to pipe) is cutout cock handle when closed?

A. Lengthwise to pipe.

(79) Q. What is the purpose of control reservoir?

A. Provides for pneumatic operation of pantographs, line breaker, motor controller and field control switch.

(80) Q. What cutout cocks are provided in control air line and where are they located?

A. One at feed valve; one above line breaker; one at each pantograph magnet valve.

(81) Q. What is a drum switch?

A. Mechanical device containing electrical contacts, main reservoir cutout cock and brake pipe cutout cock, operated by magnet valves or by hand.

(82) Q. Is it absolutely necessary to have drum switch in position, whereby electrical contacts are closed and cutout cocks are open?

A. Yes.

(83) Q. How is drum switch lever pointed when coupling is properly made?

A. Lever is pointed to center of track.

(84) Q. How is drum switch lever pointed when car is uncoupled?

A. Lever is pointed to extreme opposite position.

(85) Q. Drum switch lever indicates coupled position and brakes are inoperative. What should be done?

A. This would indicate a defective drum switch and air should be by-passed around same.

Note: Main reservoir and brake pipe cutout cocks to drum switch must be open.

(86) Q. What method is provided to connect brake pipe and main reservoir to coupler?

A. By armored hose or Barco Joints.

(87) Q. What indicates power failure?

A. By noting pilot light on "A" board or by continuous drop in main reservoir air pressure, if operating from trailer cab.

(88) Q. What should be done in case of power failure?

A. Coast to next stop, if possible.

(89) Q. If power is not restored, what should be done?

A. Look for grounded pantograph and remove source of ground, if possible.

(90) Q. If power fails again when attempting to start train what should be done?

A. Single unit: Proceed to cut out "motor cutout" switches.

(91) Q. What pair of motor switches should be cut out first, unless it is evident what pair of motors is defective?

A. Motor switches 3 and 4.

(92) Q. Why?

A. Majority of failures occur in motors 3 and 4.

(93) Q. How would you proceed to cut out motors 3 and 4?

A. Lower and ground pantographs, pull out top motor cutout switch, make certain connection is made with bottom clips; remove ground hooks, raise pantograph, reset line breaker and attempt to move.

(94) Q. If this does not correct defect what should be done?

A. Proceed as outlined above. Cut motors 3 and 4 in and motors 1 and 2 (bottom switch) out.

Note: IF TRAIN CONSISTS OF MORE THAN ONE UNIT PROCEED WITHOUT CUTTING OUT MOTORS OR RESETTING LINE BREAKER.

(95) Q. How many times may line breaker be reset before locating trouble and why?

A. Three, because severe damage to equipment will be done if continued; also, it may cause interruption to other trains.

(96) Q. If pantographs fail to respond to operation of push button, what should be done?

A. Check control and pantograph switches. Test their fuses. Check pantograph magnet valves' cutout cocks.

(97) Q. Can main reverser be operated by hand?

A. Yes, in emergency, by using reverser handle.

Note: BOTH PANTOGRAPHS MUST BE LOWERED AND GROUNDED.

(98) Q. What should be done in case of an air compressor failure?

A. Check switches and test fuses on "A" board. Check governor contacts. Change 1500 volt fuse on main switch and fuse board.

Note: BEFORE OPENING SWITCHES OR RENEWING OF FUSES ON MAIN SWITCH AND FUSE BOARD, PANTOGRAPHS MUST BE LOWERED, GROUNDED AND SWITCH HOOK USED.

(99) Q. What should be done in case of motor generator failure?

A. Check switch and fuses on "A" board. Change 1500 volt fuse in main switch and fuse board.

Note: BEFORE OPENING SWITCHES AND RENEWING OF FUSES ON MAIN SWITCH AND FUSE BOARD, PANTOGRAPHS MUST BE LOWERED, GROUNDED AND SWITCH HOOK USED.

(100) Q. If unable to start motor generator, how would you proceed?

A. Preserve battery current, using minimum lights and doors.

(101) Q. If train consists of more than one unit, what should be done?

A. Close battery trainline switches, located under No. 2 long seat motor car, #7 long seat trailer car.

(102) Q. With blown battery fuse and motor generator running can pantographs be lowered?

A. Yes.

(103) Q. Can pantographs be raised?

A. No, not from cab control.

(104) Q. For what reason?

A. With motor generator running contactor is closed, but when pantograph is lowered, contactor is opened and cannot be closed if main battery switch fuse is blown.

(105) Q. Where is fuse tester located?

A. In motor generator, regulator box located on east side of motor car.

(106) Q. What does this box also contain?

A. Spare 1500 volt air compressor, motor generator, heat and 32 volt main battery switch fuses.

(107) Q. If unable to uncouple units from cab control, what can be done?

A. Units can be uncoupled by hand as follows: Close drum switches, pull hand levers, taking slack if necessary.

(108) Q. What should be done if brakes fail to release in running position using electric feature?

A. Pull out electric feature plug at brake valve. If this does not release brakes pull plug at every magnet valve bracket on each car in train.

(109) Q. If undesired emergency occurs repeatedly, what should be done?

A. Pull out electric feature plug at brake valve.

(110) Q. How does deadman control operate?

- A. If main handle of master controller is released in any position including "off", while reverse handle is in either forward or reverse position, power will be cut off and an emergency brake application made.

(111) Q. If deadman control sticks open what would you do?

- A. Apply one inch pipe plug carried in 32-volt fuse rack inside cab door. Reverser handle can be used to apply this plug.

(112) Q. How should defective PS Electro-Pneumatic valve be cut out?

- A. Close brake pipe cutout cock at valve and close side vent cutout cock at brake cylinder affected.

(113) Q. What should be done in case of ruptured armored hose or Barco Joint main reservoir line "B" end, and how would operation of unit be affected?

- A. Close cutout cock in main reservoir line on motor car.

Southward movement—not affected.

Northward movement—unable to operate from trailer cab.

Note: If train consists of more than one unit, both main reservoir cocks must be closed at rupture. Train may be operated from either cab, air compressor ahead of rupture furnishing air for brake equipment.

(114) Q. If break occurs at "A" end in train of more than one unit?

- A. Close cutout cocks ahead of drum switches. Operation is same as noted above.

(115) Q. What should be done in case of ruptured armored hose or Barco Joint brake pipe "B" end, and how would operation of unit be affected?

- A. Close brake pipe cutout cocks at "B" end on motor and trailer.

Southward movement—brakes on motor car only.

Northward movement—brakes on trailer car only.

(116) Q. If rupture occurs at "A" end in train of more than one unit?

- A. Close brake pipe cutout cocks ahead of drum switches. Brakes can only be obtained ahead of rupture in both directions.

(117) Q. After making desired reduction, in what position should brake valve be placed?

- A. Electric holding.

(118) Q. Why?

- A. Because in this position brake cylinder pressure is maintained and brake pipe pressure is restored.

(119) Q. How should a service stop be made?

- A. Initial reduction should be made heavy enough that no additional reductions are necessary. Brakes should be graduated off so that brakes are fully released as train comes to a stop.

(120) Q. In what position should brake valve be placed after applying brakes when stopping at rear of other trains, bumping posts, etc?

- A. LAP position.

(121) Q. Why?

A. Should a defect occur in electric holding circuit, brakes would release immediately and before pneumatic feature could restore brake cylinder pressure, an accident may result.

(122) Q. How would you release a "stuck" brake?

A. By closing side vent cutout cock at brake cylinder affected.

(123) Q. If brakes do not release after cutting out side vent cutout cock, what could be the cause?

A. Hand brake may be applied.

(124) Q. What must engineers do to keep down excessive use of power?

A. Coast every possible second.



