

G.E.

TYPE 17LV23 REGULATING RELAY

1. DESCRIPTION

The regulating relay consists of a frame mounting a shunt coil and series coil wound on the same spool, and an armature carrying a movable contact which operates between two fixed contacts. The contacts are connected to resistor tubes and arranged to vary the current flowing in the generator shunt field to maintain constant voltage.

2. OPERATION

The series coil is connected in the battery circuit so that it carries the charging current to the battery from the generator. The shunt coil is connected in series with a 20-ohm control resistor directly across the generator terminals and so varies in strength as generator voltage.

There are three possible circuit combinations depending on the position of the relay armature which in turn depends on the relation between the pull of the armature calibrating spring and the combination of the shunt and series coils. With low trolley voltage resulting in lower M-G speed, or heavy generator load, the generated voltage will drop, allowing the moving contact on RR to contact point 2. This produces maximum generator field to raise the voltage since there will be only 10.5 ohms resistance in the circuit from GA through the generator field. For intermediate load and speed the moving contacts on RR may float between points 2 and 3 inserting an additional 13 ohms in the field circuit. For light loads and higher speeds the moving contact may contact point 3 reducing the generator field still further by shunting the generator field with 5.65 ohms resistance. In actual operation, since the relay armature is very light weight and moves only a small amount, a minute voltage change will move the armature, so it vibrates very rapidly to produce a steady voltage regardless of load or speed conditions.

The series coil on the regulating relay carries only the charging current to the battery and normally has very little effect on the relay armature since this charging current is very small with a fully charged battery. If, however, the battery becomes discharged, the charging current would try to go very high since the shunt coil on the relay tries to hold full voltage. To protect the battery and generator from damage, the charging current through the series coil produces a pull which limits the charging current by reducing the generator voltage in the same manner as an increase in voltage previously described.

3. ADJUSTMENTS

Ordinarily all necessary adjustments can be made on the regulating relay by changing the tension of the calibrating spring. Increase spring tension to raise setting. The relay should be set to hold 35.5 volts if the equipment is cold, and 36.5 volts if the equipment has been running long enough to heat up to normal operating temperature.

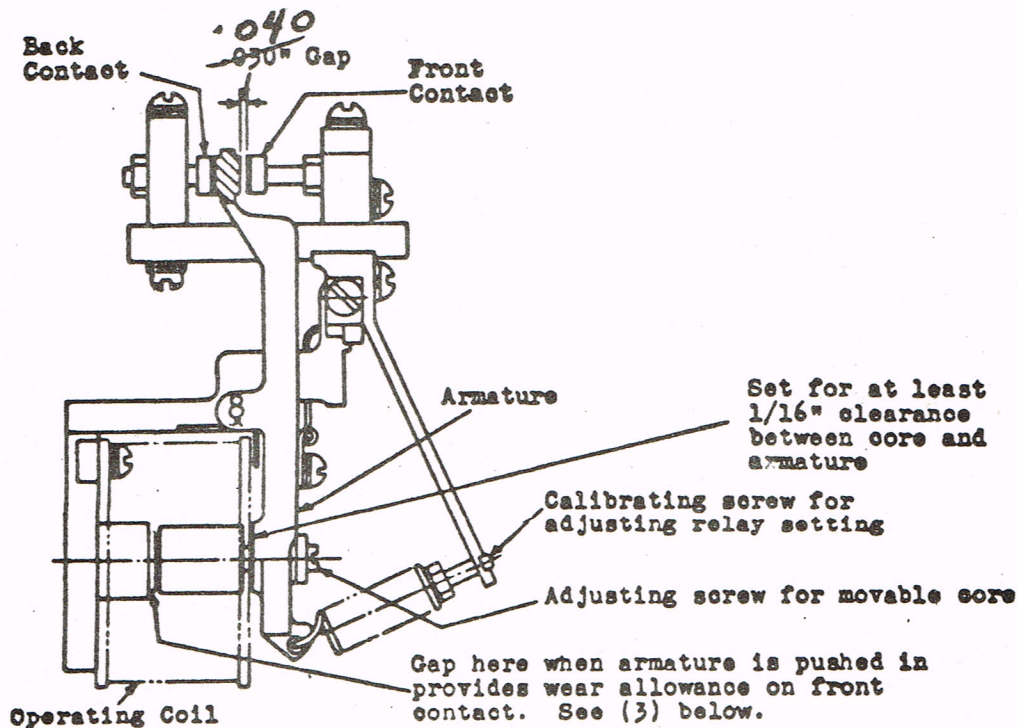
If any parts of the regulating relay are disassembled, or replaced, or if any new resistor tubes are installed, the contact adjustment should be checked as indicated on drawing and setting of relay rechecked.

General Notes

The battery floats on the motor-generator set, the latter supplying all load requirements. The battery is considered more or less as a standby and supplies low-voltage power under emergency conditions, such as loss of line voltage or trouble with the motor-generator set.

The figure of 36.5 volts mentioned in the foregoing applies to a 16-cell lead battery. If a 24-cell Edison battery is used, the generator voltage should be adjusted at 41.0 volts.

4. INSPECTION AND DATA - See INSPECTION SECTION.

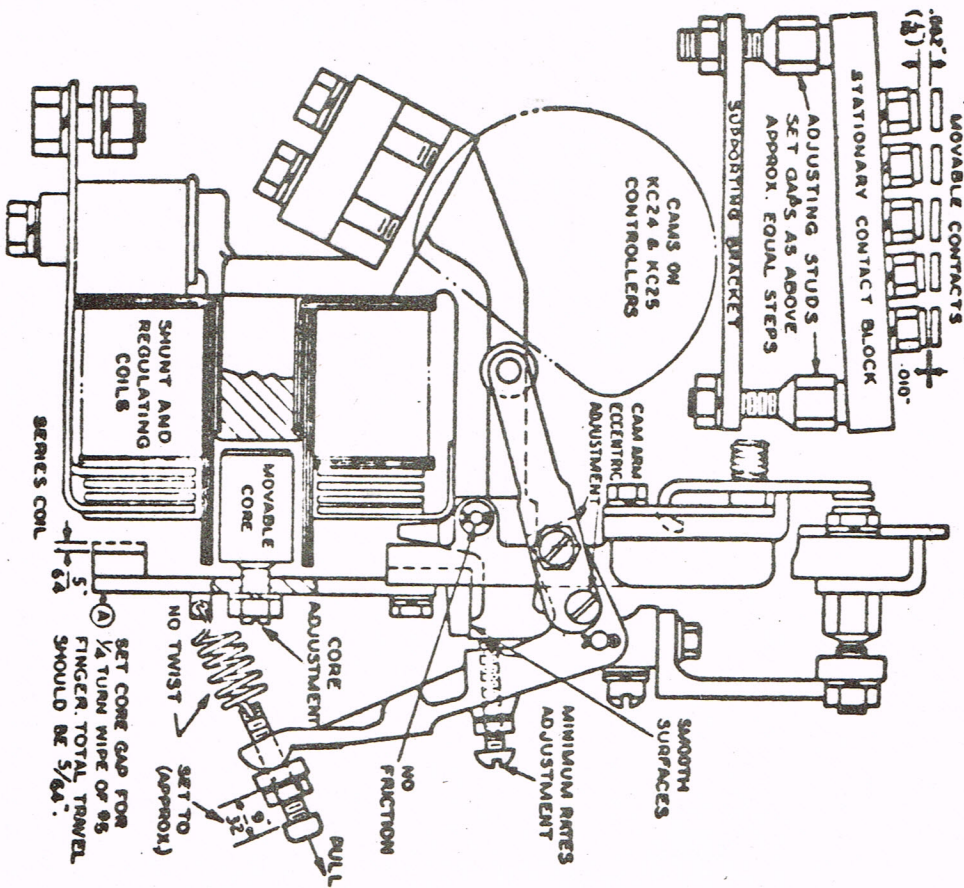


Contact Adjustment - 17LV23 Relay

1. Set movable core so there is at least 1/16" clearance between core and armature. This adjustment required so overhanging edge of armature will not strike flange on operating coil.
2. With stationary contacts free, push armature in until core bottoms and hold there while screwing up front contact until it touches movable contact.
3. Screw front contact one more turn toward center to provide about .030" wear allowance before core can bottom.
4. Screw out back contact until there is no gap between front and back contacts, then back off one turn and lock. This will provide total gap of .030" between front and back contacts.

Voltage Adjustment

Set voltage by calibrating screw. If regulated voltage differs more than $\frac{1}{2}$ volt between front and back contacts, change core position slightly to correct.



FIELD ADJUSTMENTS OF ACCELERATING AND BRAKING RELAYS

FOR PCC CARS

TYPES 17LC20A4 AND 17LC20D4

1. SET CORRECT CAR PEDAL TRAVEL - APPROX. 1/8" CLEARANCE MEASURED AT CONTROLLER STOPS IN MAXIMUM POSITIONS.
2. MAKE MECHANICAL ADJUSTMENTS AS PER SKETCHES. MEASUREMENTS MAY BE MADE AT POINT (A) WITH DIAL INDICATOR.
3. SET MAXIMUM RATES BY CAM ARM ECCENTRIC WITH BRAKE OR POWER PEDAL FULL ON BY WEIGHING ARMATURE SPRING OR CHECKING SHUNT COIL DROP OUT AMPS PER TABLE BELOW.
4. BOTH CONTROLLERS OFF, SET COASTING AND MINIMUM RATES WITH STOP SCREW ADJUSTMENT.
5. SET C2 PICK-UP RATE WITH ADJUSTABLE KC24 CAM

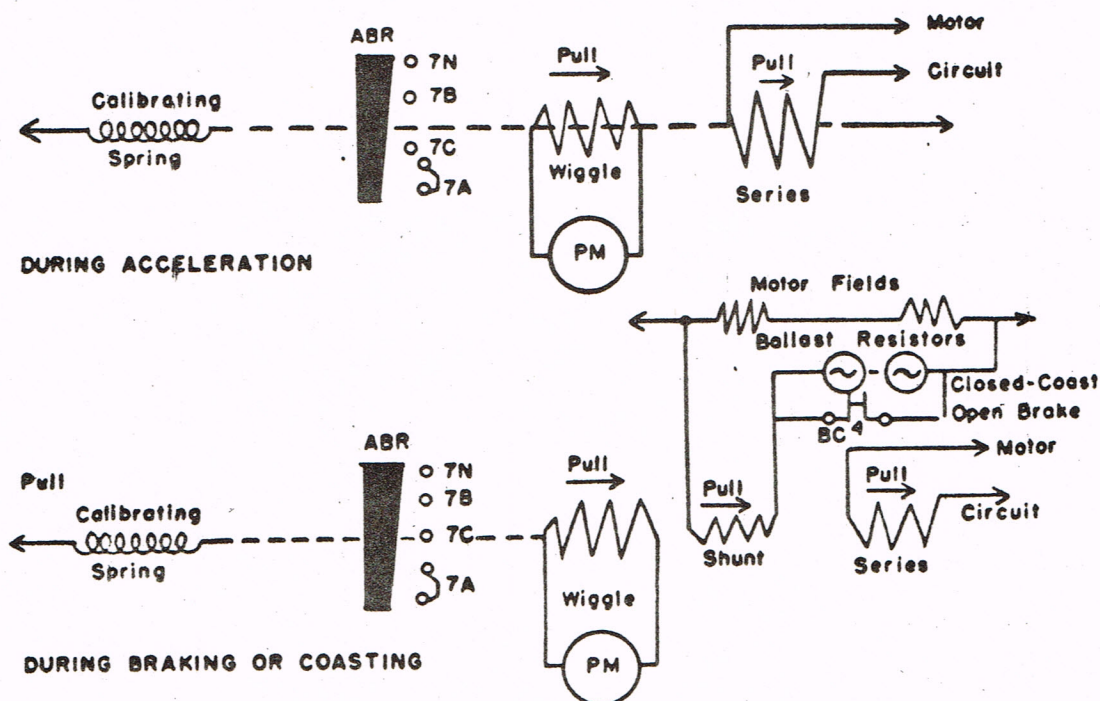
	BRAKE FULL ON	POWER FULL ON	MINIMUM POWER	COAST	C2 PICK-UP
A. FOR 4 3/4 MI./HR./SEC. ACCELERATION AND 4 MI./HR./SEC. BRAKING					
SPRING TENSION	40 OZ.	42 OZ.	6 1/2 OZ.	8 1/2 OZ.	10 1/2 OZ.
SHUNT COIL D.O. AMPS	7.5	7.6	3.8	3.8	4.6
SINGLE MOTOR AMPS	180	250	112	20	135
B. FOR 4 1/2 MI./HR./SEC. ACCELERATION AND 3 1/2 MI./HR./SEC. BRAKING					
SPRING TENSION	35 OZ.	40 OZ.	8 1/2 OZ.	8 1/2 OZ.	10 1/2 OZ.
SHUNT COIL D.O. AMPS	6.6	7.4	3.8	3.8	4.6
SINGLE MOTOR AMPS	160	234	112	20	135

* SET MINIMUM POWER ACCURATELY WITH AMMETER DURING TEST RUN. RATE VARIES SLIGHTLY WITH VOLTAGE CONDITIONS. ALL VALUES GIVEN ABOVE ARE APPROXIMATE DUE TO MANY FACTORS AFFECTING RATES. VALUES ARE FOR 36000 & CAR WITH 25" WHEEL DIAMETER. FOR WORN WHEELS (23" DIA. AVG.) REDUCE MAXIMUM VALUES 5% FOR SAME RATES.



In coasting and for minimum rates, the tension of the calibrating spring is determined by the stop-screw adjustment, as the cam on the master controller (power or brake) is not striking the roller on the relay arm to stretch the spring. When higher rates of speed are desired by operator, depressing pedal turns controller on and causes rate cam to stretch relay calibrating spring and increase rate in proportion to pedal movement up to maximum rates.

When relay is operating to hold some current value, a state of approximate balance is obtained between the tension of the calibrating spring and the combined pull of the series, shunt and wiggle coils.



OPERATION OF ACCELERATING AND BRAKING RELAY

PLATE
A-118717

During braking the pull of the shunt coil is added to that of the wiggle and series coils, KC25-10 being open and ballast resistors in series with shunt coil. In coasting the KC25-10 finger closes to increase current in shunt coil to allow relay to regulate for low motor-current values. Current through motor fields produces a voltage across fields proportional to current across fields, this voltage being applied to shunt coil.

By connecting the wiggle coil across the pilot-motor armature, both "wiggle action" and "anticipation" are obtained. Wiggle action results from the fact that as relay starts to pick up and close contacts 7A, 7C, 7B and 7N, closing of these contacts results in a reduction of voltage on wiggle coil, tending to allow armature to drop out. In opening of relay contacts a similar opposing action takes place. The result of this wiggle action is a vibrating of the relay armature producing an average motor voltage to give the motor speed required to hold the current the car operator is requesting.

MASTER CONTROLLER CONTACTS

POWER 1100

00MS0000M

BRAKE OFF

00M0M500M

LOCKED

MM0M0S000

MOTOR GENERATOR 25 AMPS. 600 VOLTS	NO. 2 TRUCK BRAKE ACTUATORS 15 AMPS. 600 VOLTS	NO. 1 TRUCK BRAKE ACTUATORS 15 AMPS. 600 VOLTS	AUXILIARY 50 AMPS. 600 VOLTS	GENERATOR 60 AMPS. 32 VOLTS	NO. 2 TRUCK DRUM BRAKES 32 V.	NO. 1 TRUCK DRUM BRAKES 32 V.	NO. 2 TRUCK TRACK BRAKES	NO. 1 TRUCK TRACK BRAKES
25 A M P S .	15 A M P S .	15 A M P S .	50 A M P S .	60 A M P S .	30 A M P S .	30 A M P S .	30 A M P S .	30 A M P S .

ST. LOUIS / G.E. P.C.C. (STEPWELL)



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1
DATE • Aug. 1979
PAGE 1 OF 23

SUBJECT: "B" INSPECTION - 400 HOURS - STREETCAR

SAN FRANCISCO MUNICIPAL RAILWAY

Streetcar inspection type "B" - 400 hours preventative maintenance procedures. All PM inspections shall include the inspection, adjustment, and repair of all units and items as outlined in this procedures manual. Each item on the inspection form will be checked as O.K., repaired or replaced as indicated. Any unusual condition as noted defect will be recorded and reported to the shop or shift supervisor.

Safety rules and regulations will be observed at all times in performing work on any type of electrical or mechanical equipment. Report any hazardous or unsafe condition to shift supervisor immediately.

Caution: When working on a PCC car and Trolley coach:

1. Always stand on the rubber matting when on the roof of the vehicle.
2. If possible, place the pole under its hold-down hook before climbing to the roof of the car and after making adjustments, before climbing down from car roof. Safety chain will be used to secure trolley pole on trolley coaches.
3. Never turn the rear trolley base on a PCC car around so the pole points towards the front of the car, because the trolley base will contact the ventilating shroud. So when the pole is placed on the overhead, the shroud will pick up the charge, creating an additional unexpected shock hazard.
4. When working on 600 volt circuits always pull poles and place caution sign on ropes: "Caution: Do not put up poles."
5. Always have safety standards in place, across pits when working on switch group at Presidio and Potrero Divisions.

VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1
DATE • Aug. 1979
PAGE 2 OF 23

INSPECTION MANUAL

This Inspection Manual shall be used in conjunction with the streetcar Inspection Forms. The procedures detailed in this manual shall be followed for each inspection item noted on the forms. When an item has been inspected, adjusted, or repaired by the inspector, so that he considers that no further work is required, he shall make a check mark (✓) in the column beside that item. If further repair work is required, an X should be used. If a component should be replaced, an O should be used. In the last two cases, the inspector shall note all additional repair work and any defect not corrected on the back of the form.

A condition or defect which could cause a vehicle to be unsafe or road-called shall be promptly reported to the foreman, who shall arrange for its correction on a first-priority basis. All other defects and repairs shall be noted and reported to the foreman who shall schedule their handling when convenient.

Throughout this manual the terms "lubricate", "grease", and "oil" are used. In applying any of these materials, discipline must be used in the use of the list of approved lubricants.

STREETCAR "B" INSPECTION (400 HOURS) USE BOTH SIDES OF THE INSPECTION FORM

Carry out the work outlined in the "A" Inspection Schedule.

TOPSIDE INSPECTION

Passenger Signal

- a. Check operation of the passenger signal. Make necessary adjustments.
- b. Test pull switches for binding; check all pull cords for being too loose or too tight, and fraying at support rings.
- c. Make necessary repairs or adjustments.

GONG

- a. Check operation of the gong by operating toggle switch.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER. 2.0.5.1
DATE. Aug 1979
PAGE 3 OF 23

- b. Release toggle switch and check operation by applying "Emergency Brake".
- c. Make necessary adjustments or replacements to ensure efficient operation of gong.

Sanders

- a. Check operation of sanders both from sander switch and by applying the Emergency Brake. Sand must flow freely and drop on both rails.
- b. Make necessary adjustments to electrical equipment.
- c. Report mechanical defects or blocked sander to Foreman.

Foot Pedals and Reverser Lever

- a. Check operation of reverser lever, accelerator pedal, brake pedal and foot interlock. Reverser lever and foot pedals must operate freely with no indication of sticking nor binding in any of their operating or emergency positions.
- b. Make necessary adjustments to provide trouble free operation.
- c. Lubricate front side of brake pedal with a film of approved grease to prevent pedal from binding on its latching mechanism.
- d. Check condition of rubber foot pads; make necessary replacements.

Spare Fuses

Check to see that a spare control fuse is in place and in good order.

Windshield Wiper

- a. Inspect wiper blades to see that rubber is clean and pliable and that their entire length bears firmly on the glass; change defective blades.
- b. Using approved tools, test all wiper arm clamps and set screws, making certain they are tight.
- c. Check that the wiper blade is held to the arm with approved fasteners.
- d. Check the left side parallelogram pins and bushings, for evidence of wearing to the point where arm might contact glass. Change arm if required, or install new bushings.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER 2.0.5.1
DATE Aug 1979
PAGE 4 OF 23

- e. Check that the electric windshield wipers operate at 50 - 60 full strokes per minute. If the wiper speed varies from this rate, the motor is defective and must be changed.

Signal Lights

- a. Check operation of all door, warning, track and drum brake signal lights.
- b. Make necessary adjustments or replacements.

Defrosting Fans

- a. Inspect exposed wiring for chafed insulation or broken strands; make necessary repairs or replacements.
- b. Tighten loose mounting bolts and screws.
- d. Clean dirt from fan guard and blades.
- d. Check operation; if bearings are noisy or vibration is excessive, change the fan.

Cab Heaters

- a. Check operation of cab heaters.
- b. Inspect for evidence of loose or damaged wires or heat covers.

Forced Air Type Cab Heaters

- a. Clean inlet and outlet screens.
- b. Check operation of fan alone and with both fan and heat elements.

Forced Air Type Defroster Heaters

- a. Clean inlet and outlet screens.
- b. Check operation of fan alone and with both fan and heat elements.

Interior - General

Carefully check interior of car for sharp projections, loose screws or plating on seat frames that may cause damage to clothing. Any projection or loose plating must be filled or sand-papered smooth.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1
DATE • Aug 1979
PAGE 5 of 23

Upholstery

Check upholstery for cut or badly sagged seat backs and cushions. Make necessary repairs or replacements.

Window Glass

Check all window glass. Cracked glass must be changed.

Moveable Windows

Check all moveable windows; replace defective window regulators or life.

Front and Side Vents

Check front and side vents for operation, seals, threaded shafts, etc. Make necessary repairs or replacements.

Operator's Curtain

Check operator's curtain. Make any necessary repairs or replacements.

Route and Destination Signs

Check operation of route, destination and run number signs. Make necessary repairs.

Door Rubber

Check condition of all door rubber draft guards and rubber edging. Make necessary repairs or replacements.

Switch Iron

Check and replace with one in good condition if necessary

Sand Container

Check condition and fill with clean, dry sand.

Transfer Cutters

- a. Check tension of both springs. Make certain that the minute cutting points offer some resistance when moved on their adjusting bar and that both points are firmly in contact with the cutter body plate.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 6 OF 23

- b. Check that the hour cutting knife fully contacts the cutter body plate.
- c. Defective cutters must be changed.
- d. Lubricate mirror fitting with approved lubricant.

Lubricate Doors

- a. Lubricate top guide tracks with approved lubricant applied sparingly.
- b. Tighten loose roller guide screws.
- c. Lubricate door drive arm pins with approved oil.

Door Treadles

- a. Raise all four treadles and clean lower treadle trays.
- b. Check treadle hinges to make sure they work freely.
- c. Lubricate with approved oil.
- d. Check treadle switch contact buttons to make certain they do not bind in switch cover. Make any necessary repairs and adjustments.
- e. See that treadle plates are properly latched on completion of inspection.

Bottom Rubbers

Replace worn or damaged bottom draft rubbers.

Door Relays

- a. Check operation of door relays. If contacts are dirty, clean with a fine file.
- b. Check armature shunt for evidence of breakage of wire strands.
- c. Change relay if it does not function properly or if shunt is defective.

Door Operation

- a. Check operation of all doors to see that they open and close smoothly.
- b. Check operation of center entrance relay.
- c. Using a stop watch, time opening and closing and make any necessary speed adjustments as described hereunder.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 7 OF 23

s. Standard Door Speeds

i. Entrance Doors: From moment of operating the switch

Opening - As close to 1 1/2 - 2 seconds as possible.

Closing - 1 1/2 - 2 seconds

ii. Exit Doors: From moment of actuating treadle.

Opening - As close as 1 1/2 - 2 seconds treadle.

Closing - 2 3/4 - 3 3/4 seconds.

Door Cam-Switch

a. Check door cam-switch settings as per instructions in the following sections.

b. Make adjustments as required.

c. Settings for Door Cam-Switches

The following is a description of the settings for cam switches, exit warning light, lineswitch interlock (D.I.R.) and exit door interlock.

Measurements indicated are to be the length of a line perpendicular to the rubber seal on the door jam to the edge of the door leaf at the hinge point:

1. Entrance Doors

i. Opening and closing speeds should be set in accordance with the data in the PCC Car Inspection Manual. The following items illustrate door controlled cam-switch settings.

ii. On the closing cycle, the lineswitch interlock (or D.I.R. interlock) must close before the closing limit switch opens. The lineswitch interlock (or D.I.R. interlock) should be set to make at a measurement of 3 inches and the closing limit switch should be set to break at a measurement of about 1 inch. The closing limit switch must be open when the doors are fully closed with power on the door motor.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1
DATE • Aug 1979
PAGE 8 OF 23

- iii. On closing cycle, the front door controlled door interlock cam-switches (providing a feed to the treadles), should break when the angle between door leaves is 90°. This corresponds to a measurement of 10" to 11".

2. Exit Doors

- i. Opening and closing speeds should be set in accordance with the data in the PCC Car Inspection Manual. The following items illustrate exit door controlled cam-switch settings.
- ii. On the closing cycle, the lineswitch interlock (or D.I.R. interlock) must close before the closing limit switch opens. The lineswitch interlock (or D.I.R. interlock) should be set to make a measurement of 3 inches, and the closing limit switch should be set to break at a measurement of about 1 inch. The closing limit switch must be open when the door is fully closed with power on the motor.
- iii. On the closing cycle, the exit door controlled door interlock cam-switch (providing a feed to the treadles) should be set to break at a measurement of 4 inches.
- iv. The exit warning light cam-switch should be set to break at measurement of 3 inches.

BODY

General

Check general condition of exterior and interior of car body. Report unusual conditions, such as worn tread plates, broken seat legs, or collision damage that presents unsightly appearance.

Body & Auxiliary Lights

- a. Check body, sign, stop, marker and head light.
- b. Make necessary repairs or replacements.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 9 OF 23

Battery Inspection

- a. Open battery compartment doors and slide batteries out; remove filler plugs and check liquid level in each cell. Add sufficient water to bring level of liquid halfway up filler tubes.
- b. Clean top of batteries and check condition of connections.
- c. Defective or badly-corroded batteries must be changed.

Battery Condition Test

NOTE: For cars equipped with a voltmeter use car voltmeter, for cars not equipped with voltmeter use a hand-held voltmeter.

- a. Test condition of battery by moving the M.G. switch to its OFF position and energizing the track brakes by releasing the foot interlock pedal to its upper emergency position. Observe the voltmeter - if the battery voltage drops more than 6 volts, either the battery is defective, or one or more of the track brake shoe coils is short-circuited. Report defects to Foreman.
- b. With the M.G. switch OFF apply brake pedal to the EMERGENCY position, track brakes should be ENERGIZED. Observe the voltmeter - if the battery voltage drops more than 6 volts, either the battery is defective, or one or more of the track brake shoe coils is short circuited. Report defects to Foreman.

Battery Switch: 1000 Series Cars

On completion of electrical inspection and testing, check battery switch in the battery compartment at the rear of the car. Make certain that the knife blade is held firmly between the stationary contacts and that the connections are tight.

Trolley Catcher

- a. Lubricate the trolley catcher drum bearing with approved oil.
- b. Adjust lateral motion of drum to a minimum by tightening spindle screw, taking care not to cause drum to bind.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 10 OF 23

- c. Check operation of catcher, change if defective.

Trolley Harp

- a. Lubricate trolley harp saddle bearing with approved lubricant, using grease gun supplied for this purpose.
- b. Wipe surplus grease from saddle and harp.

Trolley Base Hinge Pin

- a. Lubricate trolley base hinge pin with approved lubricant.
- b. Wipe surplus grease from trolley base.

Trolley Base Lock Down Latch

Test operation of trolley base gag by placing pole under emergency holddown hook, and see that the gag can be freely installed and released.

Trolley Base Shunt and Connections

- a. Inspect shunt for evidence of loose connections or broken strands.
- b. Change shunt if wire strands are frayed or broken.
- c. Check main trolley connections to make certain they are tightened securely.

Trolley Base Rubber Mounts

Check for evidence of collapsing. Report defects to Foreman.

Roof

Check condition of car roof, trolley timbers, rubber mats, metal shrouds and climbing steps. Report any unusual conditions for Foreman.

Track Brakes

- a. Inspect and replace defective side bumpers.

Emergency Draw-Bar Equipment

- a. Remove and replace emergency draw-bar from its box.
- b. Check operation of catches on containers.
- c. Lubricate catches and hinge pin with approved oil.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 11 OF 23

- d. Raise and lower both emergency draw-bar anchor pins to make certain they move freely in anchor holes; repair broken pin anchor chain.

LUBRICATION AND TRUCK INSPECTION

H.B. LIFEGUARD

- a. Check to ensure that both the lifeguard trip gate and cradle are centered in relation to the rails. Inspect the trip gate and cradle and tighten or replace any loose or broken bolts; replace distorted or broken slats; change any trip gate or cradle that cannot be readily repaired in position; check the tension spring to make certain that it holds the cradle in firm contact with the rails when the cradle is tripped. See that split pins are installed through both trip gate suspension arms, to prevent the trip gate from becoming displaced on its shaft by contacting objects on roadway.
- b. Lubricate all shaft bearings and clevis pins with a small amount of approved oil.
- c. Using the approved gage, check height as follows:
 - i. The cradle, in normal running position, to be adjusted to a height of 5 1/2" above the rails, measured from the underside of both skid plates.
 - ii. The trip gate, in normal running position, to be adjusted to a height of 5 1/2" above the rails, measured from the underside of its lower slat.
 - iii. The angle of the toggle lever is to be adjusted so that the cradle will drop when the trip gate is moved backward and upward to a height of 6 1/2" above the rails, measured from the front lower edge of the bottom slat.
 - iv. Trip the lifeguard and reset it from inside the car. Make necessary adjustments to the reset lever, so as to ensure easy resetting of the



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1
DATE • Aug 1979
PAGE 12 OF 23

lifeguard by operating personnel.

EMERGENCY LIFEGUARD HOLDUP

- a. Inspect the spring and operating lever, to make certain that the holdup device will be in good working order and ready for instant use in the event of a storm or other emergency.
- b. Holdup cables exposed to the weather should be coated with approved grease.

SWING LINK AND BOLSTER BEARINGS

- a. Using approved lubricant, lubricate all swing link and bolster trunnion bearings. Then: using jacks, raise the car body high enough to relieve body weight from truck bearing surfaces, and AGAIN apply lubricant to all swing link and bolster bearings.

Apply sufficient lubricant to ensure complete lubrication of all bearing surfaces

JOURNAL BEARINGS

- a. Lubricate with SAE 40 oil, applied at the front filler plug hole with a pump type oil can until oil starts to run out of filler hole. Let excess oil drain out before replacing plug.

NOTE: Any discoloration of oil indicates contamination which might ruin the lubricating qualities of the oil. If the oil is milky, it indicates that water has been drawn into the journal bearing housing through the outer seals. If the oil is black, it indicates that oil from the gear case is getting past the inner journal housing seals. It is most important that contaminated oil be drained off and the journal bearing refilled with new SAE 40 oil.

BRAKE SHOE FULCRUM LUBRICATION TYPE B3 TRUCKS ONLY

- a. Lubricate all brake shoe fulcrum points with approved lubricant.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 13 OF 23

GEAR CASES

- a. Check lubricant level in gear cases.
- b. Fill level with filler hole with approved lubricant and report defects to Foreman.
- c. Remove and clean breather unit if necessary to ensure pin is loose and will move freely in breather hole.

DRIVE SHAFT UNIVERSAL JOINTS

- a. Lubricate all universal joints and driveshaft splines with approved lubricant.

CENTRE BEARINGS

- a. Remove lower center bearing dust cap. Jack up car body clear of the center bearings, check condition of upper and lower bearings.
- b. Check condition of felt dust rings and replace with new ones if necessary.
- c. Lubricate surfaces of upper and lower bearings, with approved lubricant, by means of the special attachment for this purpose.
- d. Report unusual conditions such as evidence of galling, poor lubrication, cracks upper king pin castings, to Foreman.

LOWER KING PIN BEARINGS

- a. Using approved lubricant, lubricate lower king pin bearing, with sufficient lubricant to ensure complete lubrication.

SWITCH GROUP INSPECTION

CONTROL APPARATUS

Remove accelerator, contactor, line switch and controller compartment covers and inspect the control apparatus as follows:

ROTOR AND PERMANENT RESISTORS

- a. Check rotor and all permanent resistors for evidence of loose connections, burnt or distorted ribbons; make necessary repairs or replacement.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1
DATE • Aug 1979
PAGE 14 OF 23

- b. Inspect rotor drum interlock cam switch moving and stationary contacts; clean blisters from contact surfaces using a fine file.
- c. Change cam switches and stationary contacts on which the silver has worn to 1/32" thickness.
- d. Check cam switch shunts for indication of frayed or broken strands.
- e. Change defective shunts.
- f. Change cam switches that show excessive wear in roller axle pins or any other defect that might interfere with trouble-free operation.

MASTER AND BRAKE CONTROLLERS (KM CARS 1101-1170; 1006-1015)

- a. Inspect cam switches, stationary contacts and KM brushes. Remove and replace the KM brushes if they are chipped or worn below the mark. Clean blisters from contacts using a fine file. Change contacts on which silver has worn to 1/32" or less in thickness. Change cam switch shunts that show indication of frayed or broken strands.
- b. Inspect track brake cam switches and stationary contacts. Clean blisters from contact using a fine file. Change contacts that are badly burnt. Change contacts on which silver is worn to 1/32" or less in thickness.
- c. Inspect cam switch shunts; change shunts that show indication of frayed or broken strands. Check KM arm shunt and brushholder shunts.
- d. Report unusual conditions to Foreman.

CONTACTORS AND LINE SWITCH

- a. Inspect all control contactors and line switch.
- b. Check main contact tip screws to make certain they are tight. Change contactor main tips when worn to less than 1/4" total thickness. Change line switch main tips when worn to less than 5/16" total thickness.
- c. Inspect interlock moving and stationary contacts; clean blisters from contact



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 15 OF 23

surfaces using a fine file; change contacts on which silver has worn to $1/32$ " in thickness. Interlock compression springs should compress for a distance of $3/32$ " when interlock makes full contact. Test interlock drag links to make certain they do not bind in the interlock rocker arms or their hinge pins.

- d. Change any armature shunt that shows evidence of having broken wire strands; check shunt screws to make certain they are tight
- e. Clean inside walls of arc chutes; change broken or badly burned arc chutes. By hand, carefully close and open each contactor and line switch to make certain that armatures do not bind on hinge pins, armature stop arms, arc chutes, or due to improperly adjusted drag links
- f. Make necessary adjustments, or replace complete contactor unit. NOTE: A binding contactor will result in service failures that will only be prevented by carefully carrying out the foregoing inspection. Whenever Main Contact Tips are changed on the line switch, the line switch is to be checked for pick-up and sealing at 24 volts.

CARS 1016 TO 1040 AND 1180 TO 1190

Check interlocks on R-2 contactor and make certain that the C3-3C interlock makes contact before the 5A-5B interlock. Make necessary adjustments.

LIMIT RELAY: CARS 1016 TO 1040

- a. Inspect limit relay contacts. Change moving carbon contact when the projecting contact surface is worn almost level with the main body of the carbon; change stationary contacts when the silver is worn to $2/32$ " or less in thickness. Using a clean, dry wiping cloth, clean dust from contacts.
- b. When new contacts are applied, the rear stationary contact should be adjusted so that the outer face of the relay armature is at the correct angle. Use the square gage provided for this purpose. The front stationary contact should then

be adjusted to provide a gap of $5/32$ " between it and moving carbon contact.

Using the gage, adjust the auxiliary contact finger to $1/8$ " gap with $1/32$ ".

- c. Check the condition of the limit relay shunts, change any that appear frayed abnormally twisted or that exhibit other signs of failure.
- d. Check limit relay spring tension with accelerator and brake pedals in release position.

ACCELERATING AND BRAKING RELAYS: (CARS 1006-1015; 1101, 1103-1170)

- a. Inspect and clean relay contacts
- b. Measure gap between moveable contacts and contacts on stationary contact block. The maximum gap at the upper end of the stationary contact block should not exceed 0.010 ". The maximum gap at the lower end of the stationary contact block should not exceed $1/16$ " (0.062 "). If the gaps exceed these values, remove accelerator and braking relay unit for bench repair and adjustment.

DRUM BRAKE LOCK OUT RELAY

- a. Check operation of drum brake lock-out relay. Using a fine file, clean all contact tips. Adjust "IN" interlock contact gap by loosening the lock nut on the stationary contact and turning contact until there is a $1/8$ " gap between the stationary and moving contact; then tighten lock nut securely.

AUXILIARY RELAYS

- a. Inspect all auxiliary relays and contactors for worn tips, worn interlocks or loose connections. Move each relay in and out by hand to make certain there is no binding action and that the contacts have good compression.

REVERSER: CARS 1016 TO 1040

- a. Inspect reverser drum and fingers for evidence of poor contact between fingers and segments, indicated by discoloration of finger tips and segments.

Also inspect the 4 cam switches and stationary contacts located at left end



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER 2.0.5.1

DATE Aug 1979

PAGE 17 of 23

- of reverser drum. Clean blisters from contacts using a fine file. Change contacts on which silver has worn to $1/32$ " or less in thickness.
- b. Remove the old lubricant from the main fingers and segments and recoat lightly with approved lubricants. Inspect all reverser contacts.
 - c. Check main contact tip screws to make certain they are tight. Change contactor main tips when worn to less than $1/4$ " total thickness.
 - d. Inspect interlock moving and stationary contacts. Clean blisters from contact surfaces using a fine file; change contacts on which silver has worn to $1/32$ " in thickness. Interlock compression springs should compress for a distance of $3/32$ " when interlock makes full contact. When closing the contactor by hand, the OUT and the IN interlocks must momentarily make contact at the same time. When the armature is SEALED in, the OUT interlock must be open. Test interlock drag links to make certain they do not bind in the interlock rocker arms of their hinge.
 - e. Change any armature shunt that shows evidence of having broken wire strands; check shunt screws to make certain they are tight. By hand, carefully close and open each contactor to make certain that the armatures do not bind on hinge pins, armature stop arms, or due to improperly adjusted drag links. Make necessary adjustments or replace complete contactor unit.
 - f. Check all connections for evidence of loose contact. Make necessary repairs.

VOLTAGE REGULATOR (CARS 1016 - 1040)

- A. Examine the contacts for wear. The carbon contacts should be replaced before the contact gap exceeds $1/8$ ". The moving contact should be replaced when there is danger of it wearing to the center groove before next inspection. The stationary contacts should be changed if they will wear to the brass bushing before the next inspection.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1
DATE • Aug 1979
PAGE 18 OF 23

Method of Adjusting Regulator

i. Holding the regulator at a 90° angle to the lower pole face (this is done by lining up the scratched line on the armature with the knife edge pivot) adjust the right hand stationary carbon contact to touch fully the right side of the moving armatures carbon contact then lock it securely in place.

ii. Adjust the left-hand stationary contact to have a clearance of $1/16"$ between it and the left hand face of the armature's carbon contact.

c. Checking and Adjusting Generator Voltage

i. Start the M.G. Set and move battery switch to its OFF position. Check that all auxiliary switches (except M.G. Switch) are in their OFF position, and that track brakes are fully released, then:

ii. Connect the master voltmeter at the regulator between connections GA and GAA, and adjust the knurled calibration screw until meter reads 36 volts. Make sure that on completion of each adjustment, the "V" projection of the knurled adjusting nut is fully engaged in its locking slot in the stationary bracket.

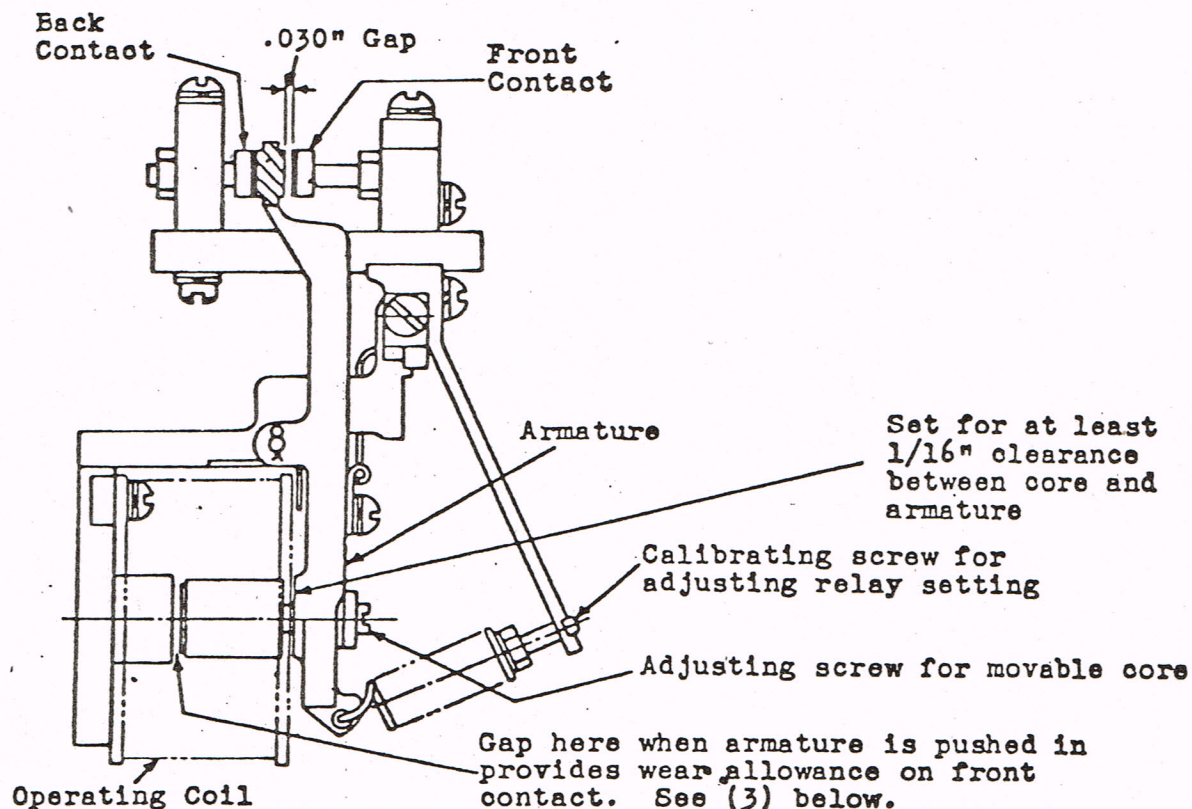


VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER. 2.0.5.1
DATE. Aug 1979
PAGE 19 OF 23

VOLTAGE REGULATOR (CARS 1006-1015 AND 1100 SERIES)

- a) Check voltage regulator stationary contacts and movable bar for wear, blistering, or signs of damage. Replace contacts or bars if necessary then adjust as outlined below.



1. Set movable core so there is at least $1/16$ " clearance between core and armature. This adjustment required so overhanging edge of armature will not strike flange on operating coil.
2. With stationary contacts free, push armature in until core bottoms and hold there while screwing up front contact until it touches movable contact.
3. Screw front contact one more turn toward center to provide about .030" wear allowance before core can bottom.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 20 OF 23

4. Screw out back contact until there is no gap between front and back contacts, then back off one turn and lock. This will provide total gap of .030" between front and back contacts.

VOLTAGE ADJUSTMENT

Set voltage to 36 volts by calibrating screw. If regulated voltage differs more than $\frac{1}{2}$ volt between front and back contacts, change core position slightly to correct.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER. 2.0.5.1

DATE. Aug 1979

PAGE 21 OF 23

EQUIPMENT COVERS

Remove dust, dirt and foreign objects from accelerator contactor, lineswitch and controller compartment covers before re-installing.

WIRING

- a. Inspect motor, track brake, and drum brake wiring for chafing on drive shafts or adjacent truck parts.
- b. Make necessary repairs or replacements.

CONTROL SEQUENCE TEST: ALL PCC CARS

- a. Connect master voltmeter to GA and GAA.
- b. Place motor cut-out switch to A-L OUT position, or Open Knife Switch on cars 1016 to 1040.
- c. Place pole on wire.
- d. Start M.G. Set.
- e. Disconnect battery switch.
- f. Reduce battery voltage to 24 volts.
- g. Close entrance and exit doors and check the operation of control equipment as follows:
 - i. Move accelerator slowly to the full ON position by the lever provided for this purpose.
 - ii. Check to see that all contactors pick up and seal in their correct sequence
 - iii. Refer to "Sequence Book" for control sequence for the type of car being tested.

ALL MOTOR BRUSHES

All carbon brushes for motors must be inspected. The worn brush must be measured according to the detailed instructions on the following pages. If the brush length exceeds these instructions and is otherwise in good condition, it should be reinstalled, if not it should be discarded and replaced with a new brush.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER. 2.0.5.1

DATE. Aug 1979

PAGE 22 OF 23

TRACTION MOTORS

- a. Check carbon brushes. Change brushes that bind in the brushholder box or are worn to wear line.
- b. Check commutators for evidence of flat bars, flashovers, etc.
- c. Check that inspection cover gaskets are in good condition and that latches hold the covers tightly closed to minimize entrance of water into motor frames.
- d. Check condition of motor bellows. Report broken bellows springs or torn canvas to Foreman. Report unusual conditions to Foreman.

MOTOR GENERATOR SET

- a. Check carbon brushes. Change brushes that bind in the brushholder box or are worn to their scrapping limit.
- b. Change MOTOR end brushes when worn to 1 1/4" in length.
- c. Change GENERATOR end brushes when worn to 7/8" in length.
- d. Check commutators for evidence of flat bars, flashovers etc.
- e. Check motor and generator leads for being chafed or broken. Make repairs or replacements. Report unusual conditions to Foreman.

PILOT MOTOR

- a. Remove and inspect pilot motor carbons for worn or for binding in brush holder. Change brushes that are worn to less than 11/16" in length.
- b. Wipe carbon and brush gear with lint free rag before replacing.

VOLTMETER (FOR CARS SO EQUIPPED)

- a. Move M.G. and battery switches to their OFF position and move the headlight switch to the ON position.
- b. By means of the calibration adjusting screw, set the meter pointer at zero.
- c. Move the headlight switch back to the OFF position.



VEHICLE MAINTENANCE DEPARTMENT STANDARD PRACTICE PROCEDURE

NUMBER • 2.0.5.1

DATE • Aug 1979

PAGE 23 OF 23

HEAT CONTROL DAMPER OPERATORS (WHERE APPLICABLE)

- a. Check damper doors for evidence of being loose on the operating shafts, tighten if necessary.
- b. Remove any foreign matter that has accumulated in door openings.
- c. Lubricate sparingly with approved oil.

SAN FRANCISCO MUNICIPAL RAILWAY
STREET-CAR INSPECTION
"B" INSPECTION
(400 Hours)

Page 1 of 2

CAR #	OPERATING HRS	DATE ISSUED	DATE COMPLETED	O.K. - <input checked="" type="checkbox"/> Repair - <input type="checkbox"/> x Replace - <input type="checkbox"/> 0
COMPLETE THE "A" INSPECTION				
TOPSIDE:				
PASSENGER SIGNAL			TRANSFER CUTTERS	
GONG			LUBRICATE DOOR	
SANDERS			DOOR TREADLES	
FOOT PEDAL & REVERSER LEVER			BOTTOM RUBBERS	
SPARE FUSES			DOOR RELAYS	
WINDSHEILD WIPER			DOOR OPERATION	
SIGNAL LIGHTS			DOOR CAM-SWITCH	
DEFROSTING FANS			BODY - GENERAL	
CAB HEATERS			BODY AND AUXILIARY LIGHTS	
FORCED AIR TYPE CAB HEATERS			BATTERY INSPECTION	
FORCED AIR TYPE DEFROSTER HEATERS			BATTERY CONDITION TEST	
INTERIOR - GENERAL			BATTERY SWITCH: 1100 SERIES CARS	
UPHOLSTERY			TROLLEY CATCHER	
WINDOW GLASS			TROLLEY HARP	
MOVEABLE WINDOWS			TROLLEY BASE HINGE PIN	
FRONT AND SIDE VENTS			TROLLEY BASE LOCK DOWN LATCH	
OPERATORS CURTAIN			TROLLEY BASE SHUNT AND CONNECTIONS	
ROUTE AND DESTINATION SIGNS			TROLLEY BASE RUBBER MOUNTS	
DOOR RUBBER			ROOF	
SWITCH IRON			TRACK BRAKES	
SAND CONTAINER			EMERGENCY DRAW-BAR EQUIPMENT	
INSPECTORS SIGNATURE			FOREMAN'S SIGNATURE	

SAN FRANCISCO MUNICIPAL RAILWAY
STREET-CAR INSPECTION
"B" INSPECTION
(400 Hours)

Page 2 of 2

CAR#	OPERATING HOURS:	DATE ISSUED:	DATE COMPLETED:	O.K.- <input checked="" type="checkbox"/>	REPAIR- <input type="checkbox"/>	REPLACE- <input type="checkbox"/>
<u>LUBRICATION AND TRUCKS:</u>		CHECK AND ADJUST GENERATOR VOLTAGE				
H.G. LIFEGUARD		VOLTAGE REGULATOR (CARS 1006 - 1015 & 1100 SERIES)				
EMERGENCY LIFEGUARD HOLD UP		EQUIPMENT COVERS				
SWING LINK AND BOLSTER BEARINGS		WIRING				
JOURNAL BEARINGS		CONTROL SEQUENCE TEST: ALL CARS				
BRAKE SHOE FULCRUM LUBRICATION TYPE B3 TRUCKS ONLY		ALL MOTOR BRUSHES				
GEAR CASES		TRACTION MOTORS				
DRIVE SHAFT UNIVERSAL JOINTS		MOTOR GENERATOR SET				
CENTER BEARINGS		PILOT MOTOR				
LOWER KING PIN BEARINGS		VOLTMETER (FOR CARS SO EQUIPPED)				
		HEAT CONTROL CAMPER OPERATORS				
<u>SWITCH GROUP:</u>						
CONTROL APPARATUS						
ROTOR AND PERMANENT RESISTORS						
MASTER AND BRAKE CONTROLLERS						
CONTACTORS AND LINE SWITCH						
LIMIT RELAY: CARS 1016 TO 1040						
ACCELERATING AND BRAKING RELAYS						
DRUM BRAKE LOCK OUT RELAY						
AUXILIARY RELAYS						
REVERSER: CARS 1016 TO 1040						
VOLTAGE REGULATOR (CARS 1016 TO 1040)						
ADJUSTMENT OF REGULATOR CARS 1016 TO 1040)						
INSPECTOR'S SIGNATURE:			FOREMAN'S SIGNATURE:			